Power Xpert C445 Global Motor Management Relay

User Manual

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Powering Business Worldwide

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Cover Photo: Eaton Power Xpert™ C445 global motor management relay

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Safety

Definitions and Symbols

WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous High Voltage

WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

Warnings and Cautions

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

WARNING

The C445 may reset at any time enabling a motor start. When faulted (FAULT LED is ON) the READY LED will flash when an auto reset is pending.

CAUTION

Record all passwords in a safe location. Once a password has been set it cannot be displayed. If a password is forgotten the only method of resetting the password(s) is a factory reset.

CAUTION

In the Auto Reset mode, caution must be exercised to assure that any restart occurs in a safe manner. Auto Reset mode should not be used in environments where excessive restart attempts may cause component damage and/or create unsafe conditions.

CAUTION

The motor, the wiring diameter and the switching device(s) must be suitable for the selected Trip Class.

CAUTION

The current-dependent protective device must be selected so that not only is the motor current monitored but the blocked motor is switched OFF within the temperature rise time.

Chapter 1—Power Xpert C445 Overview

System Overview

The Power Xpert™ C445 is an advanced, global motor management relay with full line, load and motor system monitoring and protection. It is designed to protect single or three phase AC electric induction motors ranging from 0.3 to 800 A. In the event of an overload trip, C445 disconnects power flow to the monitored motor. C445 additionally provides advanced monitoring and control algorithms for efficiency, torque, speed, energy deviation, and voltage loss restart.

C445 offers a modular pass-through design, separating monitoring, protection and control functionality into individual modules. This allows the user to select the appropriate options for each module and combine them to meet the exact needs of their application. The C445 also offers multiple pre-programmed operation modes to support fast, easy and error-free installation for the majority of applications.

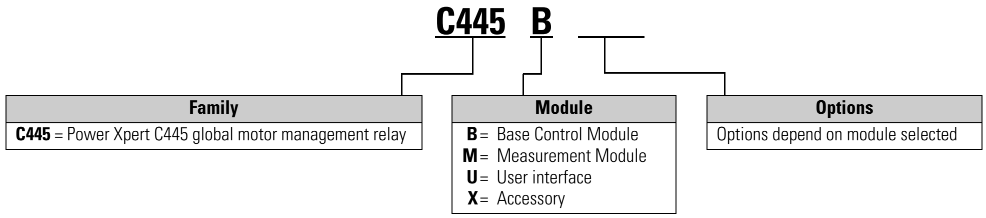
How to Use this Manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start-up, troubleshoot and maintain the Eaton Power Xpert C445 global motor management relay. To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the Eaton Power Xpert C445 global motor management relay. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Catalog Numbering

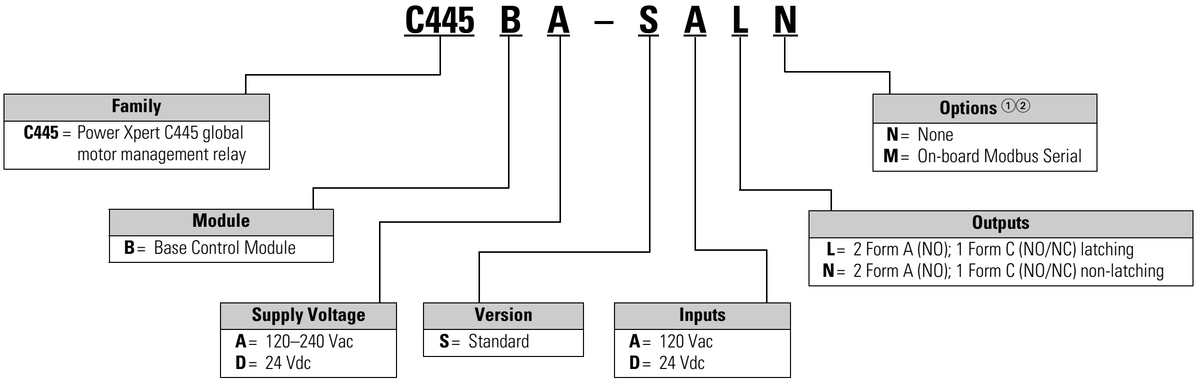
Relay

Figure 1. C445 System Catalog Numbering



Base Control Module

Figure 2. Base Control Module Catalog Numbering



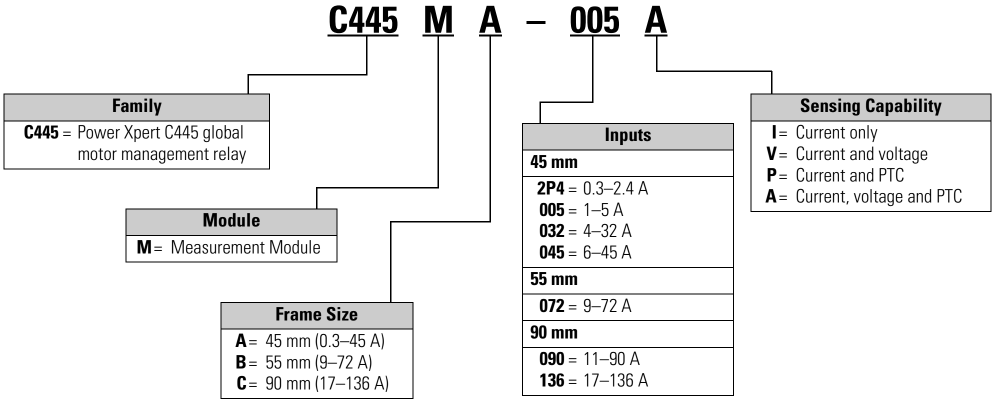
Notes

① For other communication protocol options, please see **Table 2**, Optional Communication Cards and Modules, on **Page 4**.

② If a Real-Time Clock and Memory Backup Module are required, please see **Table 2**, Optional Communication Cards and Modules, on **Page 4**.

Measurement Module

Figure 3. Measurement Module Catalog Numbering



User Interface

Figure 4. User Interface Catalog Numbering

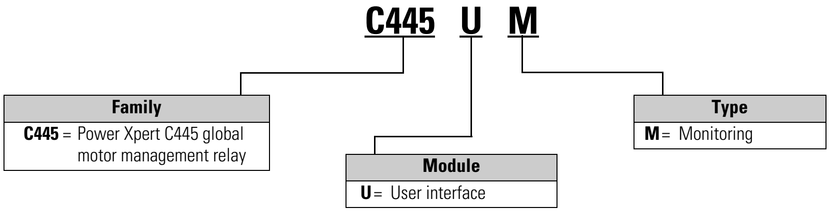


Figure 5. Optional High Resistance Ground Fault Module and CTs

Ground Fault Module
C445XG-MOD = C445 External Ground Fault Module

Zero Sequencing Ground Fault CTs
C445XG-CT2 = 28 mm diameter
C445XG-CT3 = 52 mm diameter
C445XG-CT4 = 63 mm diameter
C445XG-CT7 = 80 x 175 rectangular

Figure 6. Optional Expansion I/O

Modbus Adapter
ELC-CARS485

Digital
ELC-EX08NNDR = 4 24 Vdc inputs and 4 relay outputs
ELC-EX08NNDT = 4 24 Vdc inputs and 4 24 Vdc transistor outputs
ELC-EX16NNDR = 8 24 Vdc inputs and 8 relay outputs
ELC-EX16NNDT = 8 24 Vdc inputs and 8 24 Vdc transistor outputs
ELC-EX08NNDN = 8 24 Vdc inputs
ELC-EX08NNAN = 8 120 Vac inputs
ELC-EX08NNNR = 8 relay outputs
ELC-EX08NNNT = 8 24 Vdc transistor outputs
ELC-EX06NNNI = 6 high current relay outputs (6 amp/point)
ELC-EX08NNSN = 8 toggle switch inputs

Analog
ELC-ANO4ANNN = 4 analog inputs
ELC-ANO2NANN = 2 analog outputs
ELC-ANO4NANN = 4 analog outputs
ELC-ANO6ANNN = 4 analog inputs and 2 analog outputs
ELC-TC04ANNN = 4 thermocouple inputs
ELC-PT04ANNN = 4 platinum thermocouple (PT-100-Ohm) inputs

Accessories

Current Transformer

C445 measurement modules are designed to be used in applications up to 136 A. For applications beyond 136 A, external CTs with a 5 A output may be used.

CT Kits do not include Measurement Modules.

Table 1. Suggested Current Transformers ①

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

Note

① Catalog numbers are for one CT. Order 3 for a three-phase system. Customer supplied CTs may be also be used. See section on using C445 with external CTs.

Communication and Option Modules

Table 2. Catalog Numbers: C445XC… Optional Communication Cards and C445XO… Modules

Description	Catalog Number
EtherNet/IP and Modbus TCP card with 2-port switch	**C445XC-E**
PROFIBUS DPV1 and DPV0 card	**C445XC-P**
Real-Time Clock and Memory Backup Module	**C445XO-RTC**

Cables, Wiring Harnesses and Spare Parts

D77E connection cables are required to connect the Base Control Module to the Measurement Module and to the user interface. Use the appropriate lengths for each connection.

Table 3. Catalog Numbers: D77E… RJ-12 Cables

Description	Catalog Number
Connection cable (Base Control Module to Measurement Module or user interface), 13 cm length	**D77E-QPIP13**
Connection cable (Base Control Module to Measurement Module or user interface), 25 cm length	**D77E-QPIP25**
Connection cable (Base Control Module to Measurement Module or user interface), 100 cm length	**D77E-QPIP100**
Connection cable (Base Control Module to Measurement Module or user interface), 200 cm length	**D77E-QPIP200**
Connection cable (Base Control Module to Measurement Module or user interface), 300 cm length	**D77E-QPIP300**

User interface wiring harnesses are required to utilize the digital inputs on the Control Family of User Interfaces. Use one wiring harness per user interface to connect to these inputs.

Table 4. Catalog Numbers: C445XU… Control User Interface Wiring Harnesses

Description	Catalog Number
Control user interface digital inputs wiring harness, 50 cm, 16 AWG wires	**C445XU-050**
Control user interface digital inputs wiring harness, 100 cm, 16 AWG wires	**C445XU-100**
Control user interface digital inputs wiring harness, 200 cm, 16 AWG wires	**C445XU-200**
Control user interface digital inputs wiring harness, 300 cm, 16 AWG wires	**C445XU-300**
Control user interface digital inputs wiring harness, 100 cm, 1 mm^2 wires	**C445XU-100CXH**

USB cables are used to connect to Power Xpert *in*Control (C445XS-USBMICRO or C445XS-USBLEADS) or perform firmware updates (C445XS-USBLEADS or C445XS-USBRJ12).

Table 5. Catalog Numbers: C445XS… Spare Parts Kit and USB Cables

Description	Catalog Number
Spare parts kit – terminal connectors, mounting feet	**C445XS-TERM**
Standard USB A Male to Micro USB Male cable	**C445XS-USBMICRO**
Standard USB A Male to RJ12 cable	**C445XS-USBRJ12**
Standard USB A Male to Loose Leads cable (for use with Modbus Serial terminals)	**C445XS-USBLEADS**

Modules Overview

Base Control Module Basic Overview

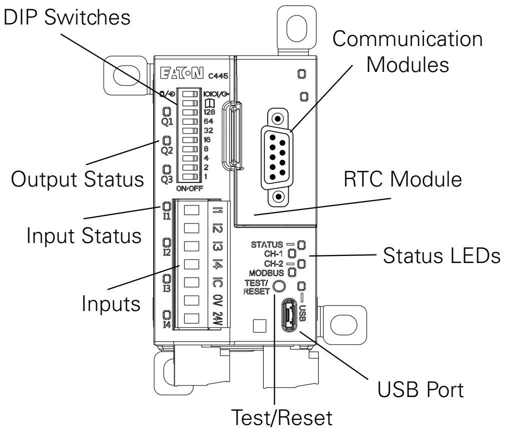
The Base Control Module is the controller of the C445 system, providing the various monitoring, protection and control algorithms. Equipped with native I/O connections, communication card options and USB connectivity, the Base Control Module provides users with real-time data on the health and status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

Figure 7. Base Control Module Image

Base Control Module Features

- Motor protection
- Current, voltage, power and system monitoring
- Pre-configured operating modes
- 120/240 Vac or 24 Vdc supply voltage options
- Four 120 Vac or 24 Vdc inputs, 2NO and 1NO/1NC relay outputs
- Integrated USB port
- Real-time clock and memory backup module option slot
- Multiple fieldbus communication options
- Status LEDs
- Provides power and communications to the Measurement Module and the user interface through the cable connection

Figure 8. Base Module Features and Connections—Front View



DIP Switches: Used for node addressing and configuration selections.

Output Status: LEDs indicate the ON/OFF status of each output.

Input Status: LEDs indicate the ON/OFF status of each input.

Inputs: Four digital inputs available. Must be purchased as 24 Vdc or 120 Vac.

Test/Reset: Used to manually trip the Base Control Module. Also used to reset the module after a trip has occurred.

USB Port: Micro AB connector. Enables configuration upload.

Status LEDs:

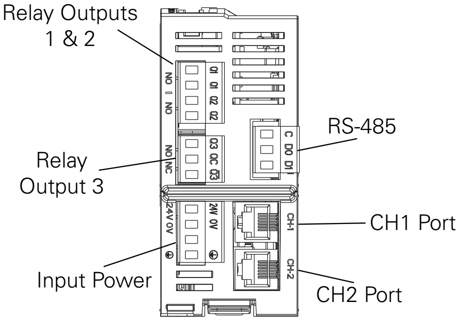
- Status: Indicates the fault and warning status of the Base Control Module
- CH1: Indicates status of modules attached to Channel 1 port on Base Control Module (Measurement Module or user interface)
- CH2: Indicates status of modules attached to Channel 2 port on Base Control Module (Measurement Module or user interface)
- USB: USB traffic indication

Real Time Clock and Memory Backup Module: Optional real time clock module. Plugs in behind the communication cards. Provides battery backed-up fault time stamping and non-volatile memory for configuration parameters.

Communication Cards: Optional modules to provide communications.

- PROFIBUS DVP0 and DVP1 (Shown)
- Ethernet for Modbus/TCP and EtherNet/IP

Figure 9. Base Module Features and Connections—Bottom View



Relay Outputs 1 & 2: Two normally open outputs.

Relay Output 3: Form C NC/NO. Factory orderable as latching or non-latching.

Two options available: 120–240 Vac or 24 Vdc

RS-485: Modbus Serial terminal (factory orderable option only)

CH1 Port: Provides communication and power from the Base Control Module to the connected module (Measurement Module or user interface)

CH2 Port: Provides connection and power from the Base Control Module to the connected module (Measurement Module or user interface)

Measurement Module Basic Overview

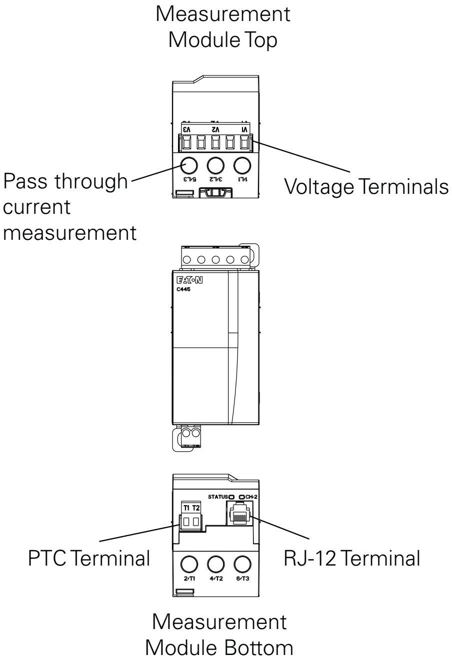
The Measurement Module is a pass-through device which samples current and voltage data consumed by the system. This data is continually transmitted back to the Base Control Module for analysis. Various frame sizes are available for applications up to 800 A, with factory orderable options for voltage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

Figure 10. Measurement Module Image

Measurement Module Features

- 0.3–136 A pass-through current measurement
- External CTs for applications up to 800 A
- Optional line voltage measurement and protection
- Optional positive temperature coefficient (PTC) protection
- DIN rail or panel mounting
- The Measurement Module is powered through its cable connection to the Base Control Module

Figure 11. Measurement Module Features and Connections



Voltage Terminals: Optional Factory installed terminals for measuring line voltage. Required for monitoring voltage, power and energy and related protection features. Cannot be installed in the field.

PTC Terminal: Optional factory installed terminal for Positive Temperature Coefficient (PTC) protection. PTC protection uses temperature measurement signals from the motors stator windings. Cannot be installed in the field.

RJ-12 Terminal: Connection port to the Base Control Module.

Pass through current measurement: for measuring motor lead current from 0.3 to 136 A.

User Interface Options Overview

C445 offers two User Interface types:

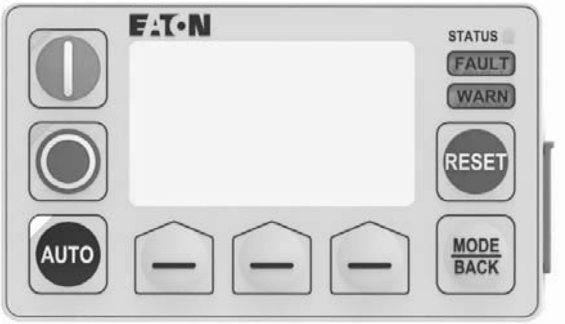
1—Monitoring User Interface (C445UM): Unlocks advanced functionality but in an intuitive format. Provides a quick start wizard, advanced monitoring, parameter editing, complete fault data and optional control. Ideal for users who want easy access to local diagnostics and setup with or without use of a network.

2—Control User Interfaces (C445UC…): 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 Power Xpert *in*Control as well as bright fault, warning and control status LEDs.

User Interface Options Overview

Figure 12. C445UM Monitoring User Interface Image



Monitoring User Interface Features

- Monitoring menus with large font display
  - Current, voltage, power, thermal, and other system data
- Setup wizard
- Easy parameter setting
- Fault notification and diagnostics
- Optional control buttons
- Running, stopped and auto status LEDs
- Fault and warning LEDs
- Micro-USB for connection to PC
- Optional password protection
- Safe remote mounting

Power Xpert *in*Control Software Tool Basic Overview

Power Xpert *in*Control device configuration and control software is a FDT/DTM based Software Tool used for configuration of the C445. This tool has been developed to provide a simple interface for configuration, monitoring and troubleshooting. The software consists of two major parts—the Field Device Tool (FDT) software, which is also known as the "frame application", and the Device-Type Managers (DTM). The DTM portion is further classified into two categories: Device DTMs which connect to the field devices configuration components, and Communication DTMs, which connect to the communications components of the device.

Pre-Defined Operating Modes Basic Overview

The C445 relay has several predefined configurations referred to as operation modes. Selecting one of these operation modes will determine the behavior of some or all of the inputs and outputs of the C445 relay.

- Overload Only
- Direct Online
- Reverser
- Star/Delta
- Two Speed Two Winding
- Two Speed Dahlander
- Auto Transformer
- Solenoid Valve
- MCCB Actuation
- Contactor Feeder
- General Purpose Input/Output
- Stand Alone Ground Fault Module

See **Chapter 5—System Configuration and Operation** on **Page 63** for detailed explanations of each operating mode.

Chapter 2—Receipt/Unpacking

Do not service with voltage applied; use Lock-out Tags.

General

Upon receipt of the unit, verify that the catalog number and unit options stated on the shipping container match those stated on the order/purchase form.

Inspect the equipment upon delivery. Report any crate or carton damage to the carrier prior to accepting the delivery. Have this information noted on the freight bill. Eaton is not responsible for damage incurred in shipping.

Unpacking

Remove all packing material from the unit. Check the unit for any signs of shipping damage. If damage is found after unpacking, report it to the freight company. Retain the packaging materials for carrier to review.

Verify that the unit's catalog number and options match those stated on the order/purchase form.

Storage

It is recommended that the unit be stored in its original shipping box/crate until it is to be installed.

The unit should be stored in a location where:

- The ambient temperature is -40°C – 85°C
- The relative humidity is 0% – 95%, non-condensing
- The environment is dry, clean and non-corrosive
- The unit will not be subjected to high shock or vibration conditions

Chapter 3—Installation and Wiring

Introduction

This chapter provides a description of the mounting and electrical connection(s) to the Power Xpert C445 global motor management relay.

While installing and/or mounting the relay, cover all openings to ensure that no foreign materials can enter the device.

Perform all installation work with the specified tools and without the use of excessive force.

The C445 relay must only be mounted on a non-combustible base.

Relevant mounting and installation instructions are provided in the following instruction leaflets:

IL043001EN for C44B… Base Control Module

IL043003EN for C445M... Measurement Modules

IL043002EN for C445UC… Control User Interface

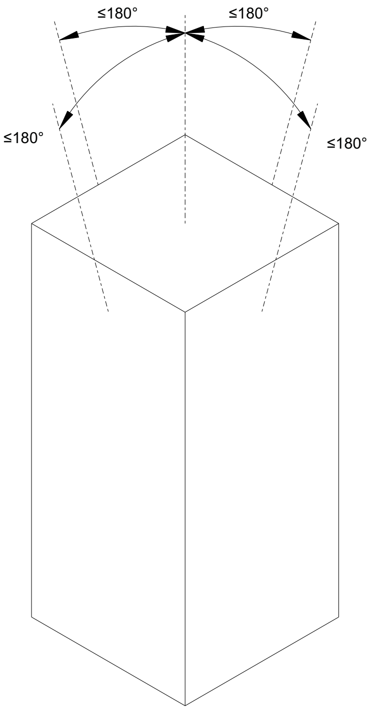
IL042004EN for C445UM Monitoring User Interface

IL042005EN for C445XG-MOD Ground Fault Module

Mounting Positions

The maximum permissible angle of inclination for all C445 devices is shown below:

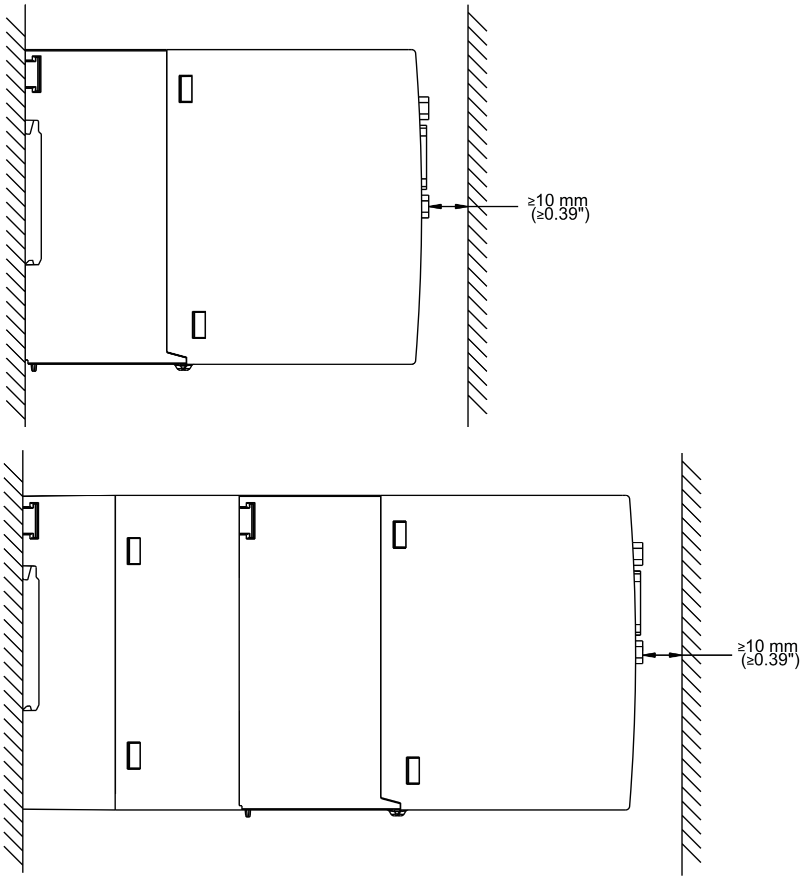
Figure 13. Vertical Position Limits



Clearance

Surrounding air temperature must be less than or equal to 60 °C. A 10 mm clearance between C445 and the enclosure door is recommended.

Figure 14. Clearance Dimensions



C445 Module Assembly

Note: Power down the C445 before adding or removing option cards or RTC module.

Figure 15. Component Exploded View (C445B...Base Module, C445M...Measurement Module, Accessory Cover, C445XO-TRTC Real Time Clock Module, C445C... Communications card(s))

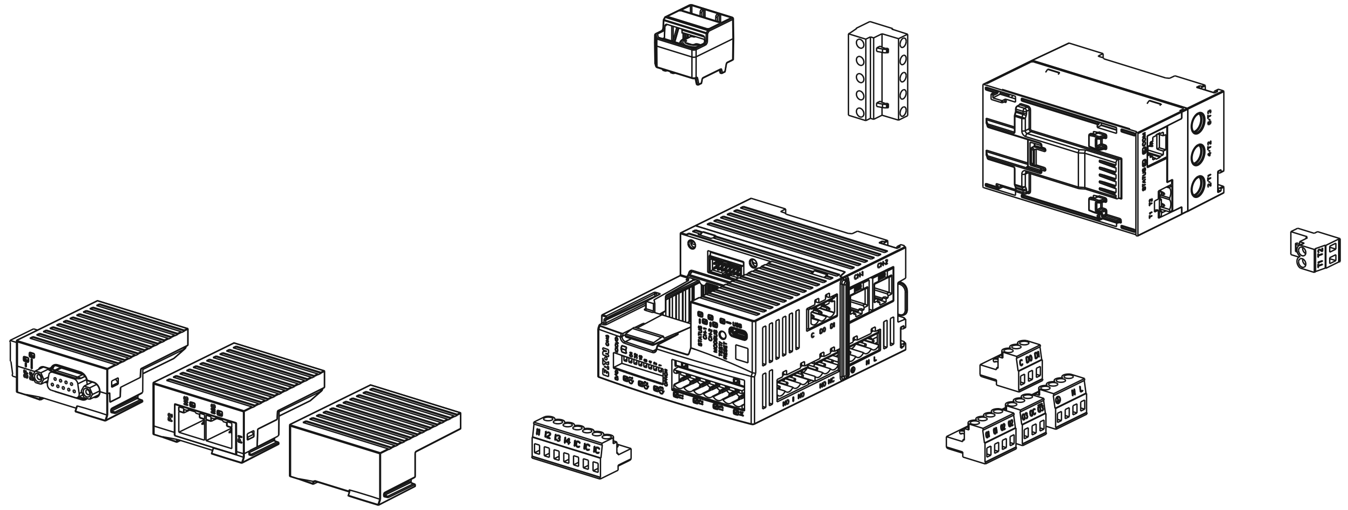


Figure 16. Option Cover Removal

Do not remove or install modules while the device is powered.

Remove the blank cover on the base control module to install the Memory/RTC (C445XO-RTC) Module and/or Communication Card (C445XC…).
If installing only the Memory/RTC module, put the blank cover back in place.
If installing a Communication Card, the blank cover can be discarded.

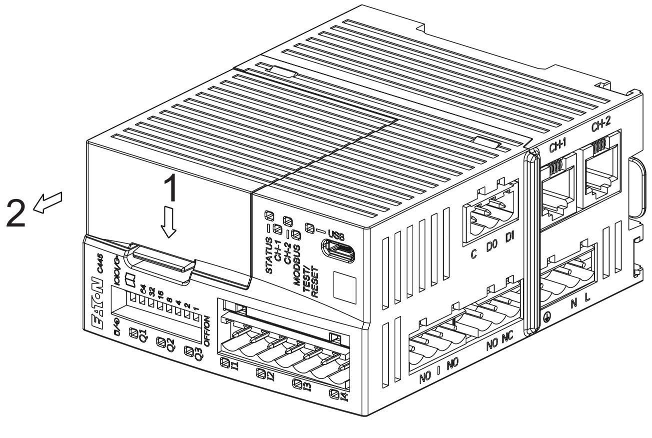


Figure 17. Real-Time Clock and Memory Backup Module Installation

Do not remove or install the module when the unit is powered.

Remove the C445B... Option Cover as shown in **Figure 16**.

The C445XO-RTC module installation is facilitated by a notch on the upper right corner of the module to provide proper orientation of the module.

Firmly push the module into the C445B... pocket until the module is completely seated.

Reinstall Option Cover.

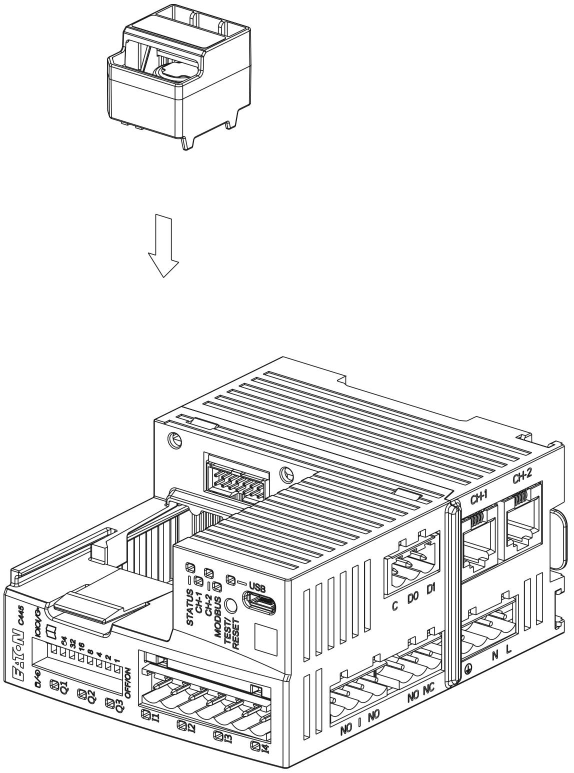


Figure 18. Communication Card Installation

Do not remove or install communication cards when the unit is powered.

Remove the C445B... Option Cover as shown in **Figure 16**.

The Option Cover may be discarded as it will not be reinstalled.

The communication card installation is accomplished by firmly pushing the card downward into the C445B... communications card pocket until the card is completely seated and the locking tab snaps into place.

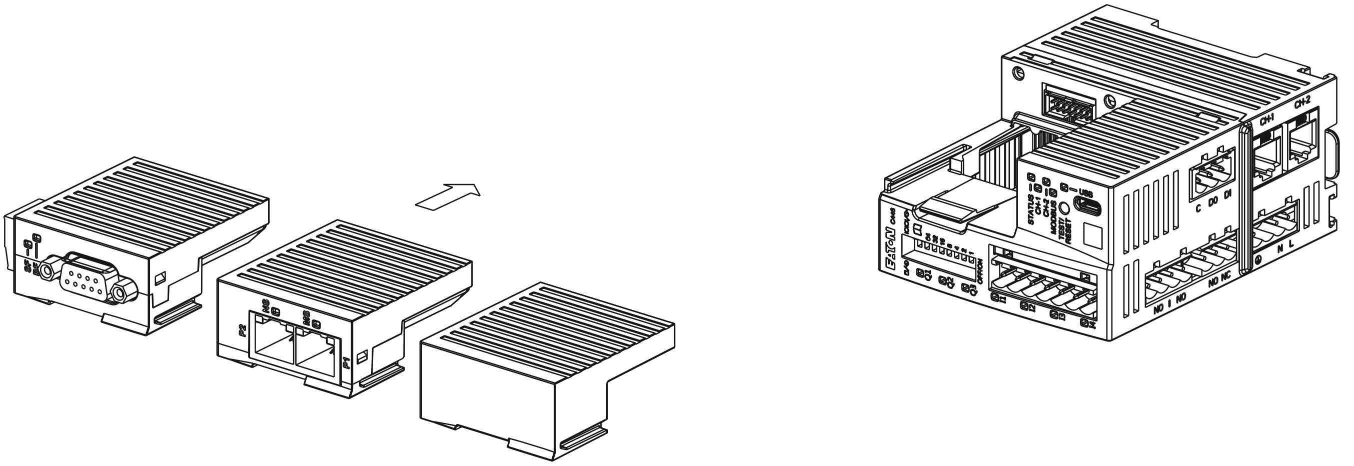


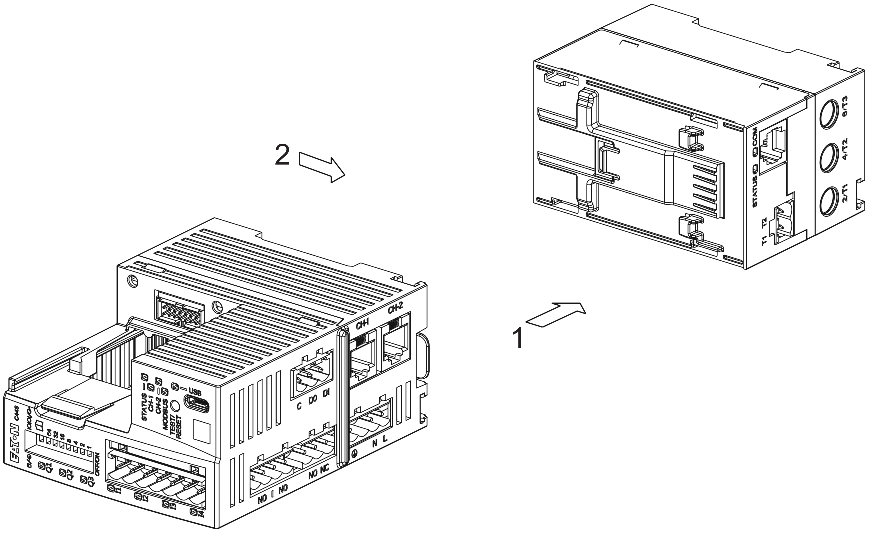
Figure 19. Component Mating

The C445B... Base Module can be attached to the top of the C445MA... Measurement module.

Orient both modules so the two (2) RJ12 jacks on the C445B... module are on the same side as the RJ12 jack on the C445MA... module.

Align the modules so there is an offset of 0.098–0.157 in (2.3–4.0 mm).

Slide the C445B... Base Module downward on the C445MA... Measurement Module until the locking tab moves into place.



C445 Mounting

To aid with the panel layout of the Power Xpert C445 modules, refer to the dimension drawings.

The C445MB… Base Control Module and the C445M… Measurement Modules are designed to be mounted utilizing a standard 35 mm DIN rail or utilizing a panel mount method.

When mounting the modules on 35 mm DIN rail, ensure that the rail is properly secured to support all devices installed on the rail.

All C445 devices may be panel mounted The C445B… base module and C445MA… Measurement Module utilize optional mounting feet that are snapped into place. A minimum of two (2) mounting feet are required. Tabs are installed at locations so one tab is on the top and one on the bottom of the device when mounted vertically.

C445MB… and C445MC… Measurement Modules have mounting tabs molded into the housing assembly. Installation of panel mount screws on all mount tabs are required.

The C445B… base module may be installed directly on top of the C445MA… Measurement Module by aligning the mating slots of the two devices and snapping them together. If the two devices are to be panel mounted, all four(4) panel mount tabs are required.

Table 6. Mounting Hardware

Mounting Fasteners		mm, Grade 4.8			SAE Grade 5		
Device	**Quantity**	**Size**	**Grip**	**Torque**	**Size**	**Grip**	**Torque**
C445B…	2	M5	0.8 mm	2.0 – 2.7 Nm	#10	0.032 in	30 – 42 lb/in
C445B… & C445MA…	4	M5	0.8 mm	2.0 – 2.7 Nm	#10	0.032 in	30 – 42 lb/in
C445MB…	2	M5	8.0 mm	2.0 – 2.7 Nm	#10	0.312 in	30 – 42 lb/in
C445MC…	4	M5	8.0 mm	2.0 – 2.7 Nm	#10	0.312 in	30 – 42 lb/in

The C445B…/C445MA… combined assembly may be mounted on a 35 mm DIN-Rail.

C445 Surface Mounting on DIN rail

Place the C445 device onto the mounting rail from above [1], push down [2], and allow the device to snap into position.

To remove any C445 device from a rail, gently press down on the unit and then pull the lower housing edge away from the rail. Lift the C445 device upward and off the mounting rail.

Figure 20. DIN-Rail Mounting Instructions

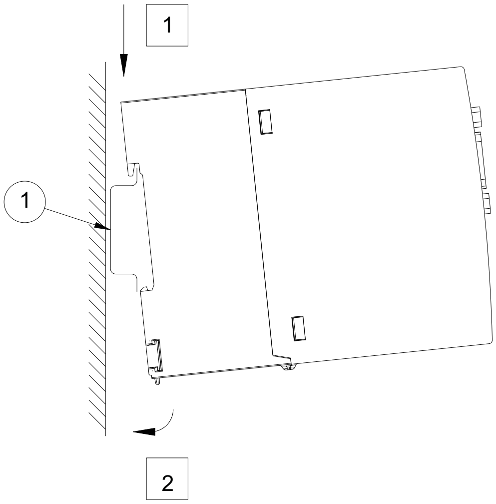
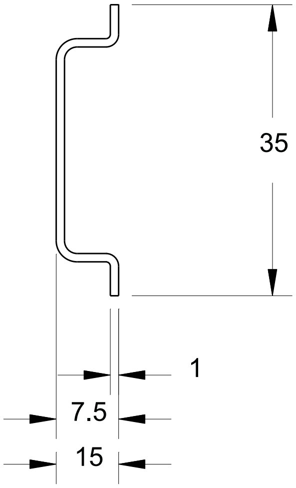


Figure 21. DIN Rail Dimensions

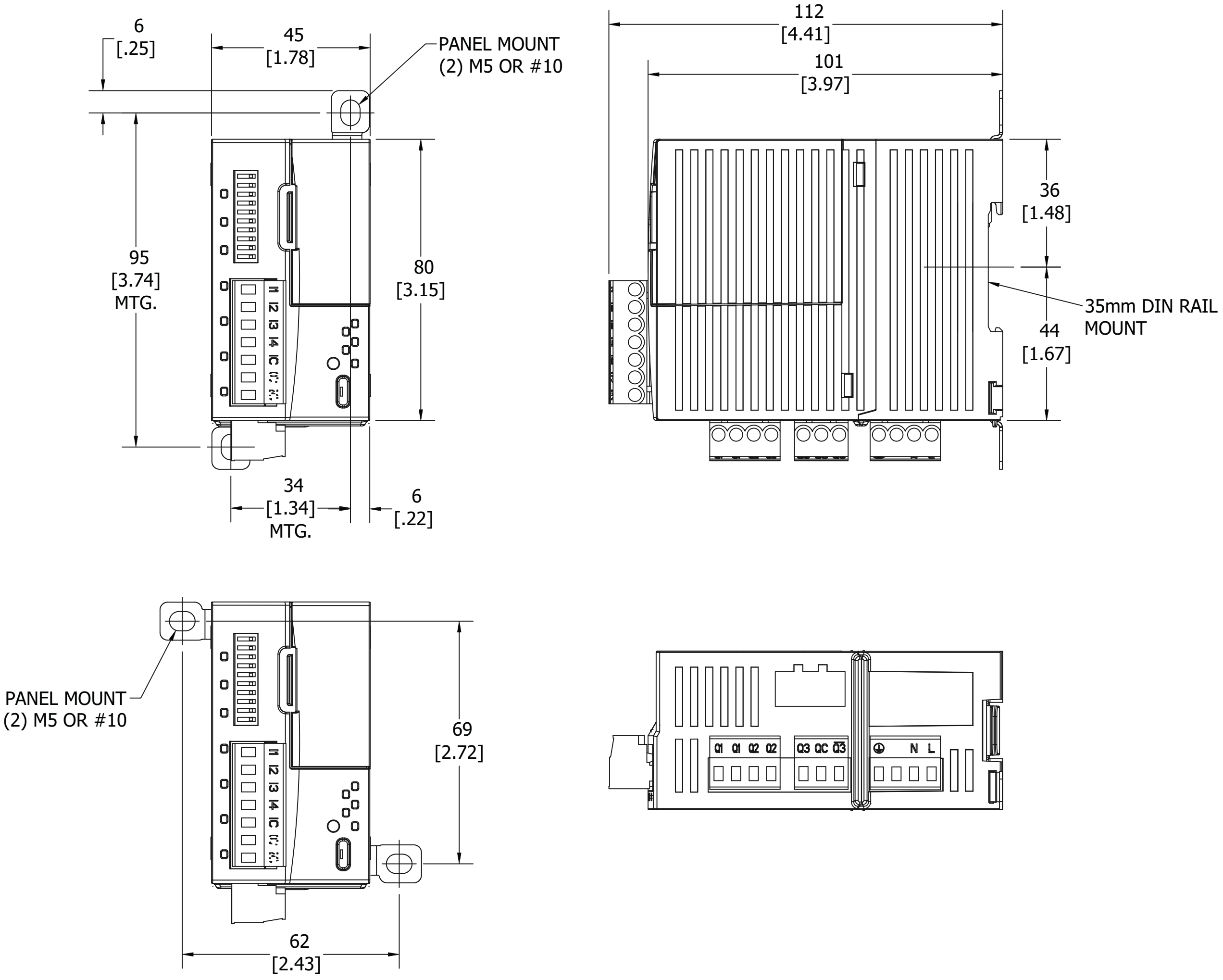


C445… Mounting Dimensions—DIN Rail and Panel Mount

A minimum of two (2) mounting clips are required to panel mount the C445MA…

Mounting clip orientation is one clip on top and one on bottom of the unit.

Figure 22. Base Control Module—C445B… Mounting Dimensions



PANEL MOUNT
OPTION 2

Figure 23. Measurement Module—C445MA... Mounting Dimensions

A minimum of two (2) mounting feet are required to panel mount the C445MA... Foot orientation is one clip on top and one on bottom of the unit.

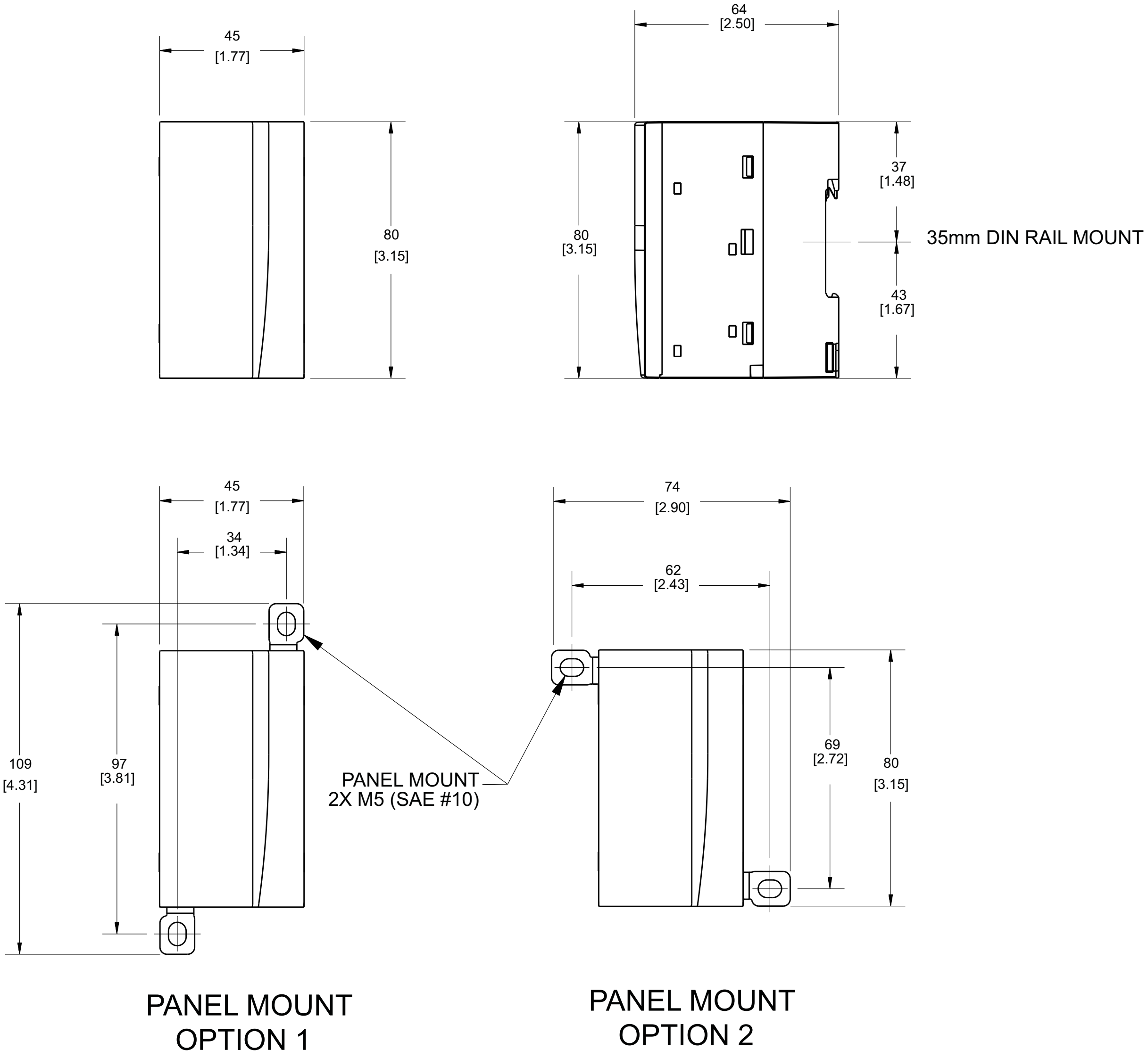
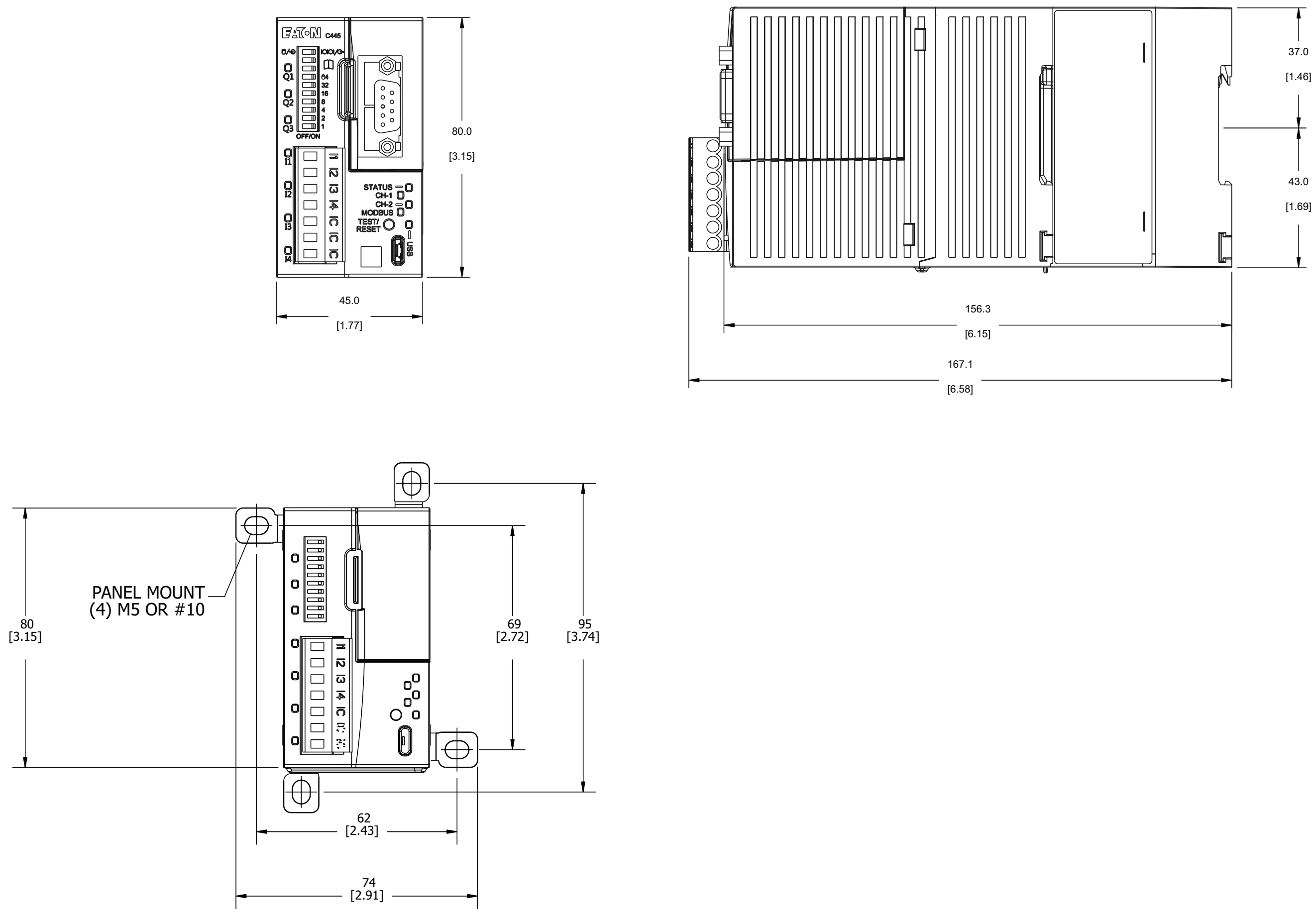


Figure 24. Stacked Base Control Module C445B… and Measurement Module C445MA… Mounting Dimensions



PANEL MOUNT
OPTION 3

Figure 25. Measurement Module C445MB... Mounting Dimensions

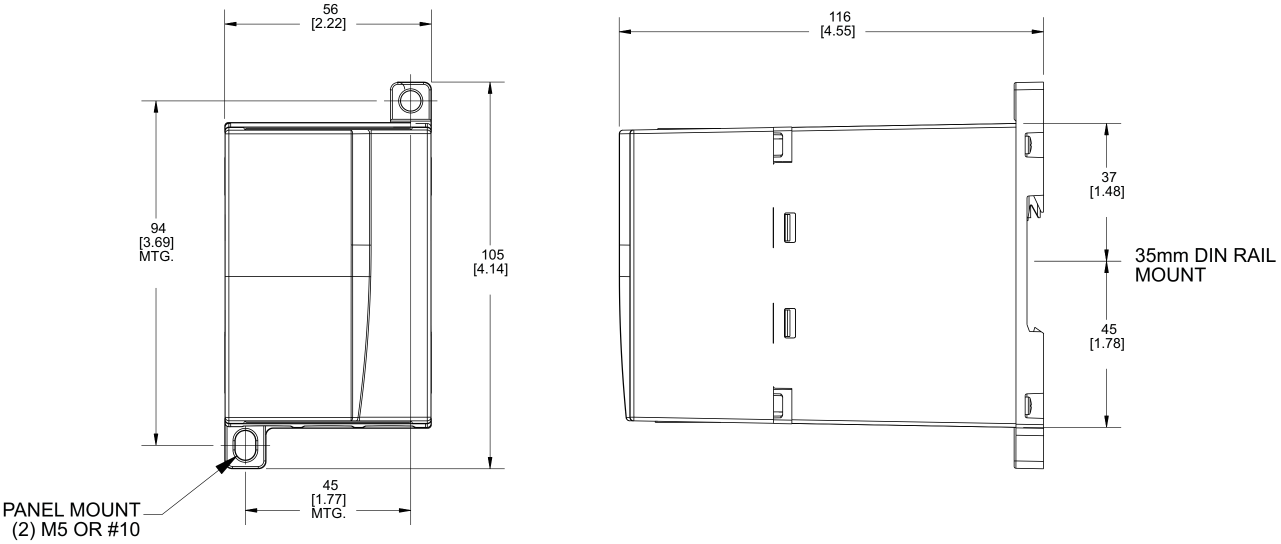
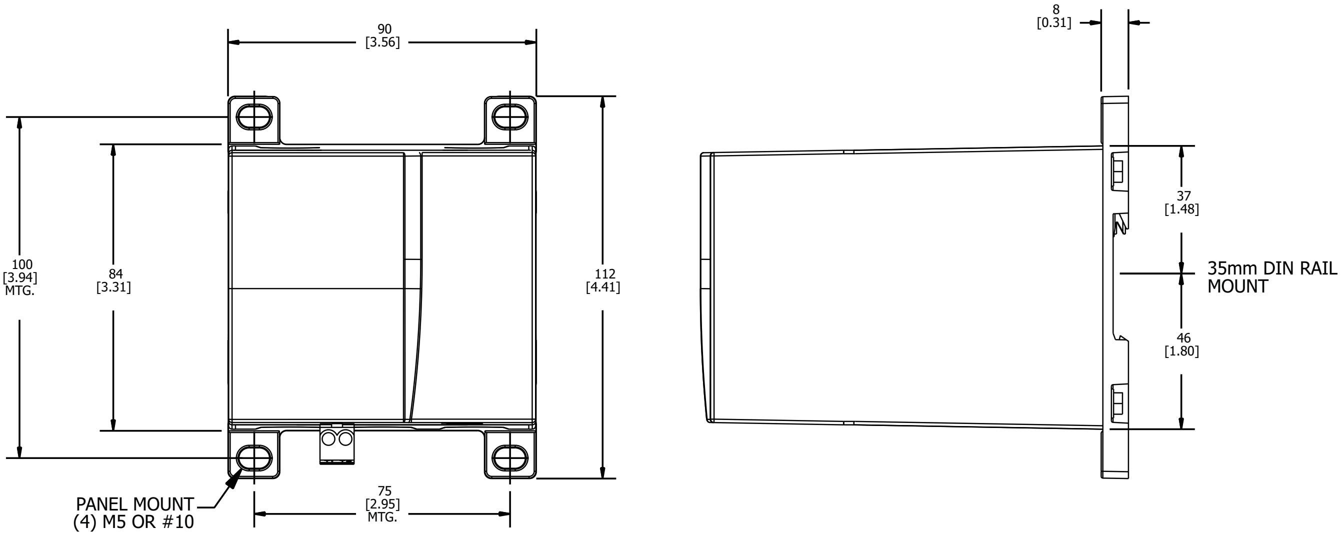


Figure 26. Measurement Module C445MC... Mounting Dimensions



Monitoring User Interface C445UM Mounting Dimensions

Figure 27. User Interface—Monitoring Option

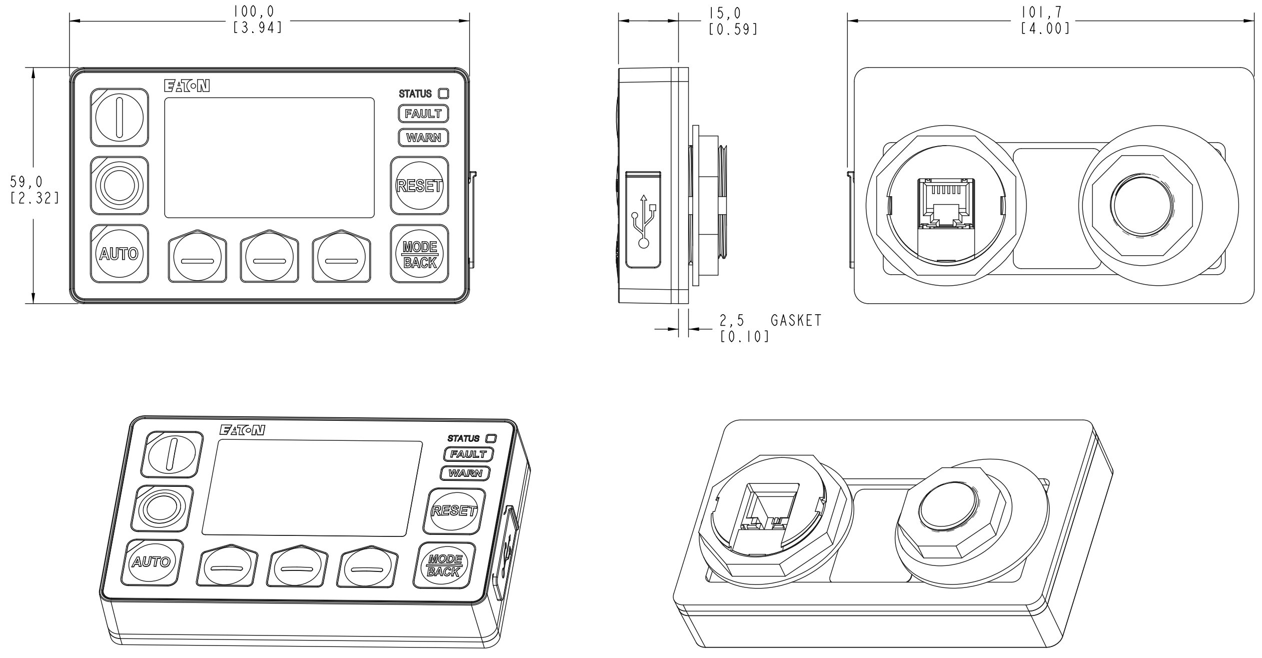
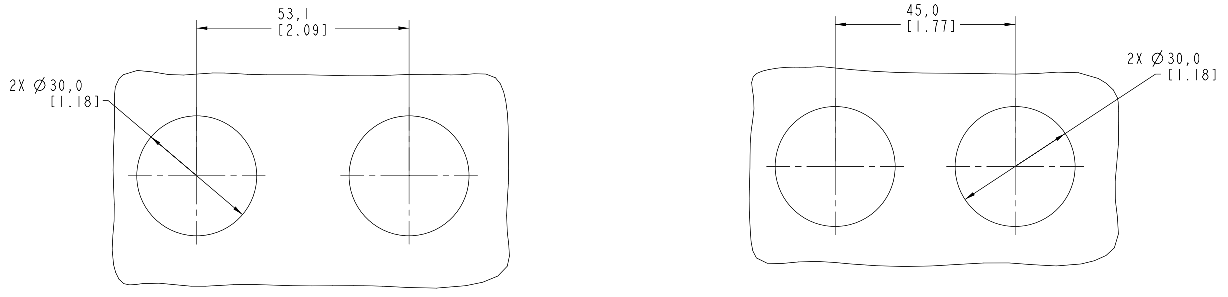


Figure 28. Panel Cutout Options



OPTION 1

OPTION 2
BACKWARDS COMPATIBLE WITH C441 MOTOR INSIGHT DISPLAY CUTOUT

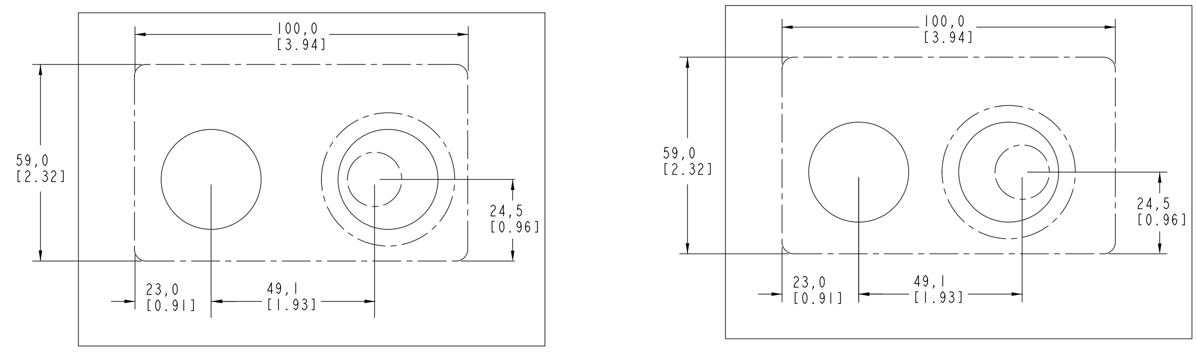
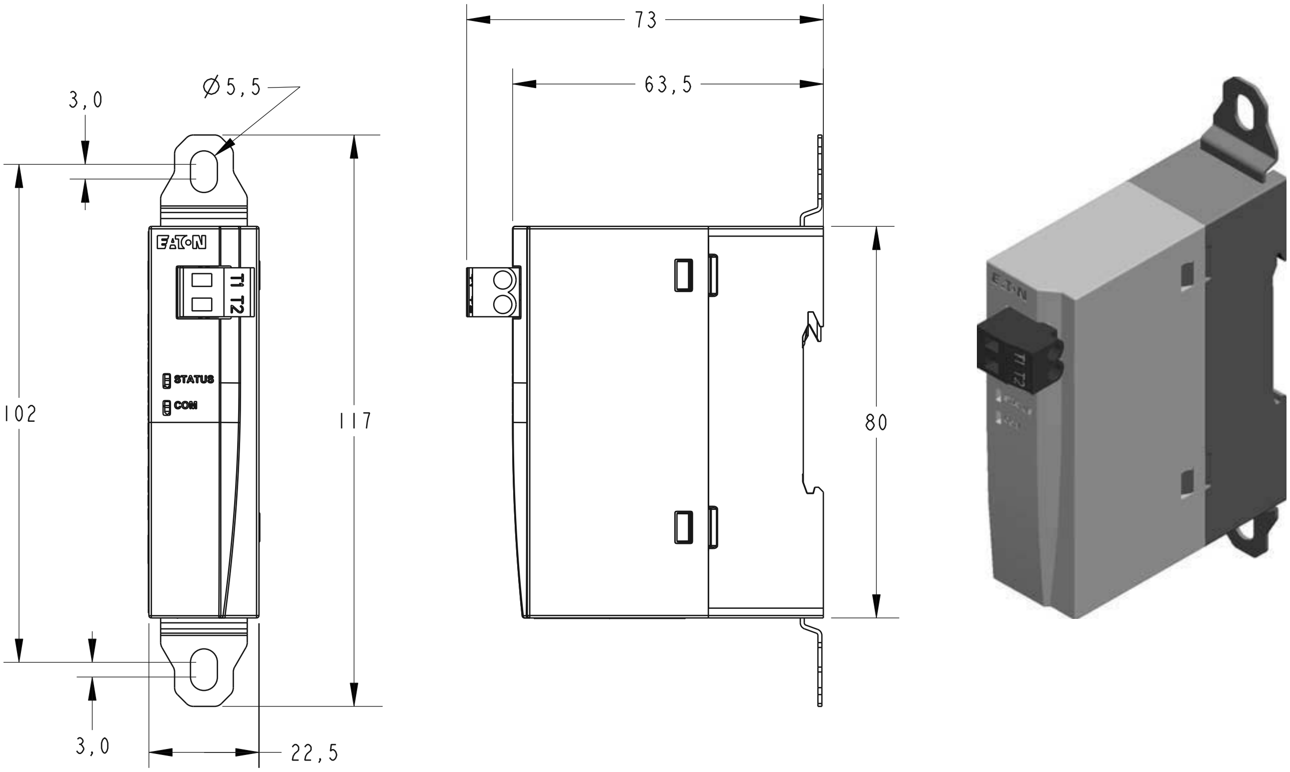


Figure 29. C445XG-MOD—C445 External Ground Fault Module



Note: Remove mounting tabs for DIN rail mount.

Figure 30. C445XG-CT2—28 mm Diameter Zero Sequencing Ground Fault CT

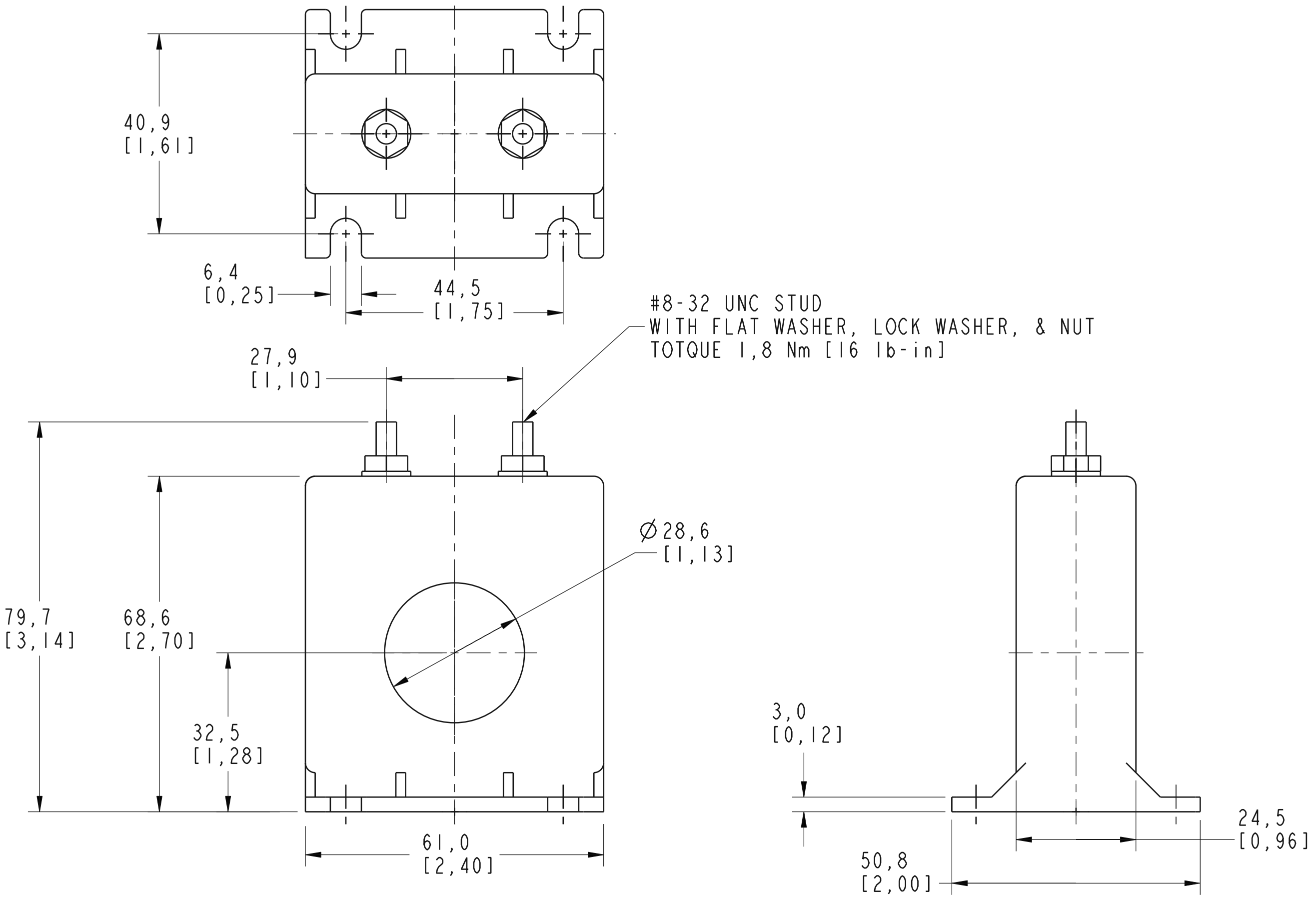


Figure 31. C445XG-CT3—52 mm Diameter Zero Sequencing Ground Fault CT

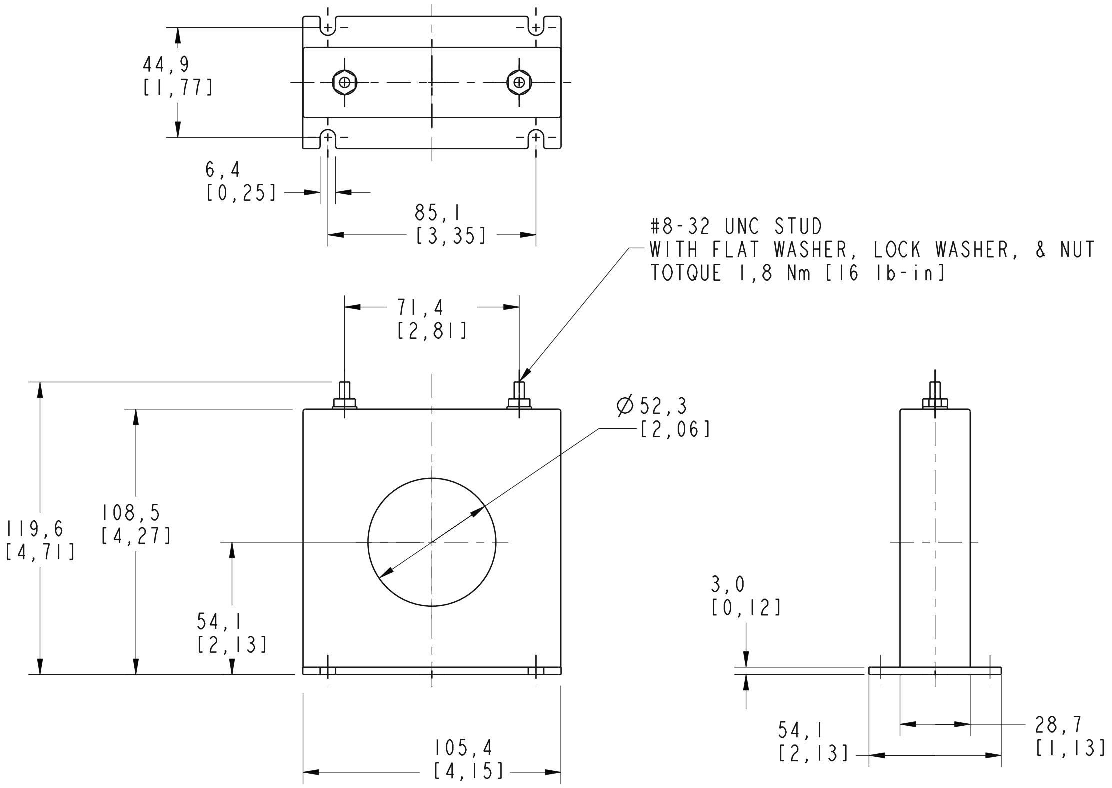


Figure 32. C445XG-CT4—63 mm Diameter Zero Sequencing Ground Fault CT

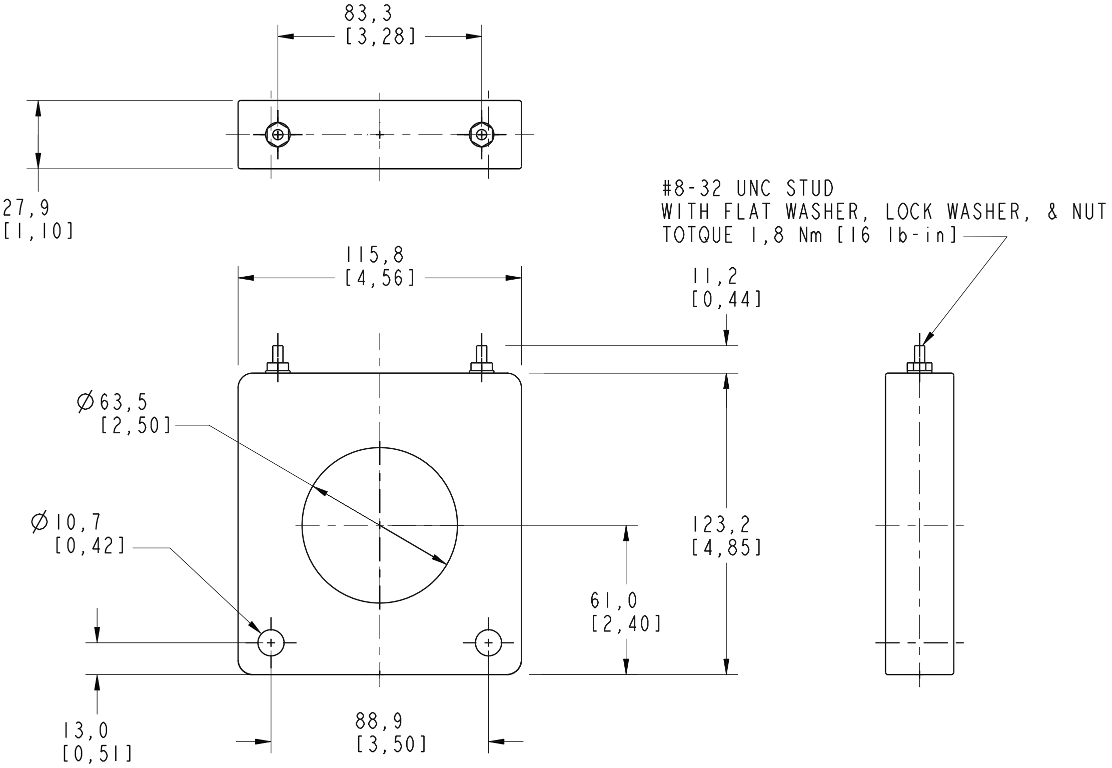
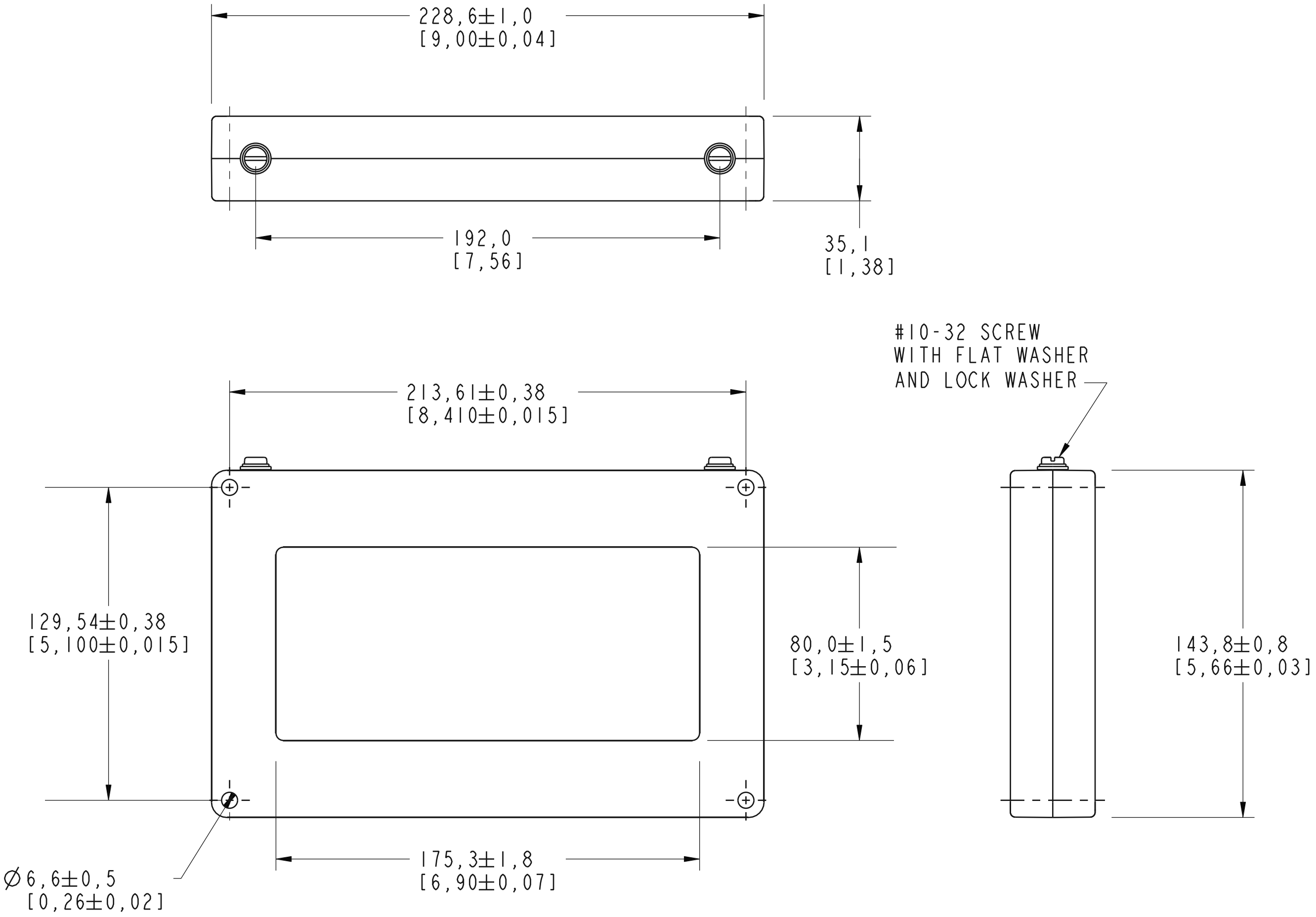


Figure 33. C445XG-CT7—80 x 175 Rectangular Zero Sequencing Ground Fault CT



Motor Wiring Connections—Typical

This section shows typical diagrams for basic overload applications. Each C445 system consists of a base Module C445B… and a Measurement Module C445MA…, C445MB…, or C445MC…

Options such as the user interface C445U…, current transformers, and potential transformers may be connected to meet the operating requirements of the customer application.

The C445 can be configured utilizing external current transformers (CT's) and potential transformers (PT's).

Current transformers and/or potential transformers may be connected to any C445 application. Please follow the device manufacturer's instructions for connection information.

The C445 will support optional mains voltage monitoring with phase voltage connections to Terminals V1, V2, and V3 on any Measurement Module.

The C445 will support optional motor positive temperature coefficient (PTC) thermistors with device connections to Terminals T1 and T2 on any Measurement Module to provide additional levels of protection to any application.

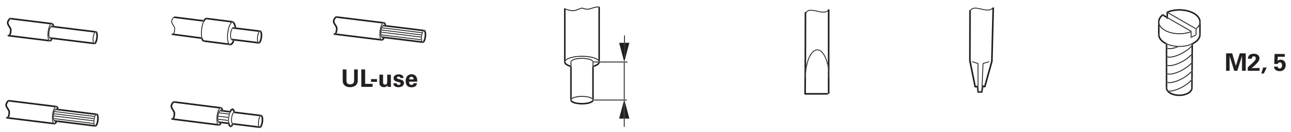
Figure 34. Terminal Fastening

Control signal terminal connector specifications apply to all connectors:

C445BA...
N L PE Q1 Q2 Q3 C Q3 I1 I2 I3 I4 C D0 D1

C445BD...
24 0 PE Q1 Q2 Q3 C Q3 I1 I2 I3 I4 C QV 24V

C445M...
V1 V2 V3 T1 T2

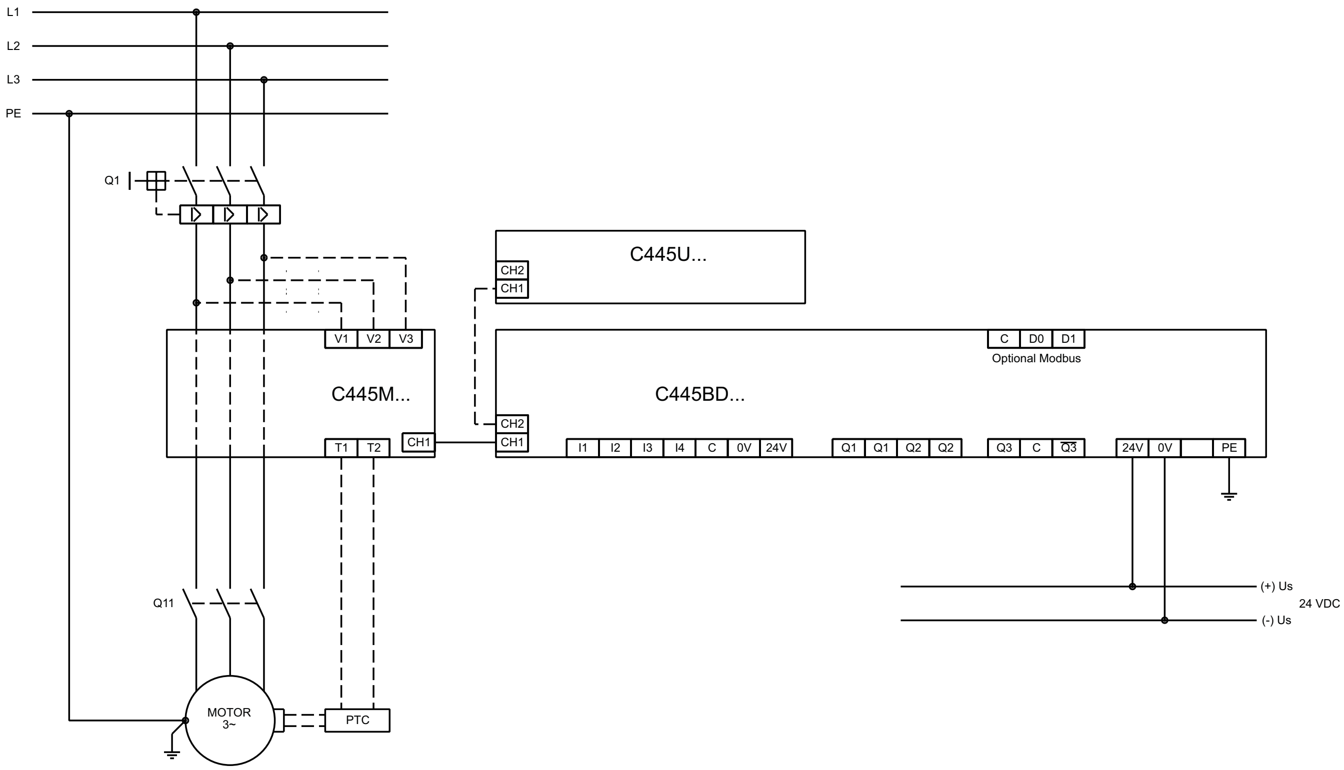


mm²	mm²	AWG	mm	inch	⊖	⊕	Nm	lb-in
1 x 0.2–2.5	1 x 0.2–2.5	1 x 24–12	7.0	0.275	0.6 x 3.5 mm	PH0, PZ0	0.4–0.5	3.5–4.4

Motor Connections for Standard Overload Control

Standard Overload Applications

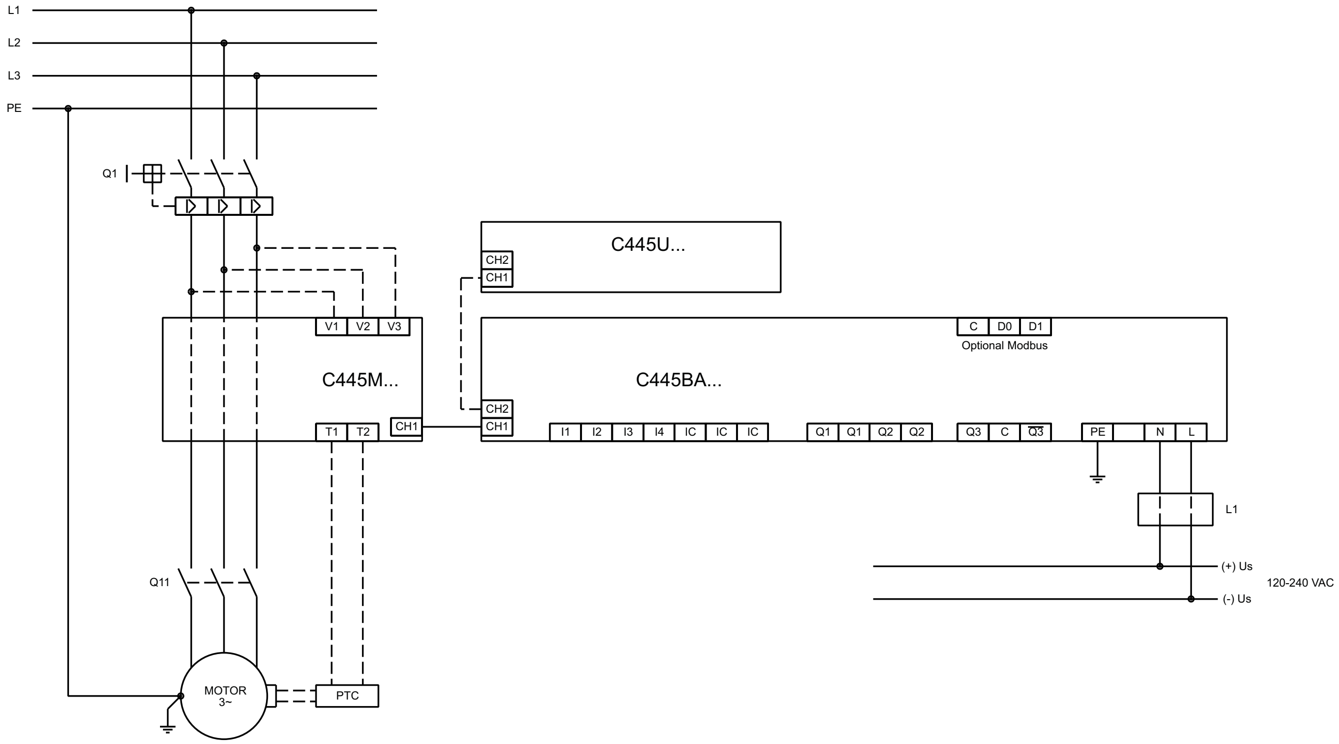
Figure 35. Motor Connections for Standard Overload Control with C445BD…



Legend

Q1 = Cable and motor protection.
Q11 = Run contactor.
PTC = Positive Temperature Coefficient (PTC) sensor.

Figure 36. Motor Connections for Standard Overload Control with C445BA…



Legend

Q1 = Cable and motor protection.
Q11 = Run contactor.
PTC = Positive Temperature Coefficient (PTC) sensor.

Using Power Xpert C445 with External CTs

C445 covers systems from 0.3 to 800A. Embedded CTs provide measurement up to 136A. Motor applications from 136A to 800A require external CTs. Systems using external CTs always use the 1-5 Amp Measurement Module (C445MA-005…).

Eaton offers the following CTs for use with C445. Catalog numbers are for one CT. Users may purchase CTs from Eaton or use their own.

Table 7. C445 CT Offering Catalog Numbers (XCT_ CTs)

CT Range	Description	Qty. ①	Use with …	Catalog Number
17–300A	300:5 single-phase CT, 1.25 inch diameter hole, Class C50	1	C45MA-005_	**XCT300-5**
75–600A	600:5 single-phase CT, 2.00 inch diameter hole, Class C50	1	C45MA-005_	**XCT600-5**
100–800A	800:5 single-phase CT, 2.50 inch diameter hole, Class C50	1	C45MA-005_	**XCT800-5**

Note

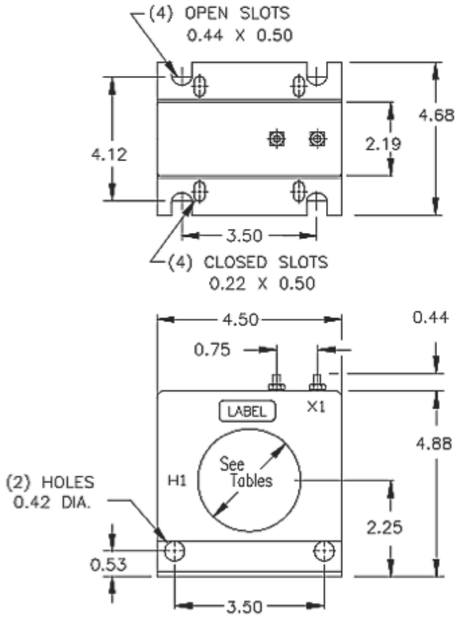
① Order 3 per system.

Mounting (XCT_ CTs)

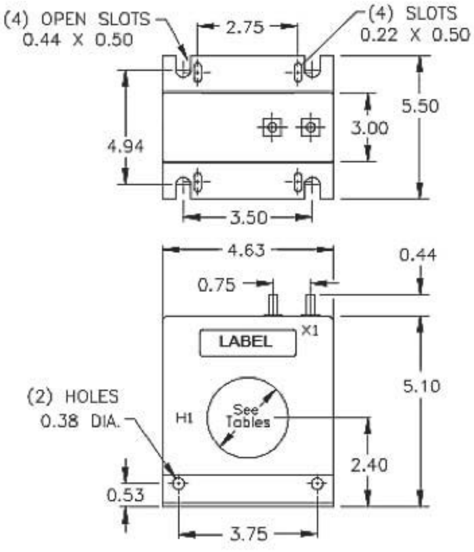
Each XCT_CT comes with a bracket mounting kit for panel mounting. Secondary terminals are 8-32 brass terminals with one flatwasher, lockwasher and regular nut.

Dimensions (XCT_ CTs)

Figure 37. XCT300-5, XCT600-5 (inches)



XCT800-5 (inches)



Using External Current Transformers

Customer Supplied CTs

Other external CTs may be used with C445. For best accuracy, provide CTs with at minimum the following ratings/ features. Customers are responsible for ensuring that the environmental and regulatory ratings of their selected CTs meet the requirements of their application.

Recommended CT Specifications:

Insulation Voltage: Equal to or above Voltage of application
Insulation Rating: 10kV BIL Full Wave <OR>
Test Voltage One Minute 3kV
Rated secondary current: 5A or 1A
Frequency: 50/60 Hz
Accuracy: 0.3 % or better

Note: Systems using external measurement CTs with a 5A secondary current or XCT_ _ _-5 should use the C445MA-005_. Systems with CTs that have a 1A secondary current should use the C445MA-2P4_ measurement module.

External CT Wiring Instructions

1. Pass primary motor lead through opening in CT in proper direction. Perform for each phase.
    - Eaton XCT_CTs: Pass through in direction **H1** → **H2**
    - Customer Supplied CTs: Follow manufacturer's directions
2. Attach wire to secondary output terminal on external CT and pass through C445MA-005_ in proper direction (in through **1/L1, 3/L2, 5/L3** terminals). Perform for each phase.
    - Eaton XCT_CTs: Start from terminal X1
    - Customer Supplied CTs: Follow manufacturer's directions
3. Secure wire after measurement module pass through into second terminal on external CT. Perform for each phase.
    - Eaton XCT_CTs: Secure in second, unmarked terminal
    - Customer Supplied CTs: Follow manufacturer's directions

Table 8. External CT Settings

When using external CTs, CT ratio must be set in the C445 using the following parameters:

Parameter	Units	Increment	Minimum	Maximum	Default	Modbus Register
CT Ratio—Primary	Amps	1	1		1	918
CT Ratio—Secondary	Amps	1	1		1	919

External CT Wiring Diagram

Terminal designations shown are for Eaton XCT family. Customer supplied CTs may have different terminal designations or wiring. Follow manufacturer's instructions for customer supplied CTs.

Figure 38. External CT Wiring Diagram

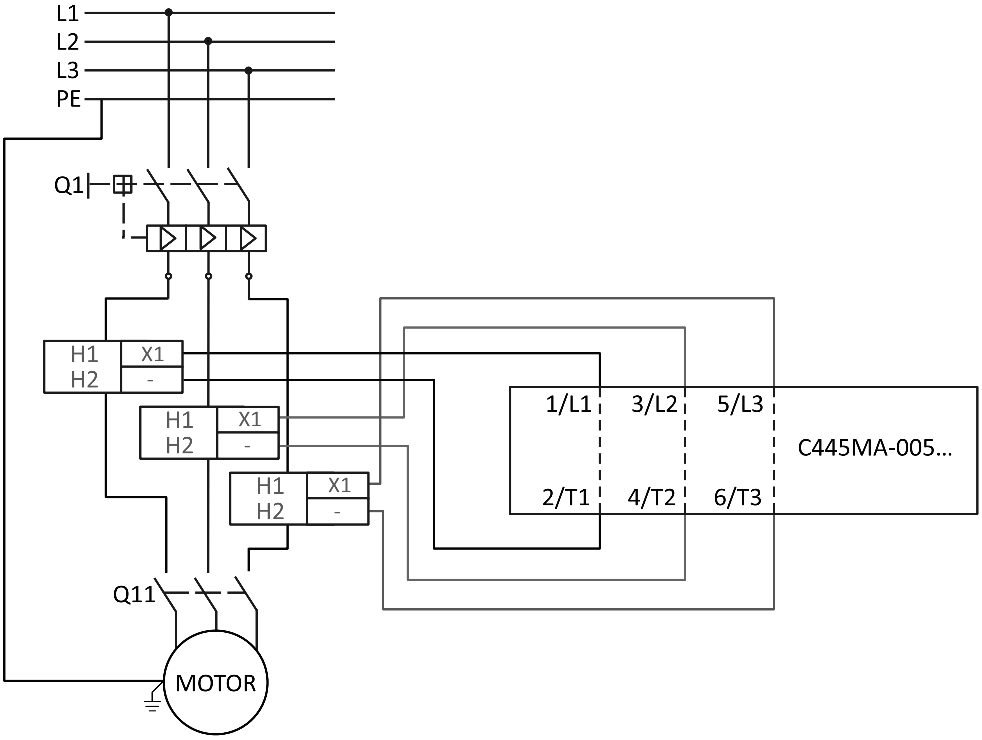
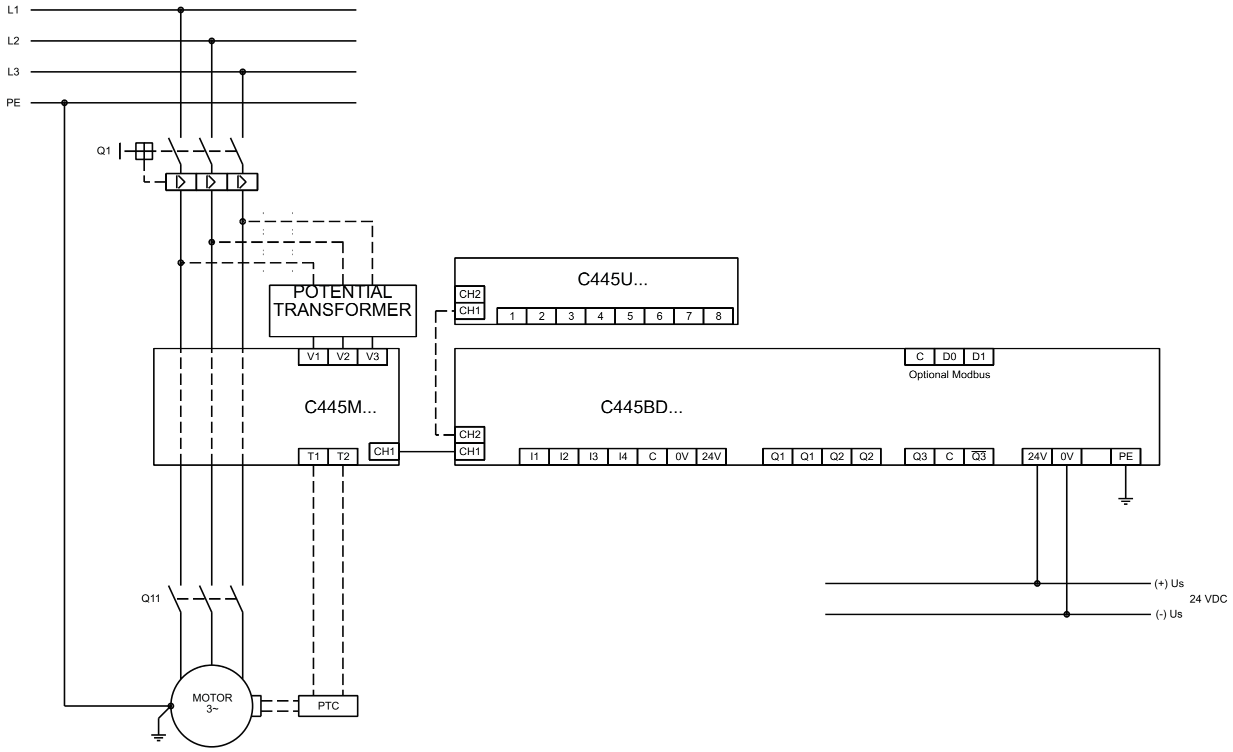


Figure 39. Motor Connections for Standard Overload Control Using Potential Transformers with C445BD…

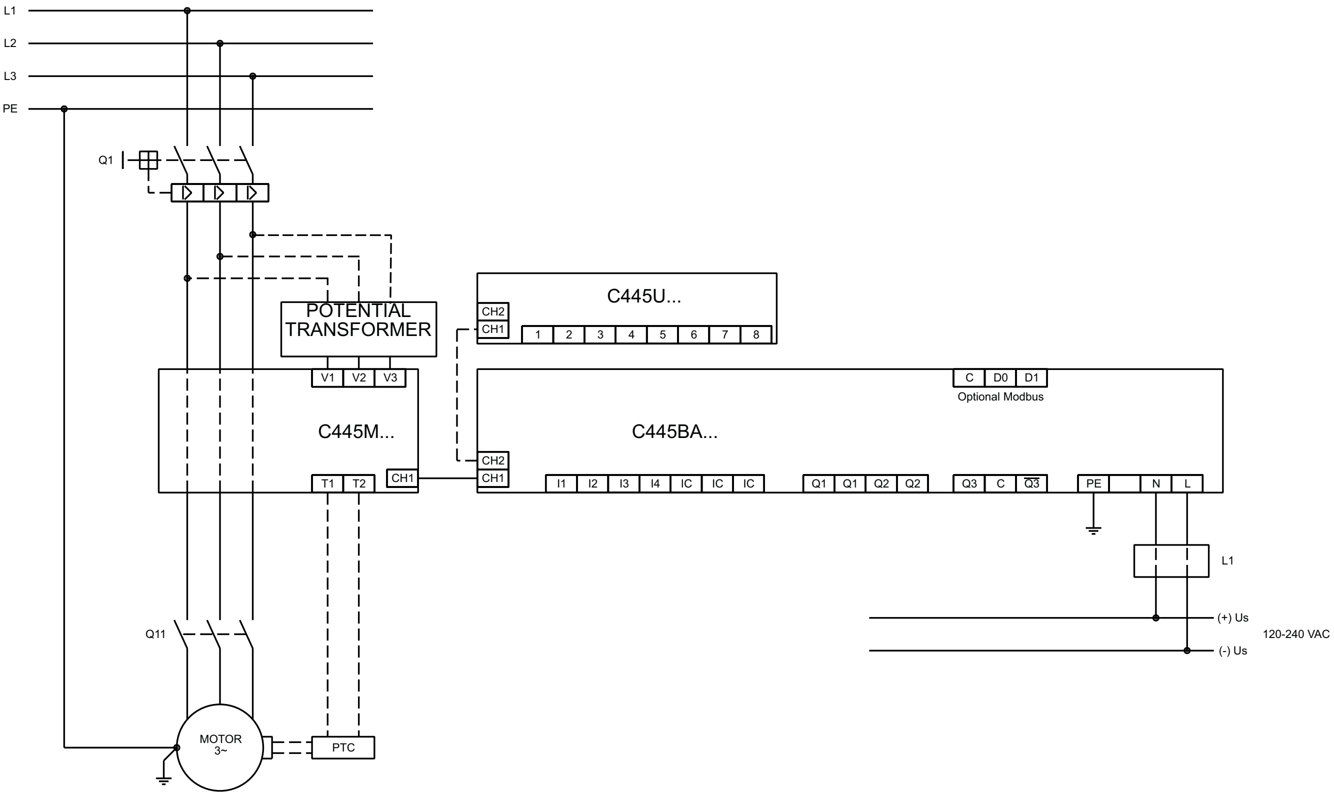


Legend

Q1 = Cable and motor protection.
Q11 = Run contactor.
External CT = External Current Transformer, connect in accordance with manufacturer's instructions.
PTC = Positive Temperature Coefficient (PTC) sensor.

Motor Connections with Potential Transformer(s)

Figure 40. Motor Connections for Standard Overload Control Using Potential Transformers with C445BA…



Legend

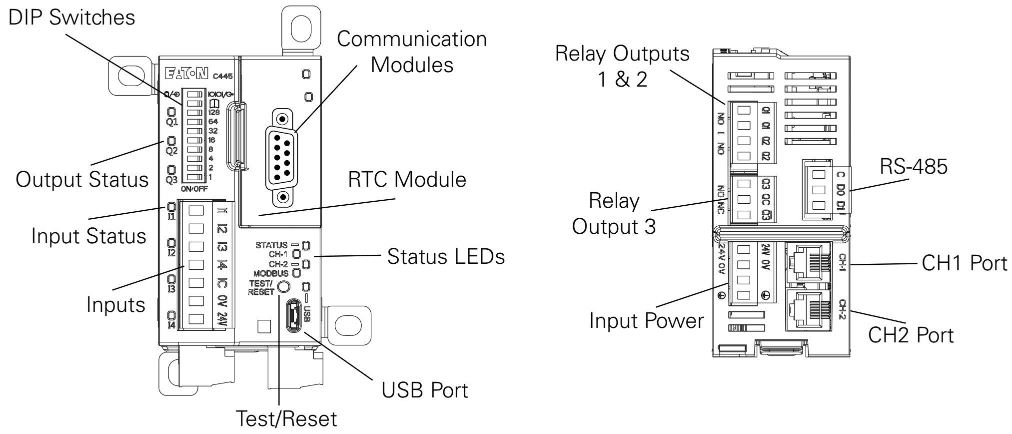
Q1 = Cable and motor protection.
Q11 = Run contactor.
External CT = External Current Transformer, connect in accordance with manufacturer’s instructions.
PTC = Positive Temperature Coefficient (PTC) sensor.

Power and I/O Wiring

Base Control Module

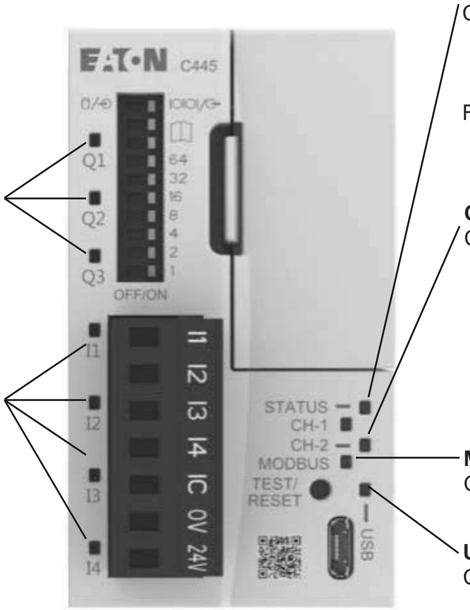
The Base Control Module is the controller of the C445 Motor Management Relay system. It provides motor protection and control algorithms and various motor data for monitoring. This module is equipped with native digital inputs for field wire control and outputs for motor control and protection. It also provides communication card options and USB connectivity for real-time data on the health and status of the motor. Base Control Module provides the slot for optional communication cards, the connectors for digital inputs and outputs, the optional RS-485 Modbus connector, the connector for powering the system, the USB port and the DIP switches (see **Figure 41**). The DIP Switch settings are dependent on the communication options installed.

Figure 41. Base Control Module Features and Connections



Base Control Module LED Behavior Overview

Figure 42. Base Control Module LED Overview



Output Status
ON = Output Active
OFF = Output Inactive

Input Status
ON = Input Active
OFF = Input Inactive

Device and Motor Status
Color
-Red = Fault
- Yellow = Warning
-Green = No Fault/Warning
Flash Rate
-Mostly ON = Actively polled >1s poll rate (any protocol)
- Mostly OFF = Not being polled from the network

CH1 & CH2 Status
Color/Flash
-Red/Slow (1s ON/1s OFF) = Connected device missing or damaged
-Green/Rapid (50ms ON/50ms OFF) = Device Discovery
-Green/Mostly ON (1.45s ON/50ms OFF) = Device connected, data being exchanged
-Green/Mostly OFF (50ms ON/1.45s OFF) = Device connected, no data being exchanged

Modbus Status
Color
-Green = Indication of traffic

USB Status
Color
-Green = Indication of traffic

LED Test
A LED Test is performed after every reset or if commanded by the network. The test cycles through both colors on bi-color LEDs. The test lasts 2 seconds.

Base Control Module Features

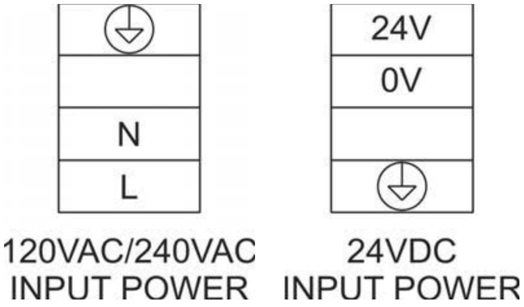
- Motor protection
- Power and efficiency monitoring
- Pre-configured operating modes
- AC (120/240) and DC (24) supply power options
- (4) Inputs / (3) Outputs
- Integrated USB port
- Real time clock memory module option
- Multiple fieldbus communication options
- Status LEDs
- Provides power and communications to the Measurement Module and the user interface through RJ-12 cables.

24 Vdc and 120/240 Vac System Power

The C445 system consisting of the Base Control Module and a Measurement Module along with a number of optional modules, cards and ports are all powered from the four point connector on the Base Control Module. The Base Control Module can be powered by one of the following sources.

Input Power: Three options available, AC powered 110 Vac, 60 Hz, 220 Vac, 50 Hz, or 24 Vdc.

Figure 43. Input Power Options



Digital Inputs

There are 4 digital inputs on the Base Control Module. The module can be ordered with four 24 Vdc inputs or four 120 Vac inputs. Some or all of these inputs may be used if Field Wire is selected as one of the control sources. Or, if Field Wire is not selected as one of the control sources, all of these inputs are available as general purpose inputs. The state of these inputs is available to a system controller over a supported fieldbus network. The wiring for the inputs if they are available as general purpose inputs is shown below for both 24 Vdc and 120 Vac.

The Operation mode selected along with selecting Field Wire as one of the control sources determines which inputs are available as general purpose inputs. Refer to **Chapter 5—System Configuration and Operation** on **Page 63** for additional information on the Operation modes of the C445 and what functionality is assigned certain inputs based on the Operation mode.

For more information on the Operation modes and Input wiring if Fieldwire is selected as one of the control sources, refer to **Chapter 5—System Configuration and Operation** on **Page 63**.

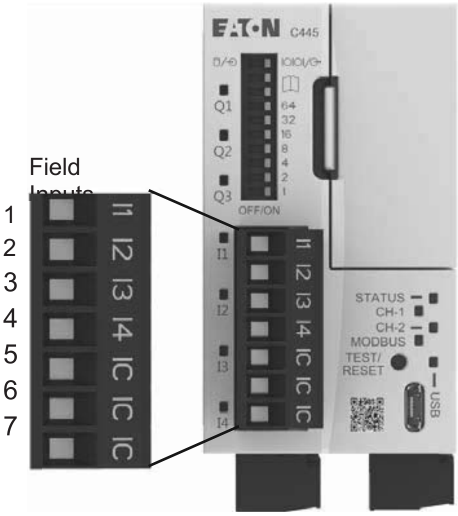
Below are wiring diagrams for the inputs on the Base Control Module assuming Field Wire is not one of the control sources, i.e. all inputs are available as general purpose inputs.

AC Input Option

The C445 Base Control Module with the AC Input option allows for up to four 120 Vac Inputs to be connected.

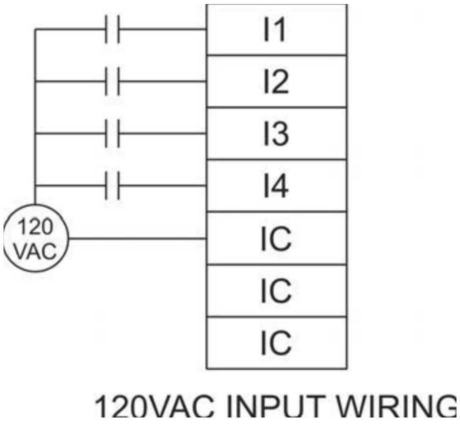
AC Input Field wiring is accomplished with a 7-pin, 5.00 mm pitch, removable screw terminal plug.

Figure 44. AC Field Input Terminal



Pin#	Circuit	Description
1	I1	AC Field Input 1
2	I2	AC Field Input 2
3	I3	AC Field Input 3
4	I4	AC Field Input 4
5	IC	Common for AC Field Input
6	IC	Common for AC Field Input
7	IC	Common for AC Field Input

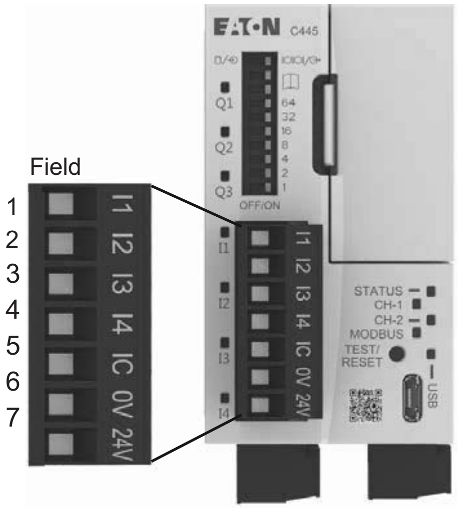
Figure 45. 120 Vac Input Terminal Diagram



DC Input Option

The C445 Base Control Module with the DC Input option allows for four isolated 24 Vdc Inputs (Option #1) or four dry contact (relay/switches) inputs (Option #2).

Figure 46. DC Field Input Terminal



Pin#	Circuit	Description
1	I1	DC Field Input 1
2	I2	DC Field Input 2
3	I3	DC Field Input 3
4	I4	DC Field Input 4
5	C	Common for DC Field Input
6	0V	Digital Electronics Ground
7	24V	Source for DC Field Inputs

Wiring Option #1—Four Isolated 24 Vdc Inputs

When using option #1, no connections are made to pins 6 or 7.

Wiring Option #2—Four Dry Contact Inputs

To use this option, pin 5 is shorted directly to pin 6. Pin 7 is connected through a switch or relay to the appropriate input.

The maximum wire length from pin 7 to the corresponding input is 10m.

DC Field Input wiring is accomplished with a 7-pin, 5.00 mm pitch, removable screw terminal plug.

Note: When using Option #2, all wiring must meet PELV requirements.

Figure 47. DC Input Wiring Option 1 (Isolated)

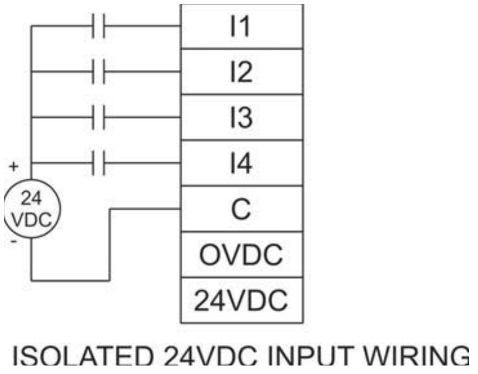
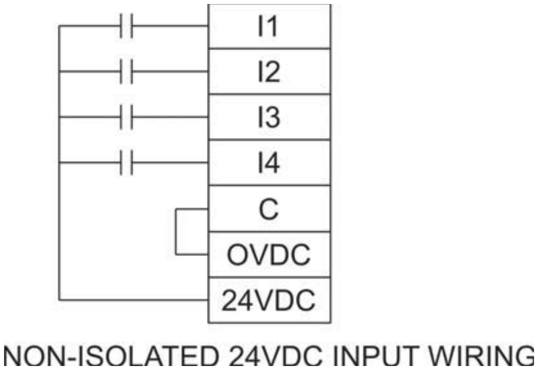


Figure 48. DC Input Wiring Option 2 (Non-Isolated)



Digital Outputs

The three digital outputs are dedicated to specific functionality based on the Operation mode selected. For example, Output 1 is used to control the contactor that energizes and de-energizes the motor for a Direct (FVNR) Motor application. In this example, Output 1 is used to control the contactor and to protect the motor. It is a normally open contact that closes when the active control source instructs it to do so, provided there are no faults or inhibits present. This same output contact opens when an active protection instructs it to do so, to protect the motor. In the case of the Direct Operation mode, only Output 1 is dedicated to this mode, leaving Outputs 2 and 3 available as general purpose relay outputs or another configurable function. This is the case for each Operation mode selected. Any of the three outputs not dedicated to an Operation mode may be used as general purpose outputs, controlled by a controller via a Fieldbus. Or, configured for another specific purpose with the Power Xpert *in*Control Software Tool.

Any available outputs configured as general purpose outputs are controlled by a controller via a fieldbus network such as EtherNet/IP, PROFIBUS, Modbus TCP or Modbus serial. The low 4 bits of the Field Output Control Word are used for this purpose. Any of the four low bits, 0-3 can be assigned to control any of the available outputs. In other words, bit 2 of the Field Output Control Word could be assigned to control output 2. But bit 0 could also be assigned as the control bit for that output. The Power Xpert *in*Control Software Tool is used to assign the bits in the Field Output Control word to the available outputs.

There are 2 bits that are needed to control output 3 if the C445 is ordered with the latching relay output option. Only output 3 can be ordered as a latching relay output. The 2 bits used for controlling output 3 when it is a latching relay are to set and reset the output. If output 3 is not ordered as a latching relay, then output 3 is controlled with one bit like outputs 1 and 2. This is the reason there are four bits in the Field Output Control word for controlling 3 outputs.

For more information on the Operation modes and associated output wiring refer to **Chapter 5—System Configuration and Operation** on **Page 63**.

All the available outputs not used for an Operation mode can be configured as general purpose outputs or can also be configured to indicate a specific Fault, Trip, Motor or Warning status. The available outputs can be configured for specific purposes using the Power Xpert *in*Control configuration Software Tool or via Modbus commands. Refer to **Appendix D**, for the Modbus Register map for C445 to perform this configuration using a Modbus master. The configuration Software Tool provides a user friendly way to configure the outputs for the various selections.

Outputs dedicated to the selected Operation mode will be shown as Reserved in the Software Tool when online with the C445. Available Outputs will be shown configured as None by default. The following functions can be selected for each of the available outputs from the following list with the Software Tool:

0: None

1: Fault Reason Type – Load Fault

2: Fault Reason Type – Supply Fault

3: Fault Reason Type – Motor fault

4: Tripped Status Bits – PTC Temperature

5: Tripped Status Bits – Phase Rotation

6: Tripped Status Bits – Stall

7: Tripped Status Bits – Overload

8: Tripped Status Bits - exceeds starts limits

9: Tripped Status Bits – Low Power

10: Tripped Status Bits – High Power

11: Tripped Status Bits – Under Current

12: Tripped Status Bits – Frequency Deviation Slow

13: Tripped Status Bits – Frequency Deviation Fast

14: Tripped Status Bits – Voltage Unbalance

15: Tripped Status Bits – Voltage Phase Loss

16: Tripped Status Bits – PF Deviation

17: Tripped Status Bits – Jam

18: Tripped Status Bits – Instantaneous Over Current

19: Tripped Status Bits – Current Unbalance

20: Tripped Status Bits – Current Phase Loss

21: Tripped Status Bits – Ground Current

22: Motor Control Status – Motor at Speed

23: Motor Control Status – Ready

24: Motor Control Status – Inhibited

25: Motor Control Status – Warning

26: Motor Control Status – Fault

27: Motor Control Status – Remote Enabled

28: Motor Control Status – Running 2

29: Motor Control Status – Running 1

30: Warning Status Bits – PTC

31: Warning Status Bits – Phase Rotation

32: Warning Status Bits – Stall

33: Warning Status Bits – Overload

34: Warning Status Bits - exceeds starts limit

35: Warning Status Bits – Low Power

36: Warning Status Bits – High Power

37: Warning Status Bits – Under Current

38: Warning Status Bits – Frequency Deviation Slow

39: Warning Status Bits – Frequency Deviation Fast

40: Warning Status Bits – Voltage Unbalance

41: Warning Status Bits – Voltage Phase Loss

42: Warning Status Bits – PF Deviation

43: Warning Status Bits – Jam

44: Warning Status Bits – Instantaneous Over Current

45: Warning Status Bits – Current Unbalance

46: Warning Status Bits – Current Phase Loss

47: Warning Status Bits – Residual GF

48: Warning Status Bits – External GF

49: Warning Status Bits – Overvoltage

50: Warning Status Bits – Undervoltage

51: Tripped Status Bits – Undervoltage

52: Tripped Status Bits – Overvoltage

53: Tripped Status Bits – External GF

54: Field Output Control word – bit 0

55: Field Output Control word – bit 1

56: Field Output Control word – bit 2

57: Field Output Control word – bit 3

58: Shunt Trip Output

59: Warning Status Bits – HRGF Pulse Detect

60: Warning Status Bits – Peak Demand

61: Base Control Module Field Input I1

62: Base Control Module Field Input I2

63: Base Control Module Field Input I3

64: Base Control Module Field Input I4

65: Tripped Status Bits (Fail Safe) – Not Ground Current

Outputs 1 and 2 are normally open form A relay outputs. Output 3 is a form C relay output with one normally open and one normally closed contact. When the output is energized, both contacts change state. When ordering the C445 Motor Management Relay, one of the options is to obtain a Base Control Module where Output 3 is either a standard form C relay output or a latching form C relay output.

Output 3 operation as a standard form C relay output means the output will de-energize and return the contacts to their normal state when the Base Control Module is powered off.

Output 3 operation as a latching relay output offers capability beyond what's available from a non-latching, or a standard relay output. The energized state of the latching relay can be maintained after power has been removed from the Base Control Module. Energized means that the normally open contact will be closed and the normally closed contact will be open.

There are two additional configuration parameter for the latching relay and that involves the Power-down behavior. The following are the four choices for this behavior. These parameter can be configured using the Power Xpert *in*Control Software or via a Modbus message from a Modbus master. These parameters are called:

Base Control Module Relay 3 Behavior (Modbus register 719):

- Behave like a non-latching relay (default) (Modbus value = 0)
- Behave like a latching relay (Modbus value = 1)

If "Behave like a latching relay" is selected for the parameter above, then the following options are available in the Output 3 Latching Relay Behavior at Power Down parameter (Modbus register 729):

- Turn Off (default) (Modbus value = 0)
- Turn On (Modbus value = 1
- Hold Last State (Modbus value = 2)
- Toggle (Modbus value = 3)

The four bits in the Base Control Module Field Output Control word (Modbus register 601) can be assigned in any order to control the various outputs as follows:

- Output 1 Function Select: Select Field Output Control Word bit 0, 1, 2 or 3
- Output 2 Function Select: Select Field Output Control Word bit 0, 1, 2 or 3
- Output 3 Function Select: Select Field Output Control Word bit 0, 1, 2 or 3
- Output 3 Reset Function Select: Select Field Output Control Word bit 0, 1, 2 or 3 (for Latching Relay Operation only)

Refer to **Appendix E** for a complete C445 Modbus register map.

The outputs are relay contacts and wired as follows.

Figure 49. 4-Point Form A (NO) Output Connector

Q1	Output 1	Normally Open (NO)
Q1	Output 1	Normally Open (NO)
Q2	Output 2	Normally Open (NO)
Q2	Output 2	Normally Open (NO)

Figure 50. 3-Point Form C (NO/NC) Output Connector

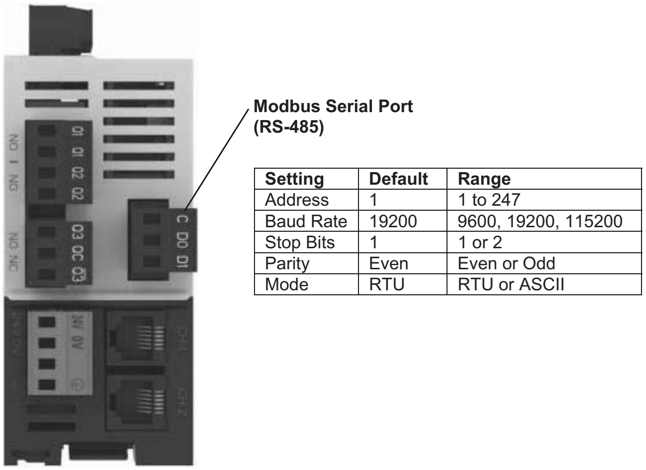
Q3	Output 3	Normally Open (NO)
C	Output 3	Common
Q3 (Not)	Output 3	Normally Closed (NC)

Optional RS-485 Port

If the C445 includes an RS-485 port on the Base Control Module and there is not an optional Ethernet or PROFIBUS Communication Card installed, the Modbus address and Baud Rate for this port is assigned with the DIP Switches on the Base Control Module.

If an optional PROFIBUS Card is installed, the DIP Switches on the Base Control Module double as the node address for the RS-485 Modbus port and the PROFIBUS slave module.

Figure 51. Modbus Serial Connection

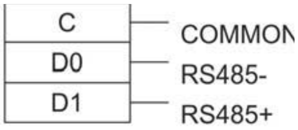


Setting	Default	Range
Address	1	1 to 247
Baud Rate	19200	9600, 19200, 115200
Stop Bits	1	1 or 2
Parity	Even	Even or Odd
Mode	RTU	RTU or ASCII

If an optional Ethernet Card is installed, the DIP Switches on the Base Control Module are dedicated to the Ethernet Card's IP address. In this case, the RS-485 port must be configured via the Power Xpert *in*Control Software or via Modbus commands form a Modbus master. The Modbus Register map is in **Appendix D**.

Note that even if there is no optional Ethernet or PROFIBUS communication card installed, the DIP Switches can be set to allow the Modbus address to be set with the configuration software.

Figure 52. RS-485 Port



Notes

- Shield shall be Earthed externally
- Shield should NOT be connected to any of these three terminals
- Wiring must meet PELV requirements

Base Control Module DIP Switches

DIP Switch settings when no optional communication card is installed in the Base Control Module, but the optional RS-485 Modbus port is included.

Figure 53. Base Control Module DIP Switches with Built-In Modbus

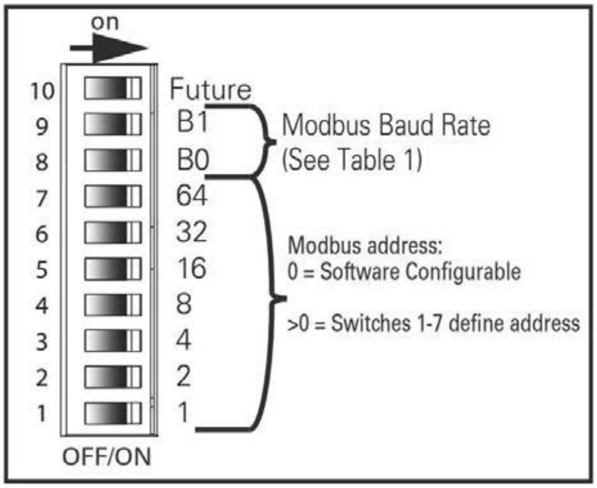


Figure 54. Base Control Module DIP Switches with PROFIBUS Card

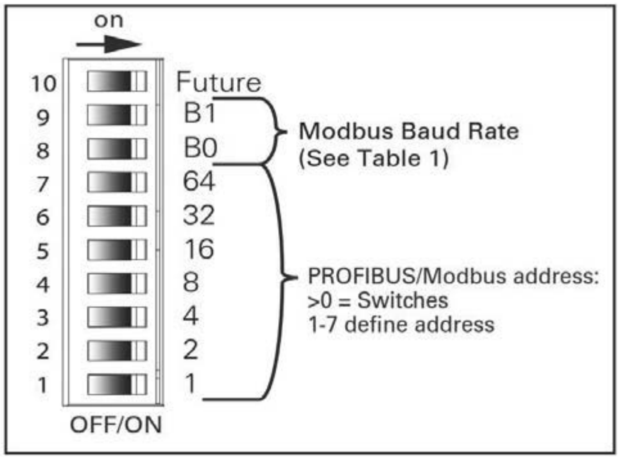
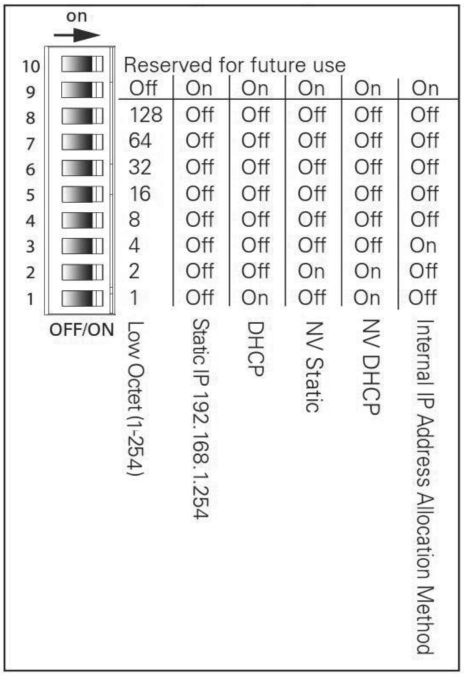


Table 9. Modbus Data Rate

B1	B0	Rate
0	0	Software Configurable
0	1	9600
1	0	115200
1	1	19200

Figure 55. Base Control Module DIP Switches with Ethernet Card



	Low Octet (1-254)	Static IP 192.168.1.254	DHCP	NV Static	NV DHCP	Internal IP Address Allocation Method
10	Reserved for future use					
9	Off	On	On	On	On	On
8	128	Off	Off	Off	Off	Off
7	64	Off	Off	Off	Off	Off
6	32	Off	Off	Off	Off	Off
5	16	Off	Off	Off	Off	Off
4	8	Off	Off	Off	Off	Off
3	4	Off	Off	Off	Off	On
2	2	Off	Off	On	On	Off
1	1	Off	On	Off	On	Off

Note: See **Appendix C** Optional Communication Cards for detailed information on each Communication Option.

USB Port

The USB port on the Base Control Module is a standard Micro USB port. It supports the Modbus protocol and is typically used to interface the Power Xpert *in*Control Software Tool to the C445 Motor Management Relay for configuration and monitoring. Since this port supports the Modbus slave protocol, it will respond to Modbus commands from any Modbus master connected to this port. All parameters shown in the C445 Modbus Register Table in **Appendix E** can be accessed by the Software Tool or any Modbus master.

When a Micro B cable is connected, this port acts as a serial Modbus port with the following interface parameters:

19200 Baud, 8 bits/byte, Even Parity and 1 Stop Bit

The LED labeled "USB" above the USB port flashes green when the port is connected and data is being transferred.

Test/Reset Button

There is a small indented push button on the front of the Base Control Module that supports reset and Test Trip functions as follows:

Factory Reset – This is a power up service. With the C445 powered down, press the button and hold it while applying power. Continue to hold down the button for 5 seconds after applying power.

Test Trip – This is a runtime service. With the C445 already powered, press and hold the button for at least 5 seconds and a Test Trip Fault will occur.

Fault Reset – This is a runtime service. With the C445 already powered, press and hold the button for at least 0.5 seconds to perform a fault reset.

RJ12 Ports

The two RJ12 ports on the bottom of the Base Control Module are used to connect the Measurement Module and the optional User Interface module, to create a complete C445 Motor Management Relay system. RJ12 cables of varying lengths are available for this purpose. Refer to **Table 3** on **Page 4** for part numbers and cable lengths.

When a Measurement Module and an optional User Interface module are initially connected to the Base Control Module, they are automatically accepted. Either RJ12 port can be used for either module. After the C445 system is initially connected, a fault will be generated by the Base Control Module if the Measurement Module is moved to the other RJ12 port on the Base Control Module while the system is powered. This applies to the User Interface as well. A fault reset must be sent to clear this fault. If the modules are connected to different RJ12 ports while the system is powered down, no faults will be generated upon power up.

If one or both of the Measurement Module and User Interface are removed while the system is powered up or down and not plugged back into the Base Control Module, a communication loss fault will be generated. If the removed module is meant to be removed from the system permanently, a "repair" service should be sent from the Power Xpert *in*Control Software Tool. Following this, the device will soft reset itself and the fault will be cleared, resulting in a new system configuration without the removed module. This really only applies to removing a User Interface module since a Measurement Module is required.

Connecting a Measurement Module or User Interface module with a different part number to the Base Control Module while the system is powered will also result in a fault. A fault reset will clear the fault. If the desire is to use the new module, a "repair" service should be sent with the Software Tool. If the new module was connected by mistake, connect the correct module with the old part number and send a fault reset. A soft reset always follows a "repair" service.

Connecting a Measurement Module or User Interface module with a different part number to the Base Control Module while the system is powered down will result in a fault when the system is re-powered. A "repair" service should be sent if the desire is to use the module with the new part number. If the new module was connected by mistake, connect the module with the old part number and issue a fault reset.

A fault reset can be issued from the following sources:

1. By holding the small button on the front of the Base Control Module down for at least 0.5 seconds while the device is powered.
2. From the Power Xpert *in*Control Software Tool.
3. From any Modbus master to the USB port or the RS-485 port.
4. From a Modbus TCP master to the optional Ethernet card.
5. From an EtherNet/IP master to the optional Ethernet card.

Measurement Module

1. PTC Input

   To utilize this optional feature, a Measurement Module must first be purchased with this feature included from the factory. This is not a field upgradable option.

   Wire a compatible thermal detector, up to a 6 MARK A type PTC thermal detector across the T1 an T2 terminals of the 2-point connector on the Measurement Module. There are no settings of any kind to make in the C445.

   To make this PTC input a Trip or Warning, enable it as such using the Power Xpert *in*Control Software Tool under the Protections category.

To monitor the status of this input, monitor the “PTC Status” register for the following:

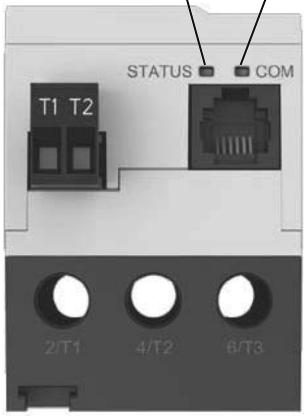
Table 10. PTC Sensor Status

Value	Description
0	PTC ok – no fault
1	PTC overtemperature fault
2	PTC shorted fault
3	PTC open fault

PTC Connection: PTC wiring is connected to terminals T1 & T2 in any polarity. This connector is designed to accept 0.2 mm^2 (24 AWG) to 2.5 mm^2 (12 AWG) wire. The use of twisted pair wiring is strongly recommended. Shielded cable should be used when the cable lengths exceed 100ft (30m) or as needed. It’s recommended that the cable shield be earth referenced near the motor frame. Cable resistance as measured at the T1 & T2 terminals must not exceed 10 ohms to retain short circuit monitoring along the entire length of the cable run

2. LEDs on the Measurement Module

Figure 56. Measurement Module LED Overview



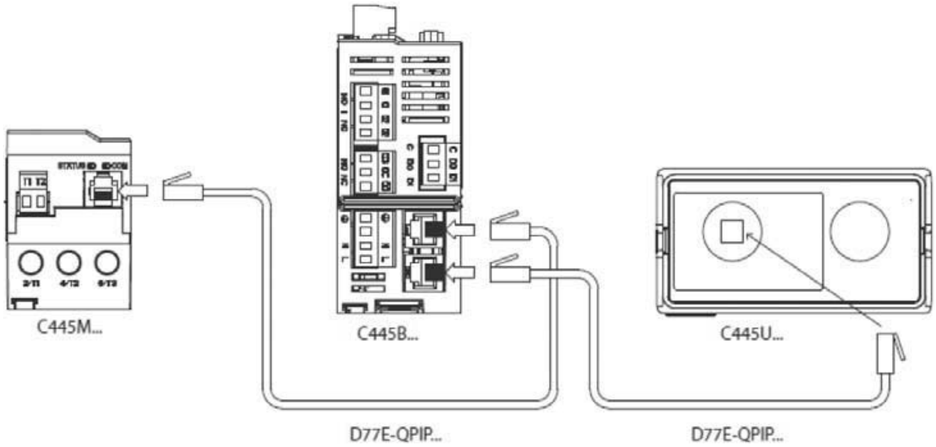
Device and Motor Status
Color
-Red = Fault
-Yellow = Warning
-Green = No Fault/Warning

COM Status (Communications with Base Control Module)
Color/Flash
-Red/Slow (1s ON/1s OFF) = Connected device missing or failed
-Green/Rapid (50ms ON/50ms OFF) = Device Discovery
-Green/Mostly ON (1.45s ON/50ms OFF) = Device connected, data being exchanged
-Green/Mostly OFF (50ms ON/1.45s OFF) = Device connected, no data being exchanged

RJ12 Connections for C445 System

Below is a diagram showing how a C445 system is connected when a Base Control Module, a Measurement Module and a User Interface are used.

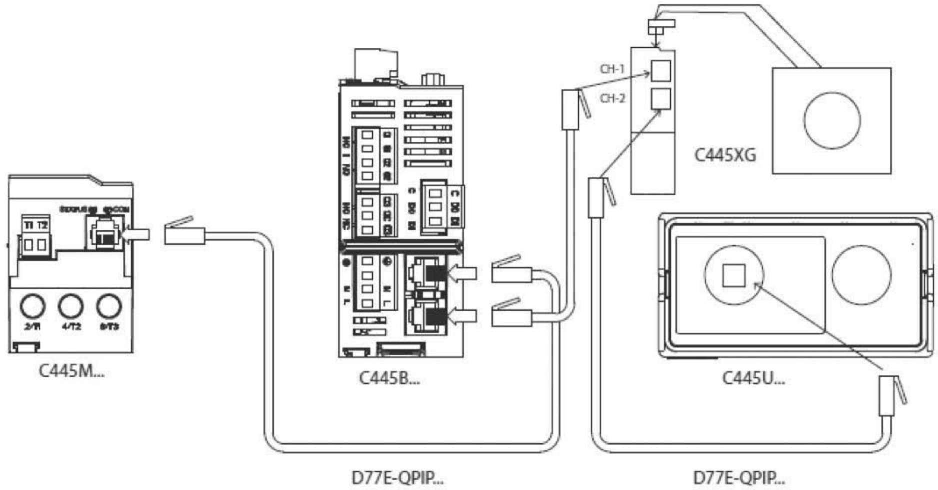
Figure 57. C445 System Connection



Ground Fault Module

When a Ground Fault Module is included in the C445 system, it is connected between the Base Control Module and the User Interface Module as shown below, or between the Base Control Module and the Measurement Module, not shown. The Ground Fault Module has 2 RJ12 ports on the bottom for connecting to the Base Control Module and the User Interface Module or the Measurement Module.

Figure 58. C445 System Connection with Ground Fault Included



Chapter 4—System Configuration and Commissioning

Commissioning

There are many ways to configure a C445 Motor Management Relay. There are configuration tools that are best to use for initial commissioning and some that are faster when configuring a replacement C445 and others that are network dependent. Each will be described below.

1. C445UM Monitoring User Interface

   (1) Easy start-up wizard for configuring critical parameters. The wizard will appear on first power-up attempt and can also be prompted in the PRG → Services menu.

   (2) PRG menu allows you to easily view or change any system parameter. Parameters are broken into simple menu groups so that it is easy to find what you are looking for without requiring use of any documentation. See Chapter 8 for more details on the Monitoring User Interface

2. The Power Xpert *in*Control Software configuration and monitoring tool. This Software Tool may be downloaded free of change from the Eaton website. It is a powerful Software Tool with many features including:

   (1) Start-up wizard for configuring the most critical motor nameplate parameters.

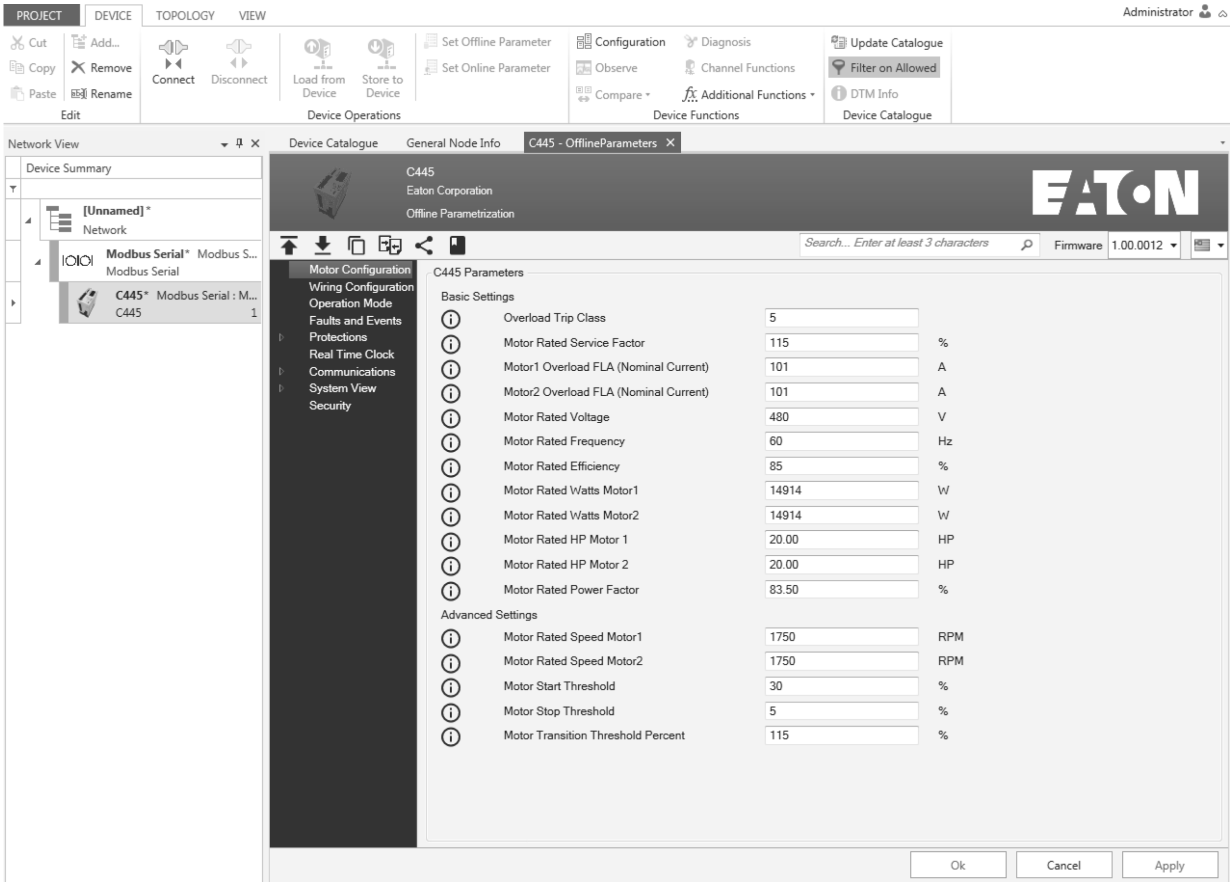
   (2) Categorized parameters for ease of finding the parameters needed to enable and configure particular features in the C445

   (3) Ability to save configuration files for easy access later or to open and download to a replacement C445

   (4) Motor Control page to monitor run status, some motor parameters such as average current and voltage as well as fault and warning codes and descriptions.

   (5) Parameter compare feature between two different configuration files.

   (6) Online and offline configuration for a C445 along with the ability to upload from an online device to an offline file and from an offline file to a device.



C445 Parameters

Basic Settings

Overload Trip Class	5	
Motor Rated Service Factor	115	%
Motor1 Overload FLA (Nominal Current)	101	A
Motor2 Overload FLA (Nominal Current)	101	A
Motor Rated Voltage	480	V
Motor Rated Frequency	60	Hz
Motor Rated Efficiency	85	%
Motor Rated Watts Motor1	14914	W
Motor Rated Watts Motor2	14914	W
Motor Rated HP Motor 1	20.00	HP
Motor Rated HP Motor 2	20.00	HP
Motor Rated Power Factor	83.50	%

Advanced Settings

Motor Rated Speed Motor1	1750	RPM
Motor Rated Speed Motor2	1750	RPM
Motor Start Threshold	30	%
Motor Stop Threshold	5	%
Motor Transition Threshold Percent	115	%

There are many more features offered by this Software Tool that are described in more detail in the Power Xpert *in*Control User Manual, publication MN040013EN.

To access a C445 online with this Software Tool, two protocols are supported: Modbus TCP Ethernet and Modbus Serial. In order to use Ethernet, the optional Ethernet card must be installed in the C445 Base Control Module. Using Modbus serial can be accomplished via the optional RS-485 serial port on the Base Control Module or via a Micro USB port on either the Base Control Module or the optional User Interface module.

The Micro USB ports use a standard USB/Micro USB cable. This cable may be ordered from Eaton as catalog number: C445XS-USBMICRO.

To access the C445 via the RS-485 serial port, a USB to RS-485 flying leads cable is also available from Eaton as catalog number: C445XS-USBLEADS.

3. Web Pages can be easily accessed using any web browser and an Ethernet cable connected between the computer running the Power Xpert *in*Control Software and the optional Ethernet card connected to the C445 Base Control Module.

   An IP address or IP addressing method must be selected using the DIP Switches on the Base Control Module. Refer to **Installation and Wiring** on **Page 10** for information on setting the DIP Switches when an Ethernet Card is installed in the C445 Base Control Module. The computer must then be configured with an IP address in the same range as the C445 Ethernet card.

   Connect an Ethernet cable between the computer and the C445 Ethernet Card. Enter the IP address of the C445 Ethernet Card on the command line in the web browser and press the Enter key. In a few seconds, the Web Pages for the C445 will open as follows:

DASHBOARD GROUP

PID	Param Name	Parameter Value	Unit
300	⊞ Motor Control Status	0x44	
304	⊞ I Average Scaled	0	
306	⊞ I Unbalance Percent	0	%
308	⊞ Thermal Memory Percent	0	%
309	⊞ Time to Trip Overload	9999	seconds
311	⊞ Time to Reset Overload	0	seconds
324	⊞ Average Line-to-Line Voltage	82	V
325	⊞ Voltage Unbalance Percent	49	%
326	⊞ Voltage Phase Order	2	
327	⊞ Total Watts	0	W
333	⊞ Power Factor Scaled	0	%
350	⊞ Number of Operating Seconds	190577	seconds
356	⊞ Operating Seconds (Resettable)	190242	seconds
362	⊞ I Average % of FLA (Nominal Current)	0	%
372	⊞ Motor State (Current Based)	0	

All parameters can be accessed or parameters in specific categories. The Web Pages can be used to configure parameters, monitor and control.

4. Any Modbus serial master can be connected to the optional RS-485 port or to either Micro USB port to modify any parameter that is a read/write parameter. A complete C445 Modbus Register Map is in **Appendix D** of this manual.
5. Any Modbus TCP Ethernet master can be used to commission a C445 provided an optional Ethernet card is installed in the C445 Base Control Module. Any read/write parameters may be modified using the Modbus Register Map in **Appendix D** of this manual.
6. The Ethernet card for the C445 also supports EtherNet/IP. An EtherNet/IP master can configure C445 parameters via explicit messages. Refer to **Appendix C** the EtherNet/IP section for additional information.
7. If a PROFIBUS option card is installed in the C445 Base Control Module, read/write parameters can be modified via the Configuration file sent from the master each time a connection is established to the C445 or from PROFIBUS DP V1 acyclic messages sent from the master. The C445 PROFIBUS Card supports both DP V0 and DP V1 PROFIBUS features. Refer to **Appendix C** the PROFIBUS section for additional information.
8. Optional Real-Time Clock and memory backup module (RTC module) continually reads the C445 configuration and downloads it to a replacement unit. This module is discussed in more detail later in this section.

Power Xpert *in*Control Commissioning Software Tool

There is a Power Xpert *in*Control User Manual that describes all the features of this powerful Software Tool (publication MN040013EN). Below is information on using the Start-Up Wizard in this Software Tool.

The Start-Up Wizard executes under the following conditions:

1. Each time a new C445 is added to a project and the parameters are accessed in the offline mode
2. Each time the parameters for a C445 are accessed online for the first time or if they are accessed again without having been saved, then opened the saved configuration file for the C445.

The wizard consists of 2 pages of parameters for single motor applications and 3 pages of parameters for two motor applications. The two pages of parameters for single motor applications are shown below:

C445
Eaton Corporation
Offline Set-Up Wizard

Firmware 1.00.0012

Active Operation Mode: 1: Direct Online

Measurement Module Selection: 1: 45mm, 0.3-2.4A, PTC + Voltage; C445MA-2P4A; 3-4105-001A

Local Motor Control Source: 0: Auto Detect User Interface

Remote Control Source Select: 1: Fieldbus is Remote Control Source

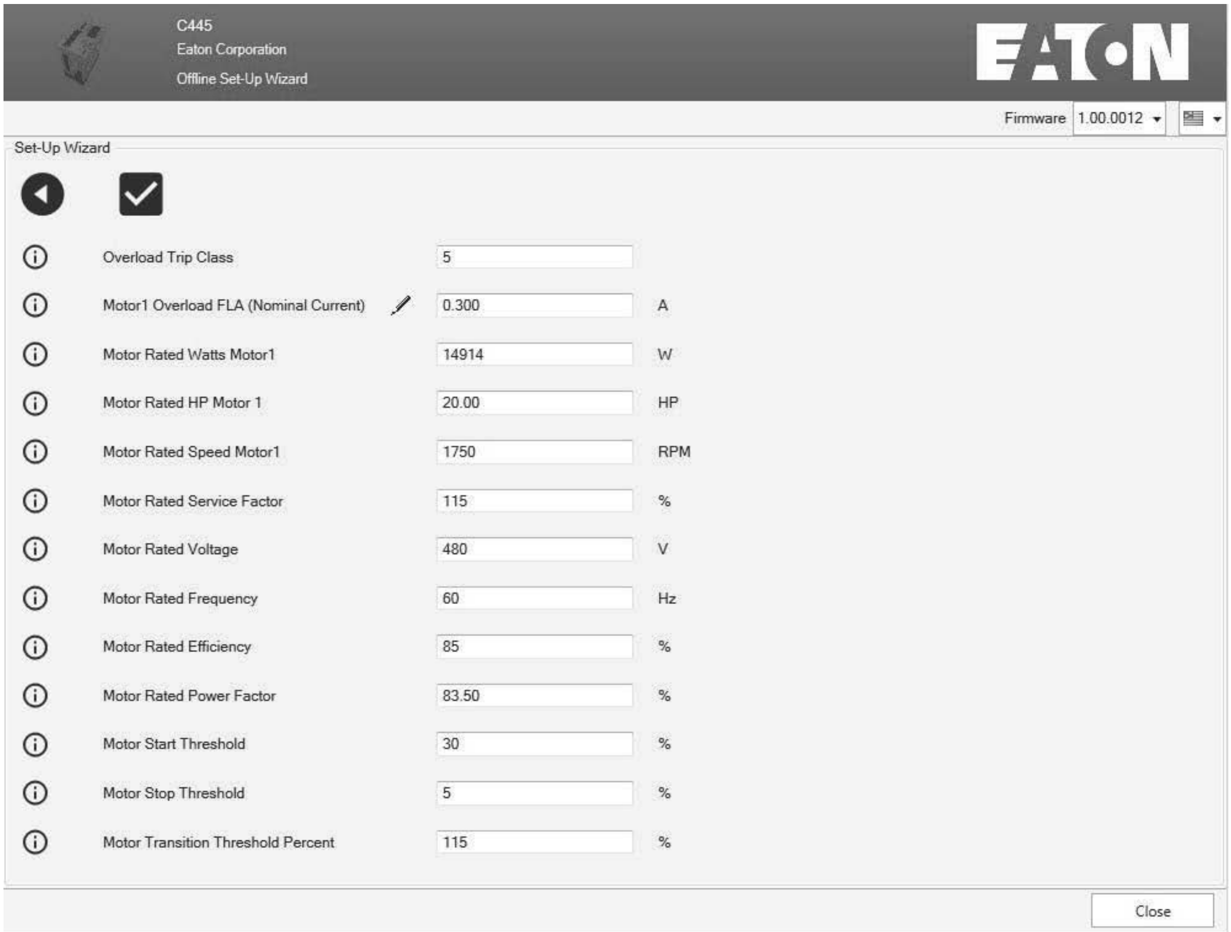
Base Control Module Field Wiring Configuration Selector: 0: Two Wire Field Wiring Configuration

If changes are made to any parameters on this page and the user does not need to view the second page, select the check mark to save the changes made on this page and exit the wizard.

If changes are made to any parameters on this page, or not, selecting the right arrow button will save those changes and progress to the second page shown below.

At any time, there is a Close button located at the bottom right of each wizard screen (not shown above). If that is selected no changes are saved and you will Exit the wizard.

Note: When a wizard opens on an online C445 DTM, the parameters contained in the wizard are read from the C445.



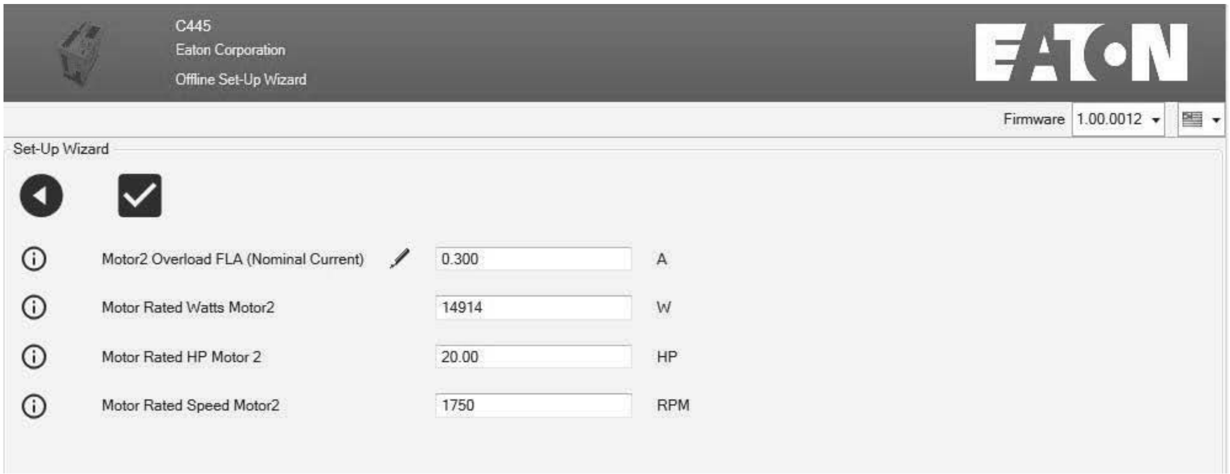
Overload Trip Class	5	
Motor1 Overload FLA (Nominal Current)	0.300	A
Motor Rated Watts Motor1	14914	W
Motor Rated HP Motor 1	20.00	HP
Motor Rated Speed Motor1	1750	RPM
Motor Rated Service Factor	115	%
Motor Rated Voltage	480	V
Motor Rated Frequency	60	Hz
Motor Rated Efficiency	85	%
Motor Rated Power Factor	83.50	%
Motor Start Threshold	30	%
Motor Stop Threshold	5	%
Motor Transition Threshold Percent	115	%

After modifying parameters on page 2 above, select the check mark to save all changes and Exit the wizard.

To go back to page 1, select the left arrow key.

To Exit the Wizard and not save any changes, select the Close button at the bottom right of the screen.

The third page for two motor applications is shown below:



Motor2 Overload FLA (Nominal Current)	0.300	A
Motor Rated Watts Motor2	14914	W
Motor Rated HP Motor 2	20.00	HP
Motor Rated Speed Motor2	1750	RPM

This screen consists of all the Motor 2 parameters.

For additional information on the Power Xpert *in*Control Software Tool including the C445 parameter categories and the many features included in this tool, refer to the User Manual, publication MN040013EN.

Real-Time Clock and Memory Backup Module (RTC Module)

The Real-Time Clock and Memory Backup module is an optional module that plugs into the Base Control Module. It is located under the communication card module.

This board provides non-volatile (NV) application configuration backup memory and clock time management.

Setting the Real Time Clock (RTC)

There are three ways to set the Real Time Clock parameters:

1. The Monitoring User Interface with the following path

   PRG → Real Time Clock → Date & Time

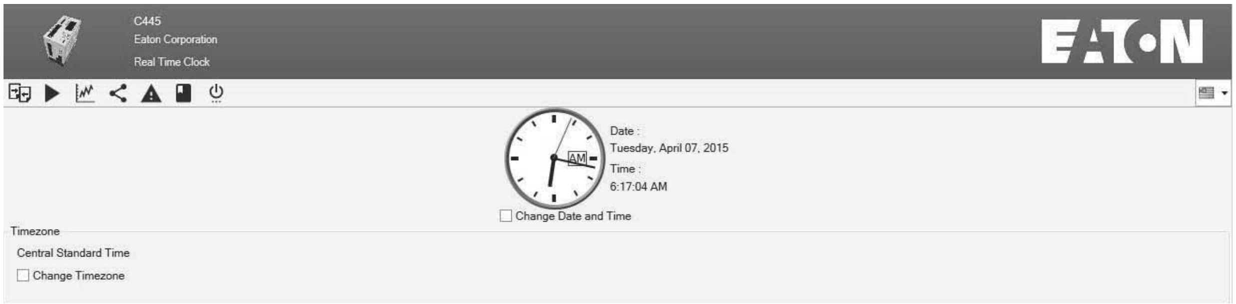
2. Using a Modbus or Modbus TCP master and writing to the RTC parameters. Refer to the Modbus register map in **Appendix D**.

   The RTC parameters begin with Modbus register 4000. Each individual time/clock parameter can be written to set the RTC, or a single parameter (register 4010) can be written with a value containing the "Real Time clock in Seconds from the UNIX Epoch". This is a 32 bit value.

3. Using the Power Xpert *in*Control Software Tool and selecting a single button to set all RTC parameters from the RTC parameters on the computer running the software.

   This is the most straight forward way to set the RTC. Connect with the C445 via one of the supported protocols and ports and perform the following steps:

   (1) Once online with the C445, select the Real Time Clock icon as shown below.



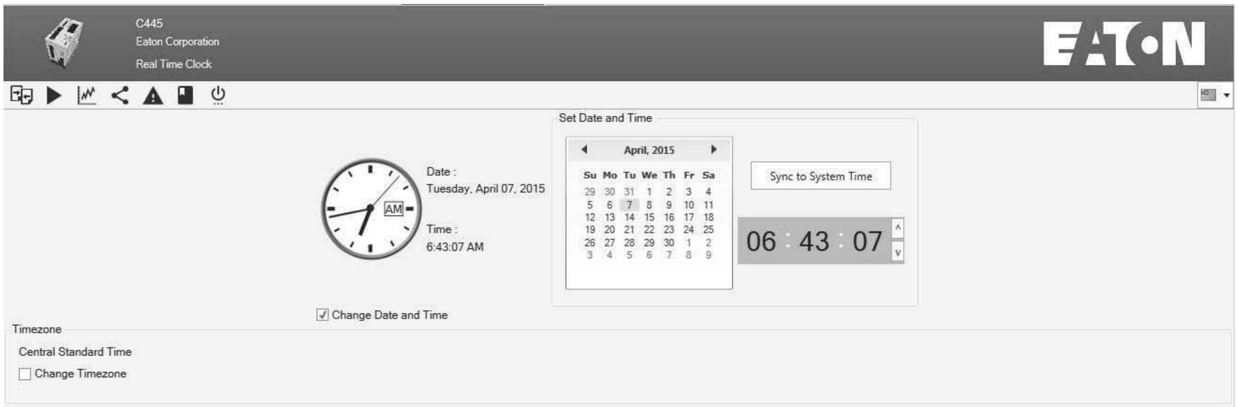
Date :
Tuesday, April 07, 2015
Time :
6:17:04 AM
☐ Change Date and Time

Timezone
Central Standard Time
☐ Change Timezone

The Real Time Clock window will open as below.

4. Select the proper time zone.

5. Select the box to the left of “Change Date and Time” below the clock to display all the RTC parameters as shown below.



C445
Eaton Corporation
Real Time Clock

Date : Tuesday, April 07, 2015

Time : 6:43:07 AM

April, 2015

Su	Mo	Tu	We	Th	Fr	Sa
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9

06 : 43 : 07

☑ Change Date and Time

Central Standard Time

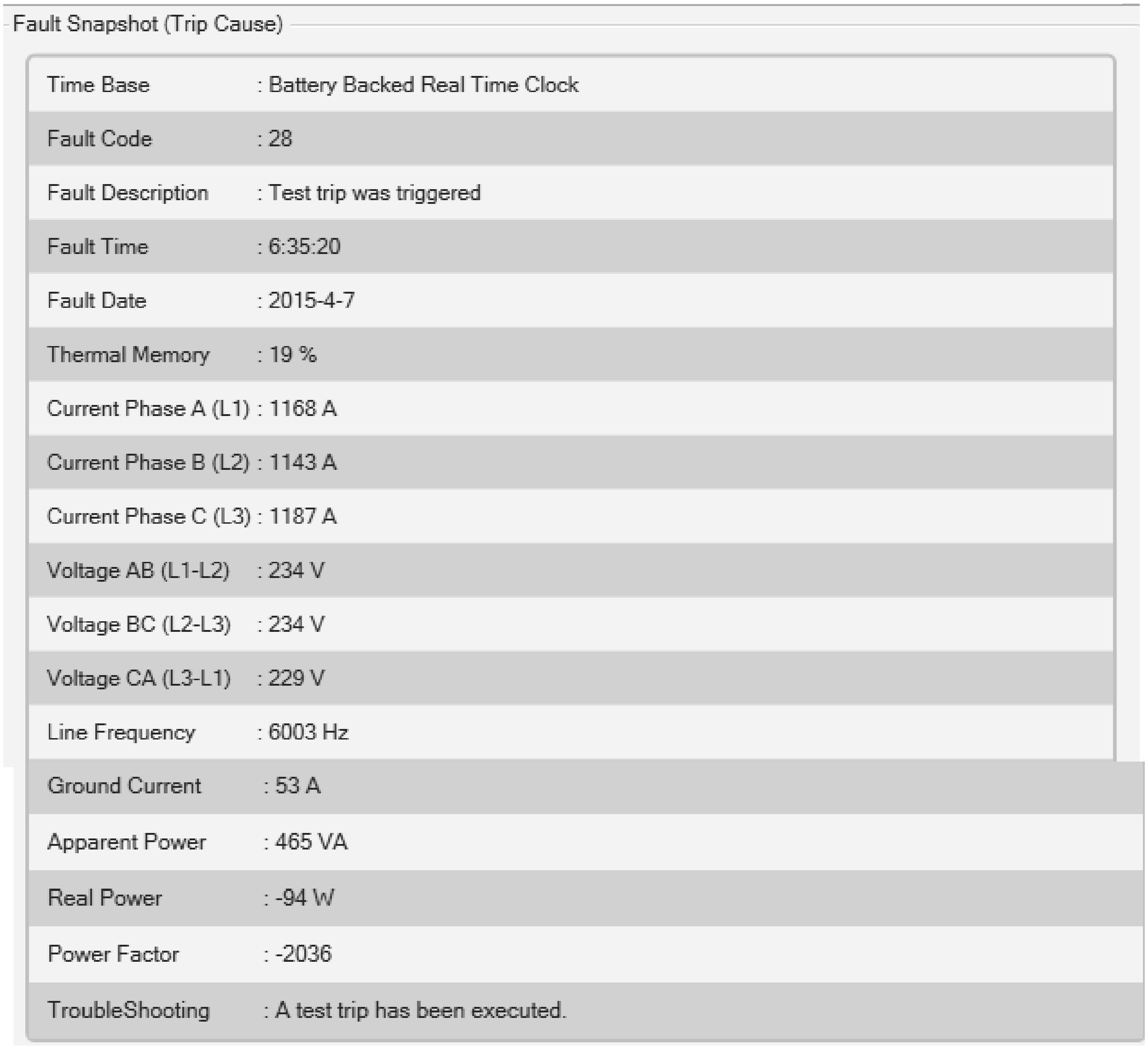
☐ Change Timezone

6. Select the “Sync To System Time” button and the RTC values will sync with the RTC on the computer and continue running from that point, keeping the correct time and date. The RTC module chip contains a battery to retain the RTC parameters even when power is turned off to the C445. The memory on-board the RTC module is non-volatile memory and does not use the battery to retain its contents. This will be discussed further below.

Note: Time management in the real time clock module starts using the default values (01/01/2000 00:00:00). If a real time clock board is not present then the date and time will reset to this value every time the C445 powers up. If a RTC module is installed, the time and date will increment continually.

RTC Module—Fault Snapshot

The C445 module saves and time stamps critical application data for the most recent fault, per the figure below.



Fault Snapshot (Trip Cause)

Time Base : Battery Backed Real Time Clock
Fault Code : 28
Fault Description : Test trip was triggered
Fault Time : 6:35:20
Fault Date : 2015-4-7
Thermal Memory : 19 %
Current Phase A (L1) : 1168 A
Current Phase B (L2) : 1143 A
Current Phase C (L3) : 1187 A
Voltage AB (L1-L2) : 234 V
Voltage BC (L2-L3) : 234 V
Voltage CA (L3-L1) : 229 V
Line Frequency : 6003 Hz
Ground Current : 53 A
Apparent Power : 465 VA
Real Power : -94 W
Power Factor : -2036
TroubleShooting : A test trip has been executed.

This information may be accessed from the Power Xpert *in*Control Software Tool.

If the Base Control Module includes a real time clock board then time stamping will be in UNIX format (day of week–month–day of month–time HH:MM:SS–time zone–year).

If a real time clock board is not present then time stamping will use the number of seconds that have elapsed since the Base Control Module started up.

RTC Module—Non-Volatile Memory Operation

One of the main purposes of the RTC module is to simplify the replacement of a C445/Base Control Module if desired. The RTC module stores a copy of the configuration parameters that can be transferred to another unit with minimal downtime.

The memory module functionality in the RTC chip operates as follows:

1. When plugged into a C445/Base Control Module for the first time, the C445 will write its configuration to the non-volatile memory on the RTC module continuously.
2. When plugged into a different C445/Base Control Module, the RTC module will download the configuration to that new C445/Base Control Module. Once download is completed, the new C445/Base Control Module will begin continuously writing its configuration to the memory on the RTC module.
3. Unplugging an RTC module and plugging back into the same C445/Base Control Module will simply result in resuming normal operation. No configuration download from the memory module to the C445 will take place.
4. The RTC module uses a non-volatile memory to store the configuration parameters of the host C445/Base Control Module device.

Parameter Lock Features

The C445 supports various protection feature options for writing to its parameters, including:

1. Administrator password Lock
2. USB lockout password
3. Running Lock option

Note: The Administrator password and Running Lock option also applies to the Web Pages if an Ethernet Card is installed. The Web Pages also allow for a separate password to be set to prevent access to the parameters from the Web Pages.

Administrator Password Lock

The Admin password protection prevents anyone who has not logged into the system with the proper password from modifying any configuration parameters. All parameters may be read, but not written.

Out-of-box, there is no active Administrator password protection.

The Administrator password is a 32-bit value that can be set as a Hex, ASCII or decimal value that fits in 32-bits. Whatever format is used to set the password will need to be used when entering the password as well, to be sure it is correct. For example, if the password is set by writing an ASCII value of 1234 and later someone tries to unlock it with a decimal or hexadecimal value of 1234, it will not work.

The Modbus register addresses that store the 32-bit Administrator password are 5000/5001. The Modbus register addresses that must be written to when logging in to a system with an Administrator password set are 5002/5003.

Reading the value at register 5010 will indicate if an Administrator password is set in the device or not. If a value of 1 is read, this indicates that an Administrator password is active. A value of 0 indicates that an Administrator password is not currently active.

When 5000 and 5001 each contain hexadecimal zeros (0x0000), this means no password is set. This is also what must be written to these registers to clear a password. The only way to write to these registers if there is a password set is to first log in. Then once logged in, hexadecimal 0s can be written to these register to clear the password. A "Reset to Factory Defaults" also clears/resets the password. Since this can be accomplished using the button on the Base Control Module, a C445 with an unknown password can be recovered in this manner, but will need to be reconfigured. All parameters will have been set to factory defaults, not just the Admin password.

The Admin password can also be set using the Power Xpert *in*Control Software Tool, under the Security category. Parameters that are locked in Admin mode are indicated in **Appendix D** Modbus Register Map

USB Lockout Password

The USB lockout password protection prevents anyone who has not logged into the system using a USB port from modifying any configuration parameters. Parameters may be read, but not written.

Out-of-box, there is no active USB Lockout password protection.

The USB lockout password is a 32-bit value that can be set as a Hex, ASCII or decimal value that fits in 32-bits. Whatever format is used to set the password will need to be used when entering the password as well, to be sure it is correct. For example, if the password is set by writing an ASCII value of 1234 and later someone tries to unlock it with a decimal or hexadecimal value of 1234, it will not work.

The Modbus register addresses that store the 32-bit USB password are 5004/5005. The Modbus register addresses that must be written to when logging in to a system with a USB password set are 5006/5007.

Reading the value at Modbus register 5011 will indicate if a USB password is set in the device or not. If a value of 1 is read, this indicates that a USB password is active. A value of 0 indicates that a USB password is not currently active.

When 5004 and 5005 each contain hexadecimal zeros (0x0000), this means no password is set. This is also what must be written to these registers to clear a password. The only way to write to these registers if there is a password set is to first log in. Then once logged in, hexadecimal 0s can be written to these register to clear the password. A "Reset to Factory Defaults" also clears/resets the password. Since this can be accomplished using the button on the Base Control Module, a C445 with an unknown password can be recovered in this manner, but will need to be reconfigured. All parameters will have been set to factory defaults, not just the password. Parameters that are locked in USB Lockout are indicated in **Appendix D** Modbus Register Map.

Running Lock Option

The Running Lock Option is not a password but is an option that can be enabled or disabled. When enabled, configuration parameters are "Read_Only" when the motor is either running or being instructed to run.

Out-of-box, this option is enabled.

To disable this running lock feature and allow configuration parameters to be adjusted during motor run time, set Modbus register 5008 to a value of 1. To enable this protection feature and restrict access to modify or write to configuration parameters during motor run time, reset this value to 0.

Reading the value at Modbus register 5009 will indicate whether this feature is enabled (locked) or not. If the value read from Modbus register 5009 is 1, this protection feature is currently enabled (locked). When this feature is enabled, all configuration parameters are read-only when the motor is running or being instructed to run.

This protection applies to the Power Xpert *in*Control Software Tool as well. If this protection is enabled, configuration parameters cannot be modified using this software while the motor is running or being instructed to run. Parameters that are locked with the Running Lock option are indicated in **Appendix D** Modbus Register Map.

Web Pages Password Protection

Only Super-User has the ability to change the User Names and Passwords for the various levels. The web page provides five levels of authorization.

Level	Default User Name	Default Password	Description
Open	<none>	<none>	Open access, has no password. Allows opening web page to be viewed, but no additional information is available
Read_Only	readonly	readonly	Read_Only access allows parameters to be viewed, but no control or configuration
Control	control	control	Control provides capabilities of Read_Only plus allows motor and discrete outputs to be turned on and off
Config	configuration	configuration	Config provides capabilities of Control plus the ability to set configuration values
Super_User	superuser	superuser	Super_User provides the capabilities of Config plus the ability to change user names and passwords

The following is a step by step process demonstrating how to set passwords for the Web Pages.

1. After opening the Web Pages, select user name/password:

SET USER NAME AND PASSWORD

Enter User Name

Enter Password

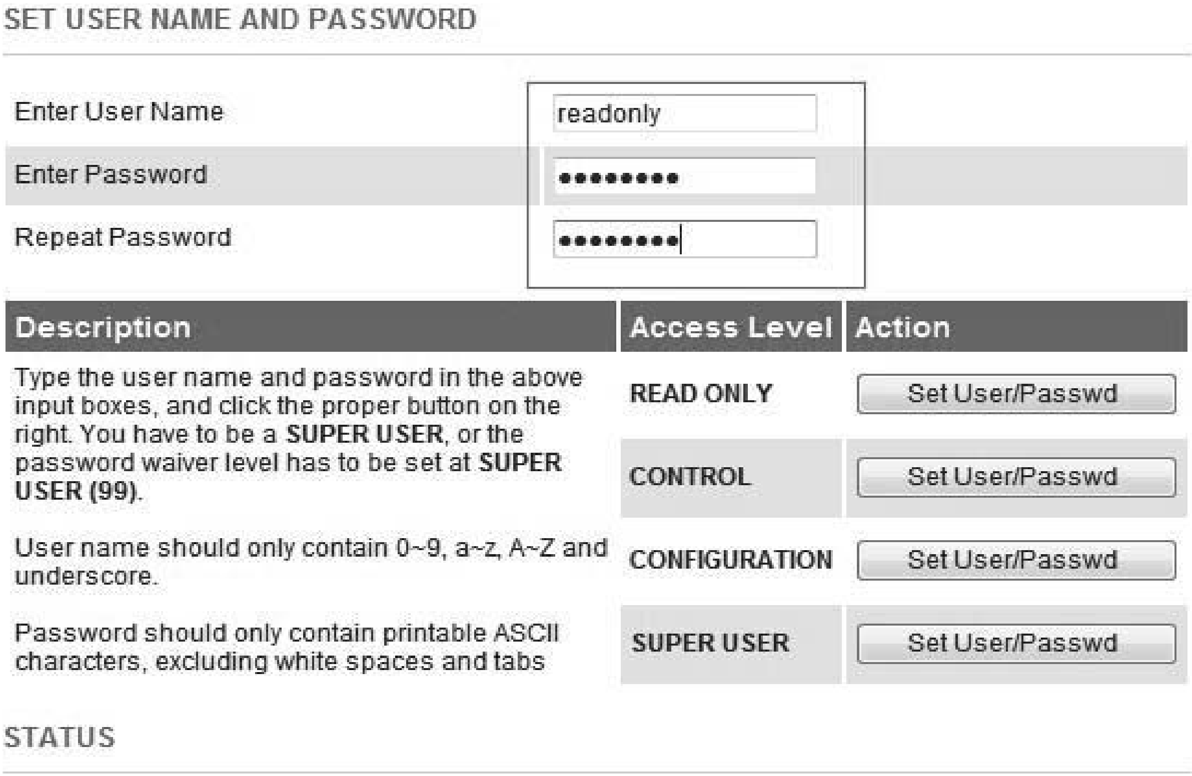
Repeat Password

Description	Access Level	Action
Type the user name and password in the above input boxes, and click the proper button on the right. You have to be a **SUPER USER**, or the password waiver level has to be set at **SUPER USER (99)**.	READ ONLY	Set User/Passwd
	CONTROL	Set User/Passwd
User name should only contain 0~9, a~z, A~Z and underscore.	CONFIGURATION	Set User/Passwd
Password should only contain printable ASCII characters, excluding white spaces and tabs	SUPER USER	Set User/Passwd

STATUS

Description for parameter 8636 loaded

2. Enter a user name and password for each level.



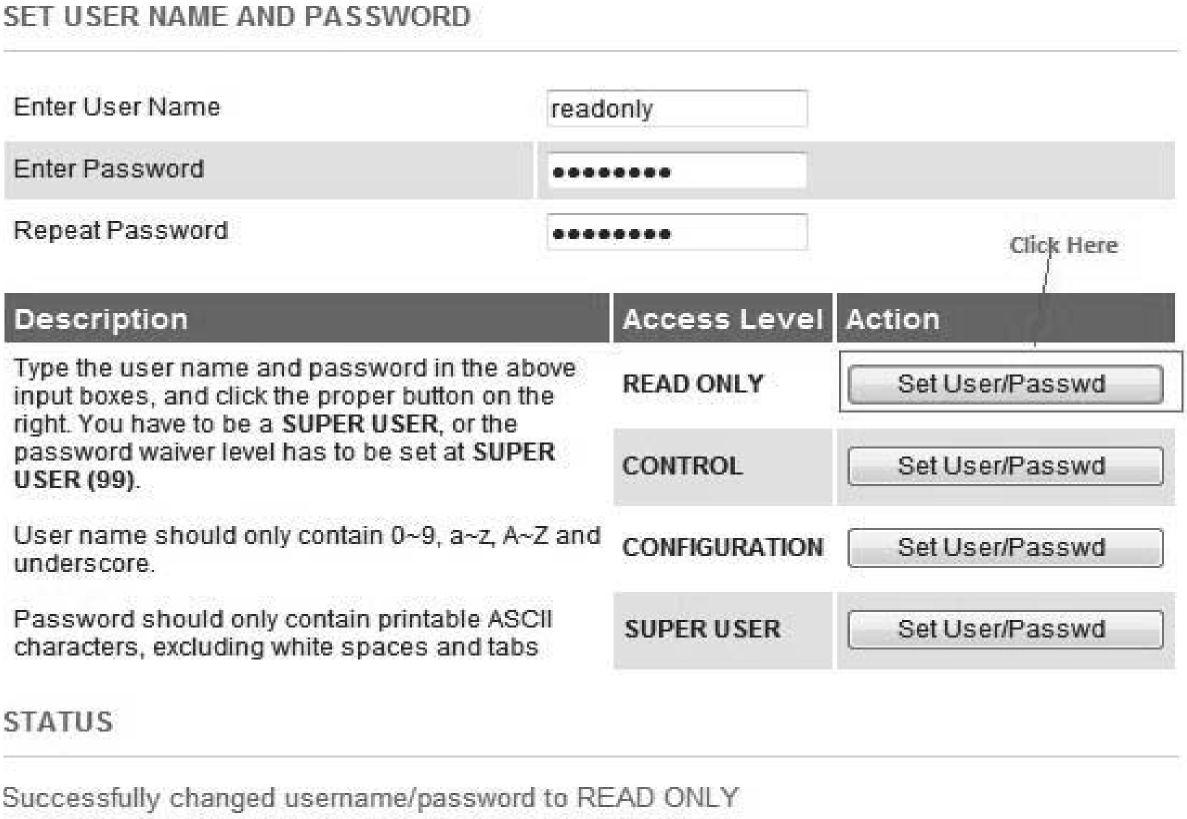
SET USER NAME AND PASSWORD

Enter User Name	readonly
Enter Password	••••••••
Repeat Password	••••••••

Description	Access Level	Action
Type the user name and password in the above input boxes, and click the proper button on the right. You have to be a **SUPER USER**, or the password waiver level has to be set at **SUPER USER (99)**.	**READ ONLY**	Set User/Passwd
	CONTROL	Set User/Passwd
User name should only contain 0~9, a~z, A~Z and underscore.	**CONFIGURATION**	Set User/Passwd
Password should only contain printable ASCII characters, excluding white spaces and tabs	**SUPER USER**	Set User/Passwd

STATUS

3. After entering the username & password, select the Set User/Password button for each level. A successful status message will be displayed per the following:



SET USER NAME AND PASSWORD

Enter User Name: readonly

Enter Password: ●●●●●●●●●

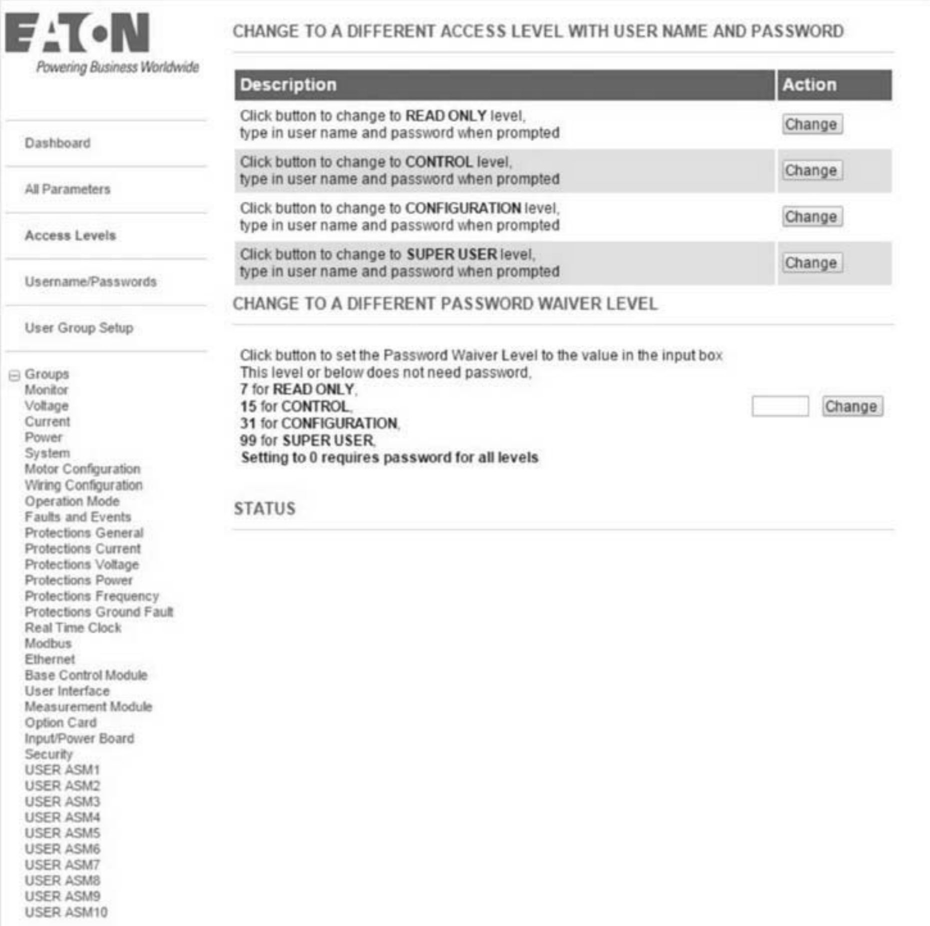
Repeat Password: ●●●●●●●●●

Description	Access Level	Action
Type the user name and password in the above input boxes, and click the proper button on the right. You have to be a **SUPER USER**, or the password waiver level has to be set at **SUPER USER (99)**.	**READ ONLY**	Set User/Passwd
	CONTROL	Set User/Passwd
User name should only contain 0~9, a~z, A~Z and underscore.	**CONFIGURATION**	Set User/Passwd
Password should only contain printable ASCII characters, excluding white spaces and tabs	**SUPER USER**	Set User/Passwd

STATUS

Successfully changed username/password to READ ONLY

4. Select an access level to change the access level to something other than Super-User.



CHANGE TO A DIFFERENT ACCESS LEVEL WITH USER NAME AND PASSWORD

Description	Action
Click button to change to **READ ONLY** level, type in user name and password when prompted	Change
Click button to change to **CONTROL** level, type in user name and password when prompted	Change
Click button to change to **CONFIGURATION** level, type in user name and password when prompted	Change
Click button to change to **SUPER USER** level, type in user name and password when prompted	Change

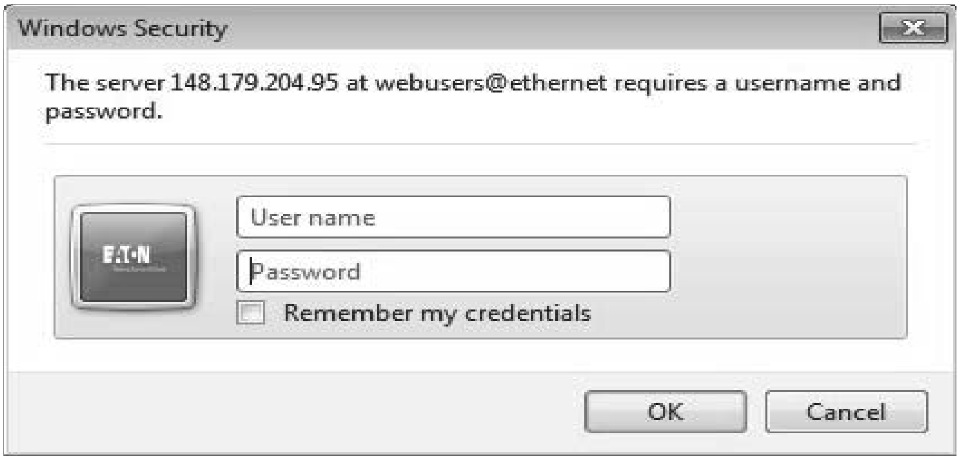
CHANGE TO A DIFFERENT PASSWORD WAIVER LEVEL

Click button to set the Password Waiver Level to the value in the input box
This level or below does not need password,
7 for **READ ONLY**,
15 for **CONTROL**,
31 for **CONFIGURATION**,
99 for **SUPER USER**,
Setting to 0 requires password for all levels

Change

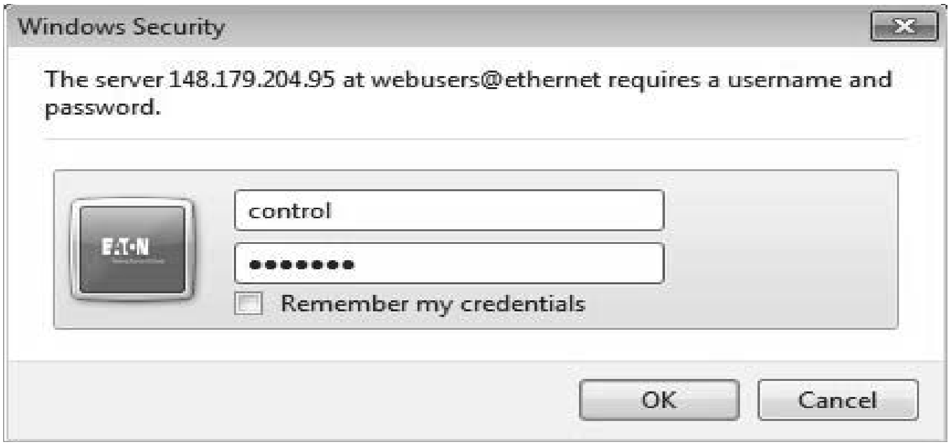
STATUS

5. Select the Control Level then the Change Button and enter a User Name and Password when prompted.



The server 148.179.204.95 at webusers@ethernet requires a username and password.

6. Enter the username & password set for Control access level.



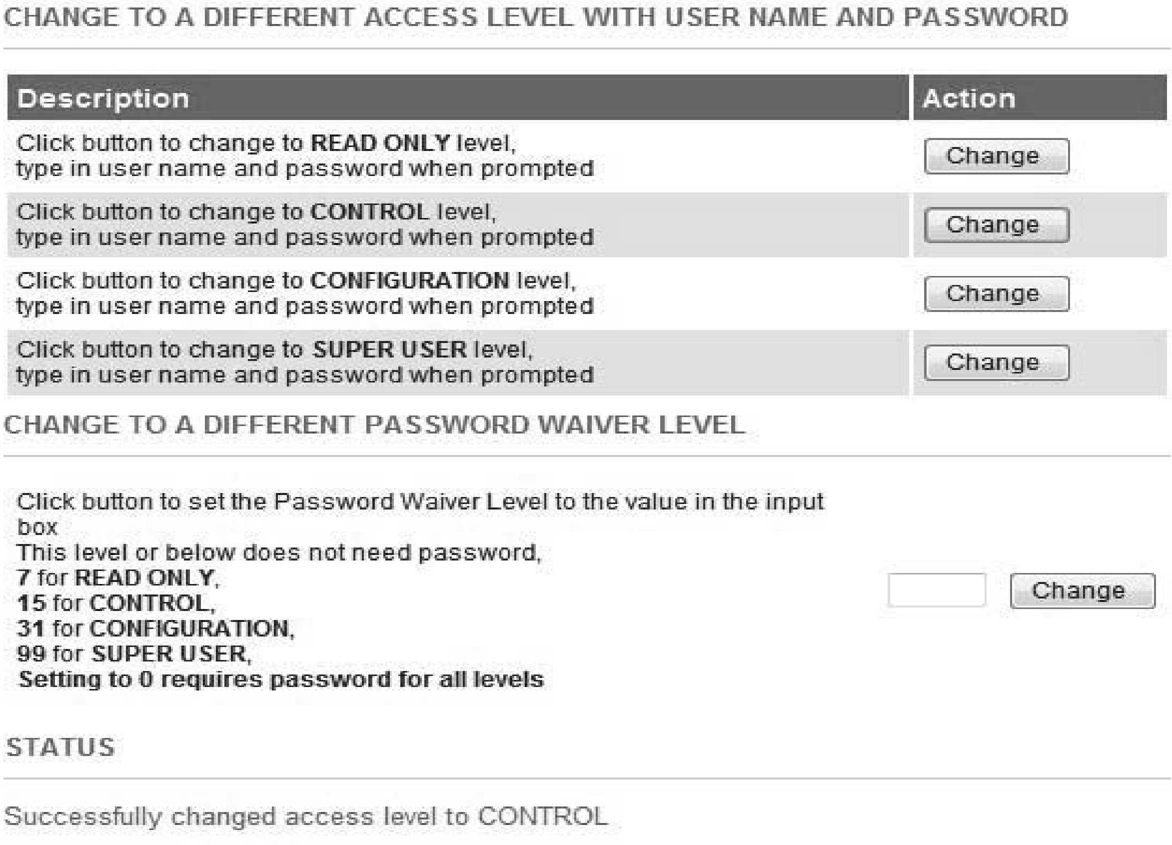
The server 148.179.204.95 at webusers@ethernet requires a username and password.

control

●●●●●●●

☐ Remember my credentials

7. The following message will be displayed if successful.



CHANGE TO A DIFFERENT ACCESS LEVEL WITH USER NAME AND PASSWORD

Description	Action
Click button to change to **READ ONLY** level, type in user name and password when prompted	Change
Click button to change to **CONTROL** level, type in user name and password when prompted	Change
Click button to change to **CONFIGURATION** level, type in user name and password when prompted	Change
Click button to change to **SUPER USER** level, type in user name and password when prompted	Change

CHANGE TO A DIFFERENT PASSWORD WAIVER LEVEL

Click button to set the Password Waiver Level to the value in the input box
This level or below does not need password,
7 for **READ ONLY**,
15 for **CONTROL**,
31 for **CONFIGURATION**,
99 for **SUPER USER**,
Setting to 0 requires password for all levels

STATUS

Successfully changed access level to CONTROL

8. Repeat this process to change the User Name and Password for other access levels.

Note: User Names and Passwords are case sensitive and must be 6-16 characters in length.

Chapter 5—System Configuration and Operation

Control Sources

Types

The C445 can be operated from either a Local or a Remote control source. There are four options for the Local Control Source:

- Auto detect User Interface
- No Local Control
- User Interface Control
- Fieldwire Control

Auto detect User Interface—By default the local control source is set to the "Auto detect User Interface" selection. In this selection, if a User Interface with control buttons is connected, the User Interface will be the Local Control Source.

User Interface Control—User Interface will be the Local Control Source. If a Status only User Interface without control buttons is connected or if no User Interface is connected at all, the system will remain inhibited.

Fieldwire Control—The Fieldwire will act as the Local Control Source. **Page 67** displays the wiring options for all modes.

There are three options for the remote control source:

- No remote control source
- Fieldbus
- Fieldwire
- Logic Engine

No remote control source—Remote Control is not allowed under any condition.

Fieldbus—Fieldbus will be the Remote Control source if the Active Control Source is Remote.

Fieldwire—Fieldwire will be the remote control source if the Active Control Source is Remote. This selection cannot be used if the Fieldwire is already selected as a local control source. The default wiring method is 2-wire control. 3-wire control is an option. Wiring options for all modes are shown later in this chapter.

Active Control Source

The C445 system can have only one active control source at any given point of time. At power up, the control source is determined by the local/remote power up mode setting, which can be set to either remote control, local control or hold last control state. By default the setting is set to hold last control state and out of the box local control will be source of control. The current active control source can be determined by reading the active control source parameter.

Switching Between Local and Remote

Local to Remote

When the active control source is local, the following actions will change the active control source to Remote control:

1. Pressing the AUTO button on the User Interface if User Interface is the local control.
2. Setting the REMOTE input on the Fieldwire if the Fieldwire is used as the local control.
3. Setting the Local Control Source to No local Control and the Remote Control Source is not set to No remote control source.

After switching to Remote control, the Remote control source is determined by the Remote Control Source parameter.

Remote to Local

When the active control source is remote, the following actions will change the active control source to Local control:

1. Pressing any button on the User Interface except the AUTO and the Reset button.
2. Clearing the REMOTE input on the Fieldwire if the Fieldwire is used as the local control.

After switching to Local control, the Local control source is determined by the Local Control Source parameter.

Note: The Remote Control source can optionally be configured to control the mode. Refer to **Appendix C** for more information.

Pre-Defined Operation Modes

There are 12 selectable Operation modes for the C445. This section describes the modes in detail. Selecting one of these modes will determine the behavior of the relay's inputs and outputs.

Active Operation Mode

The Active Operation Mode parameter is used to select the active mode. Any change to this parameter will require a soft reset or power cycle before the new mode takes effect. The following modes are supported:

- Overload Only
- Direct (FVNR)
- Reverser (FVR)
- Star/Delta
- Two Speed Two Winding
- Two Speed Dahlander
- Auto Transformer
- Solenoid Valve
- MCCB Actuation
- Contactor Feeder
- General Purpose Input/Output
- Stand Alone Ground Fault Module

Note: All Operation Modes require, as a minimum, a Base Control Module and a Measurement Module except "General Purpose Input/Output" and "Stand Alone Ground Fault Module". In the General Purpose I/O mode, only a Base Control Module is required. In Stand Alone Ground Fault Module mode, a Base Control Module and a Ground Fault Module are required.

2-Wire and 3-Wire Control Fieldwiring

The diagrams shown below for each operation mode show the default 2-Wire control. Users can also choose to select 3-Wire Control, which will change how the input behavior is defined if fieldwire is used as a local or remote control source.

2-Wire: In 2-wire control, Input 1 is dedicated to accept a run signal. The user is free to define their start stop logic as required to send a run command to Input 1. It is common to use a hand/off/auto switch to provide a maintained signal to Input 1.

3-Wire: In 3-wire control, there is a dedicated start input and a dedicated permissive (stop) input. If no signal is present at the permissive input, the system will not be allowed to run. If the permissive signal is removed while running, it will stop. If the permissive signal is present and a signal is sent to the start input, it will act as a run command. The start input can be a maintained or momentary.

The 3-wire inputs are:

For Run1 only modes (all except Reverser and 2-Speed modes): Input 1 is Start and Input 2 is permissive (stop).

For Run1/Run2 modes (Reverser and 2-Speed): 3-Wire control is only allowed if fieldwire is the remote control source. Inputs 1 and 2 are Start (Fwd/Rev and Fast/Slow) and Input 3 is Permissive.

Overload Only Operation Mode

Description

The Overload only mode uses the Motor 1 parameters for all control/protections.

C445 outputs:

- Output 1 is used as the fault contact. It is a normally open contact.
- Outputs 2 and 3 are general purpose outputs

At power up, the C445 Motor Management relay closes Output 1, provided the C445 is in the "Ready" state (no faults or inhibits active). This normally open fault contact provides fail-safe operation in case power is lost.

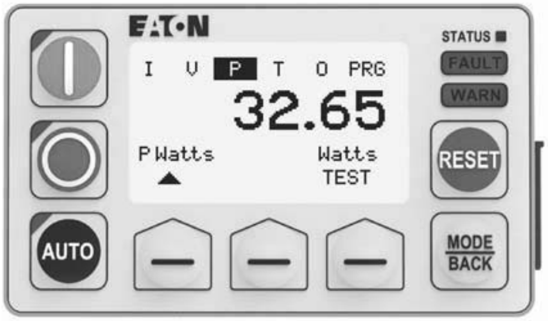
Outputs 2 and 3 are user configurable outputs that may be used to indicate a Fault, Trip, Motor or Warning status as well as general purpose outputs controlled by the fieldbus master.

The Overload Only Operation mode does not control the contactor/motor, but it does protect it. Per the output wiring diagrams shown later in this section, a control source must be used in series with the normally open fault contact for control.

The only control allowed for this Operation Mode from any of the three potential sources, User Interface, Fieldbus or Fieldwire is to Reset a Fault or Test Trip the unit.

Recommended User Interface Options for the Overload Only Operation Mode

Figure 59. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. In Overload Only, the start and stop buttons will be disabled. If a user presses a control button, the screen will notify them that the functionality is not enabled. The reset button will still function but can be disabled if desired in User Interface Settings. Monitoring, Navigation, and Parameter settings are all available. Test Trip is also available in PRG → Service.

Control Settings

The following parameters are used to configure the Overload Only Operation Mode and the C445 sources of control.

Table 11. Overload Only Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Motor#1 Overload FLA Scaled	900	This parameter is used to set the motor nameplate full load amps for the overload	R/W
Motor Overload Trip FLA	500	This parameter contains the active overload FLA	R
Trip Enable Bit Field	1000–1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002–1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Q2 Output function select ①	716	Output 2 user function selection	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The Overload Only profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1= The C445 will issue a "Test Trip" fault causing the Output 1 control relay to open

Control Status Word

The control status word of the Overload Only profile can be accessed over the fieldbus network.

Status Bits

Bit 0 0 = Stopped (No current detected)
1= Running1 (Current flow detected)

Bit 2 0 = local control source active
1= remote control source is active

Bit 3 0 = no fault present
1= C445 fault present

Bit 4 0 = no warning present
1= C445 warning present

Bit 5 0 = no inhibit present
1= C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1= C445 ready for control (No fault or inhibit present)

Bit 7 0 = motor is not up to speed (AtRef)
1= C445 has detected motor is up to speed (AtRef)

Motor status is determined by current readings obtained from the measurement module. The overload profile will signal the motor is running when the START threshold exceeds 30%. Then, when the current drops below 5%, which is the STOP threshold, the C445 will transition to stop.

Two conditions will then set the AtRef bit, signaling the motor is up to speed.

- If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- If motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Overload Only Operation Mode

Figure 60. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

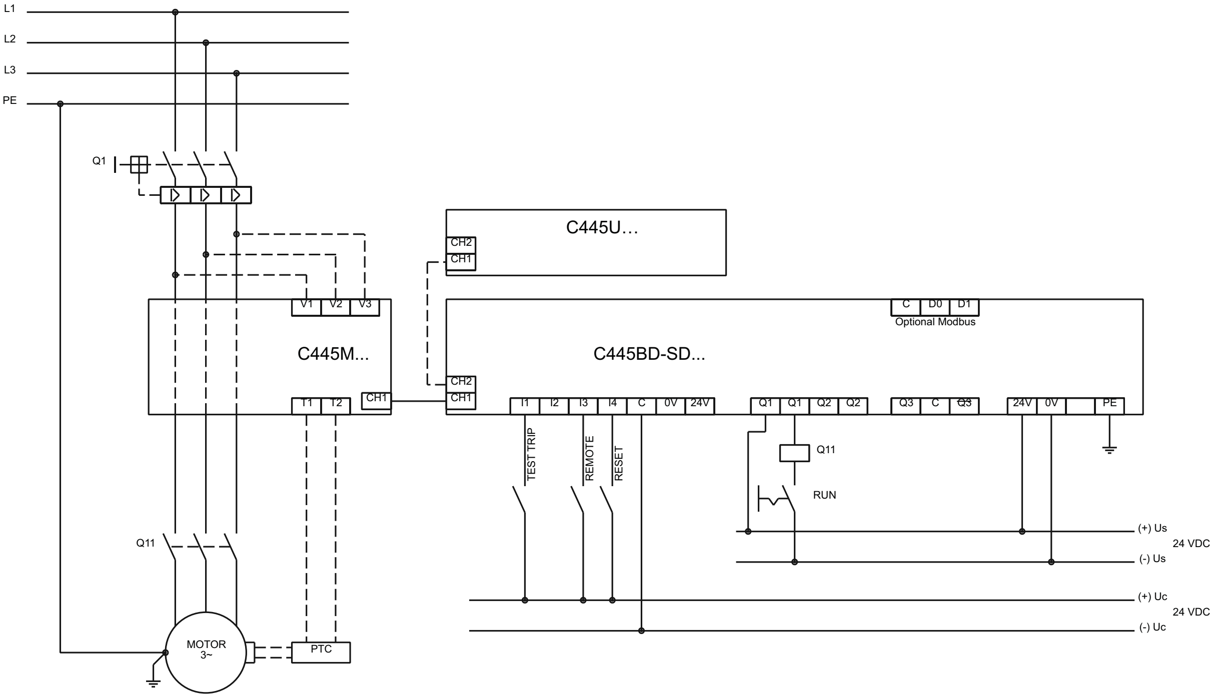


Figure 61. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

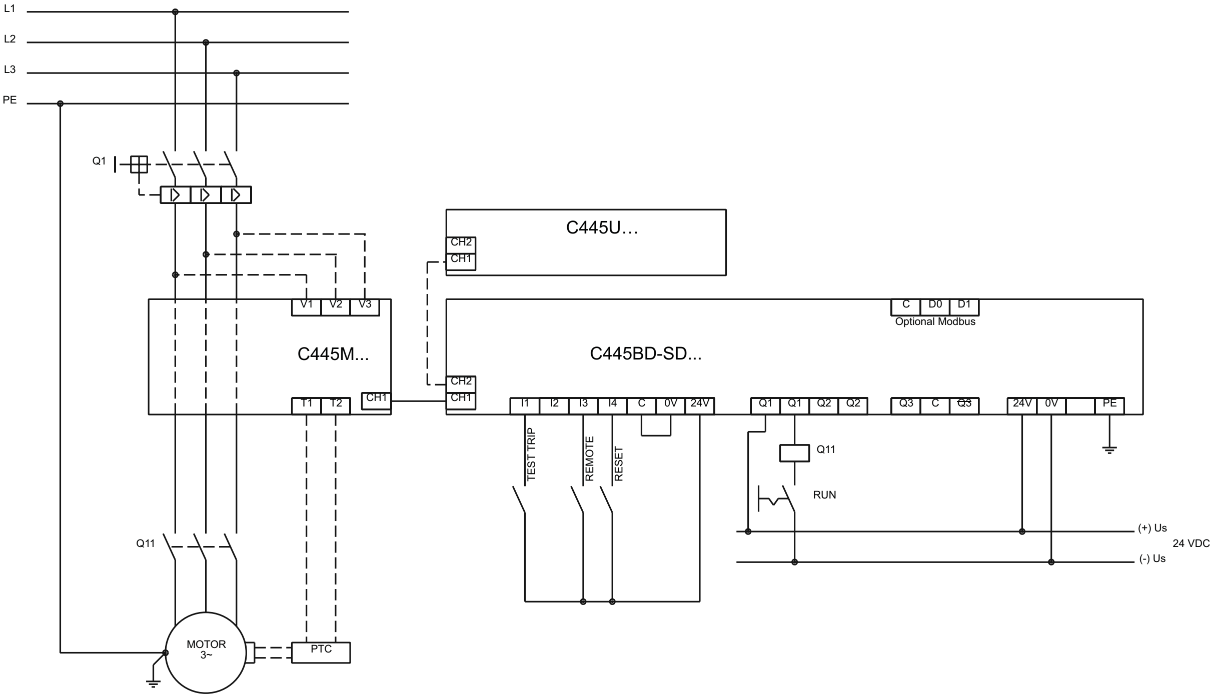
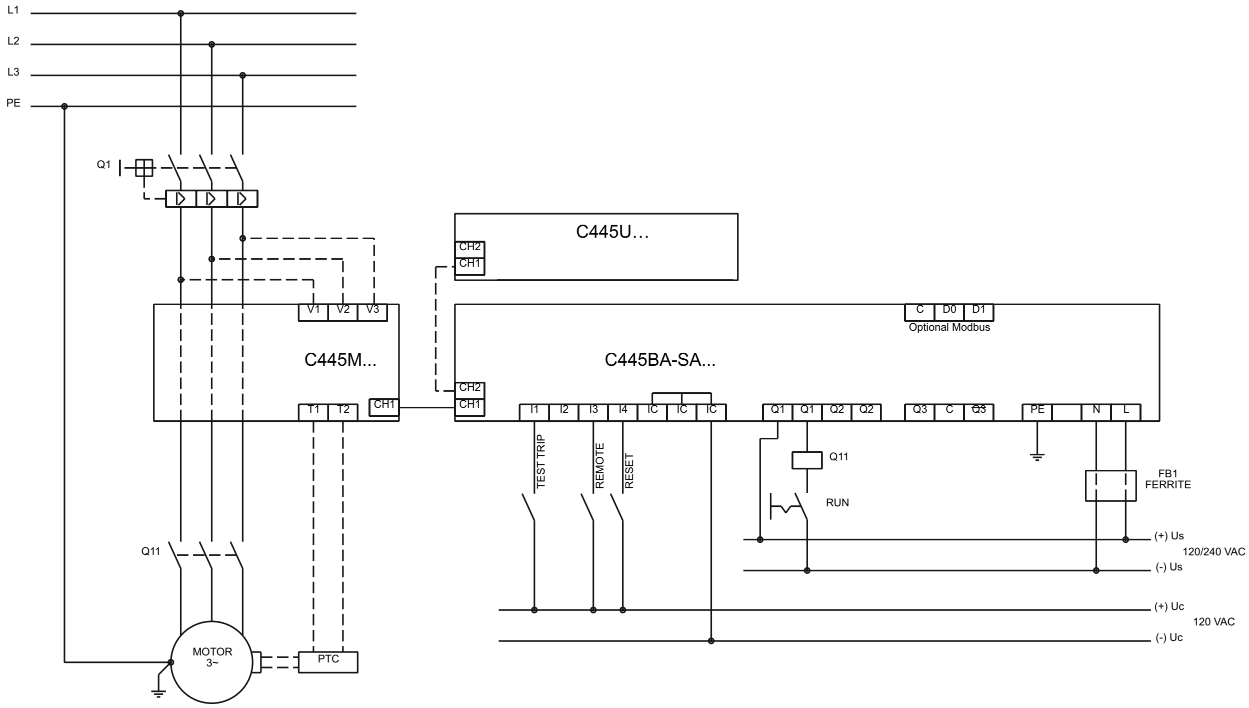


Figure 62. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. Input 2 and Outputs 2 and 3 may be used as general purpose I/O for this operation mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If Fieldwire is the Remote control source and 2-wire control (default) is selected, Input 3 is unused by this operation mode.
5. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Direct Operation Mode

Description

Direct Motor starter is the default profile. The Direct Motor starter profile will use the motor1 parameters for all control/protections.

C445 outputs:

- Output 1 is dedicated by this application mode for controlling and protecting the motor
- Outputs 2 and 3 are general purpose

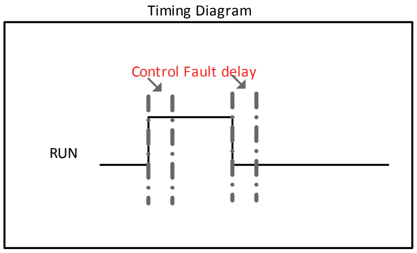
Output 1 controls and protects the contactor/motor. It will close when a valid RUN command is received by the C445, provided a fault or inhibit is not active and will open on a STOP command or if a trip occurs. A C445 Trip condition will cause the Output contact to open.

Outputs 2 and 3 are user configurable outputs and their function can be selected by the user.

The C445 will issue a control fault when:

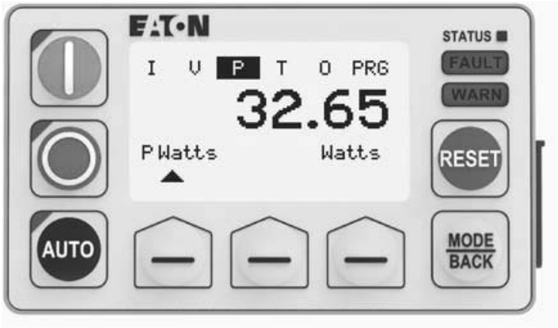
- Run command is active and phase voltage is present with no phase current detected after delay expires
- Stop command active and current detected after delay expires

Figure 63. Timing Diagram for the Direct Mode Operation



Recommended User Interface Options for the Direct Operation Mode

Figure 64. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Direct Mode. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Direct Mode if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Direct Operation Mode and the C445 sources of control.

Table 12. Direct Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. A setting of “0” disables this protection.	R/W
Motor#1 Overload FLA Scaled	900	This parameter is used to set the motor nameplate full load amps for the overload	R/W
Motor Overload Trip FLA	500	This parameter contains the active overload FLA	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Q2 Output function select ①	716	Output 2 user function selection	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The direct motor starter profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0	0 = Stop command, de-activate all control outputs 1 = Run1 command, activate Output 1
Bit 2	This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.
Bit 3	0 = No action 1= Reset fault (will clear fault provided condition has cleared)
Bit 5	0 = No action 1= The C445 will issue a “Test Trip” fault causing the Output 1 control relay to open

Control Status Word

The control status word of the direct motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0	0 = Stopped (No active Run1 command) 1= Running1 (Run1 command is present)
Bit 2	0 = local control source active 1= remote control source is active
Bit 3	0 = no fault present 1= C445 fault present
Bit 4	0 = no warning present 1= C445 warning present
Bit 5	0 = no inhibit present 1= C445 control inhibit present
Bit 6	0 = C445 not ready (fault and/or inhibit present) 1= C445 ready for control (No fault or inhibit present)
Bit 7	0 = motor is not up to speed (AtRef) 1= C445 has detected motor is up to speed (AtRef)

Motor status is determined by current readings obtained from the measurement module. The overload profile will signal the motor is running when the START threshold exceeds 30%. Then, when the current drops below 5%, which is the STOP threshold, the C445 will transition to stop.

Two conditions will then set the AtRef bit, signaling the motor is up to speed.

- If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- If motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Direct Operation Mode

Figure 65. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

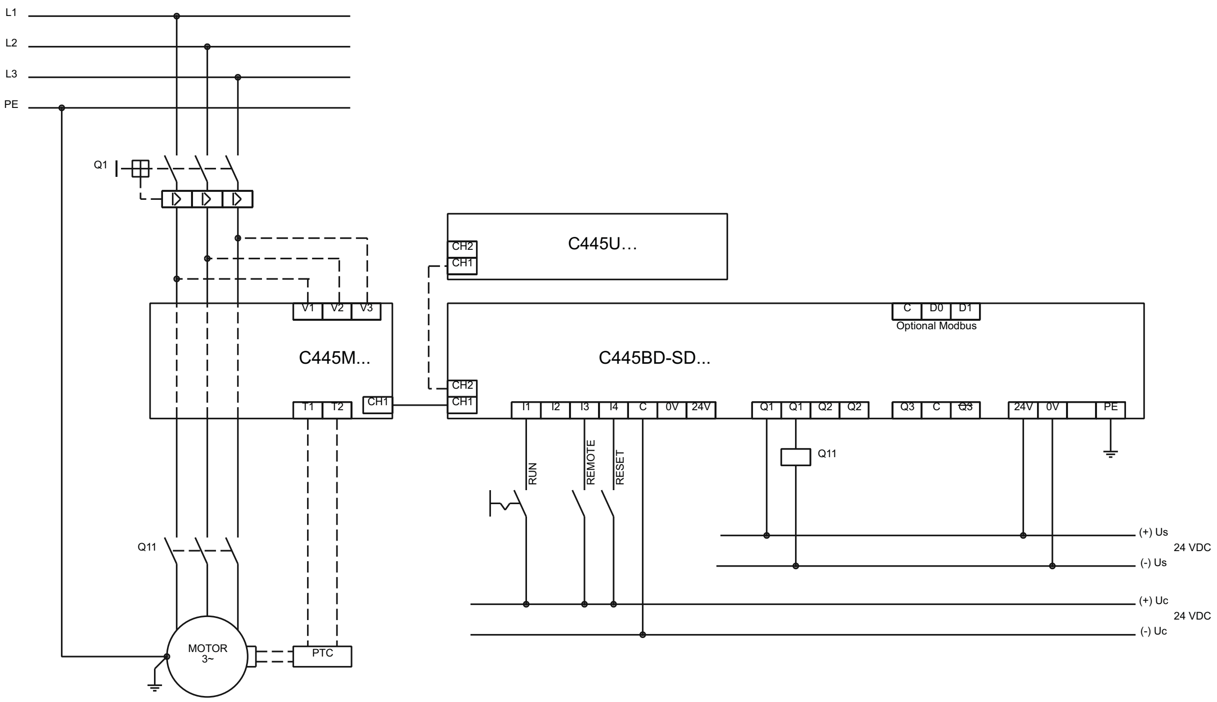


Figure 66. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

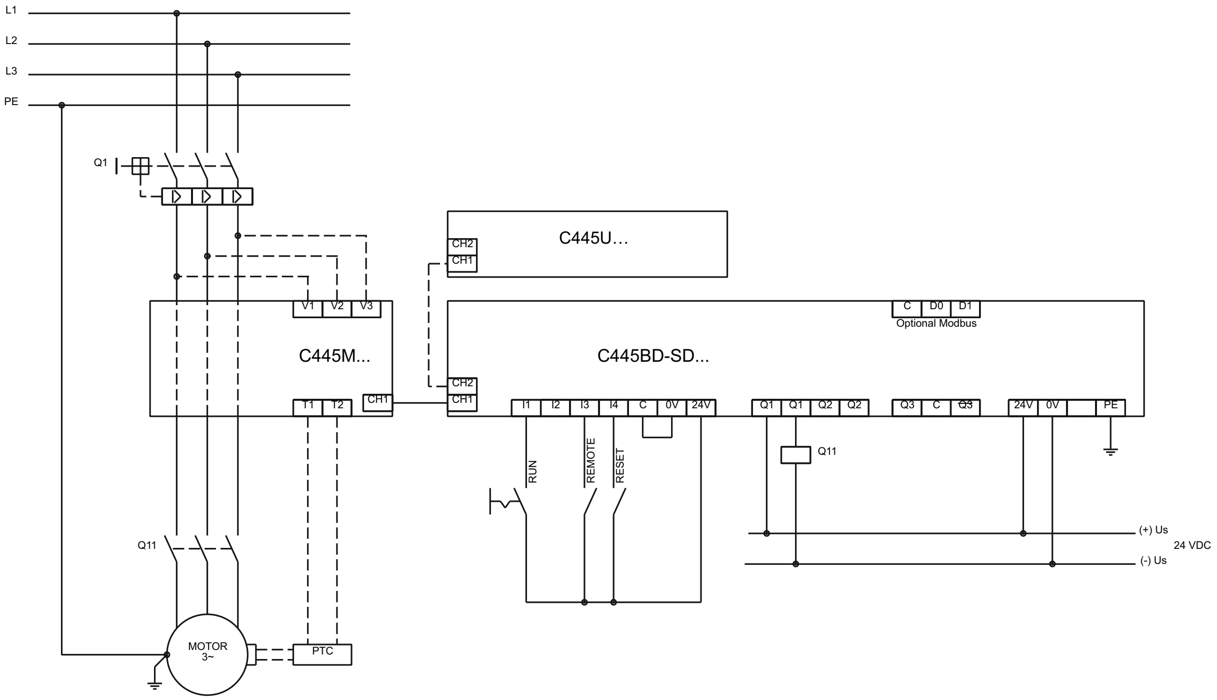
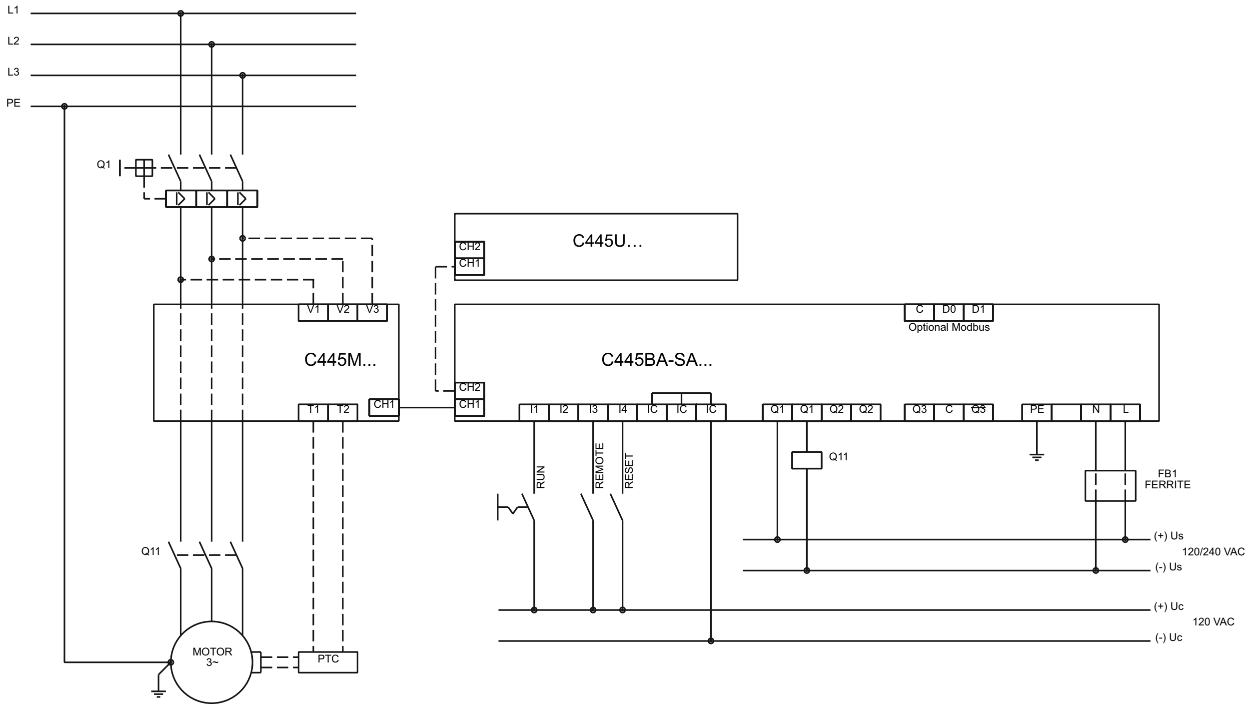


Figure 67. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. Outputs 2 and 3 may be used as general purpose outputs for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If Fieldwire is the Remote control source and 2-wire control (default) is selected, Inputs 2 and 3 are unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.
6. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Reverser Operation Mode

Description

The Reverser starter profile will use the motor1 parameters for all control/protections.

C445 outputs:

- Output 1 is configured as the FWD relay output
- Output 2 is configured as the REV relay output
- Output 3 is general purpose

Output 1 controls the FORWARD contactor. Output 1 will close when a valid FWD(RUN1) command is received and there is no active fault or inhibit.

It will open on a STOP command or if a trip occurs.

Output 2 controls the REVERSE contactor. Output 2 will close anytime a valid REV(RUN2) command is received and there is no active fault or inhibit. It will open on a STOP command or if a trip occurs.

A C445 trip will cause Outputs 1 and 2 to open effectively dropping out the reverser.

Output 3 is a user configurable output whose function can be changed by the user.

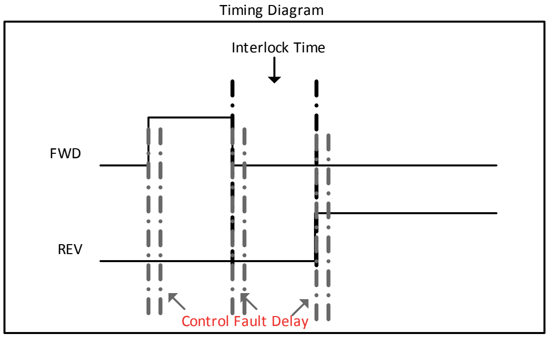
A transition from FWD to REV or REV to FWD must first go through STOP unless the Control Interlocking Time parameter is set to a value of 0. If the value of this parameter is greater than 0, the control will transition to Stop for that delay time before transitioning to the new direction. The Control Interlocking Time parameter can be found in the Operation mode category in the Power Xpert *in*Control Software Tool.

The C445 will issue a control fault when:

- RunFwd or RunRev command is active and phase voltage is present with no phase current detected after delay expires
- Stop command active and current detected after delay expires

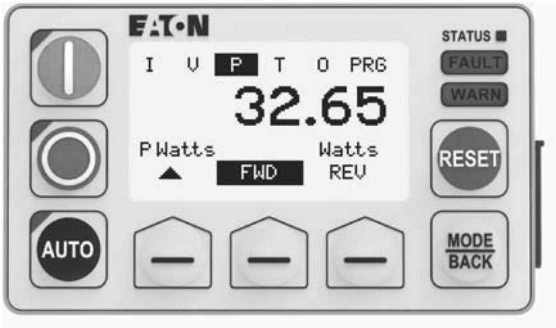
Note: Even with the control fault disabled, the C445 will NOT transition to a new direction until current readings decrease to zero.

Figure 68. Timing Diagram for the Reverse Operation Mode



Recommended User Interface Options for the Reverser Operation Mode

Figure 69. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Reverser Mode. The screen provides selection and indication of Fwd/Rev. Use the soft keys to select Fwd or Rev before pressing the Start button. When running, the highlighted selection indicates direction. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Reverser if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Reverser Operation Mode and the C445 sources of control.

Table 13. Reverser Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. A setting of "0" disables protection.	R/W
Control Interlock Time Delay	702	Time delay before change of direction allowed	R/W
Motor#1 Overload FLA Scaled	900	This parameter is used to set the motor nameplate full load amps for the overload	R/W
Motor Overload Trip FLA	500	This parameter contains the active overload FLA	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The reverser motor starter profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0/1 00 = Stop command, de-activate all control outputs
01 = Run FWD command, activate Output 1
10 = Run REV command, activate Output 2
11 = Unknown command, No action

Bit 2 This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1= The C445 will issue a "Test Trip" fault causing the Output 1 & Output 2 control relays to open.

Control Status Word

The control status word of the reverser motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0/1 00 = Stopped (No active Run commands)
01= Running1 (Run FWD command is active)
10= Running2 (Run REV command is active)

Bit 2 0 = local control source active
1= remote control source is active

Bit 3 0 = no fault present
1= C445 fault present

Bit 4 0 = no warning present
1= C445 warning present

Bit 5 0 = no inhibit present
1= C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1= C445 ready for control (No fault or inhibit present)

Bit 7 0 = motor is not up to speed (AtRef)
1= C445 has detected motor is up to speed (AtRef)

Two conditions will set the AtRef bit, signaling the motor is up to speed.

- If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- If motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Reverse Operation Mode

Figure 70. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

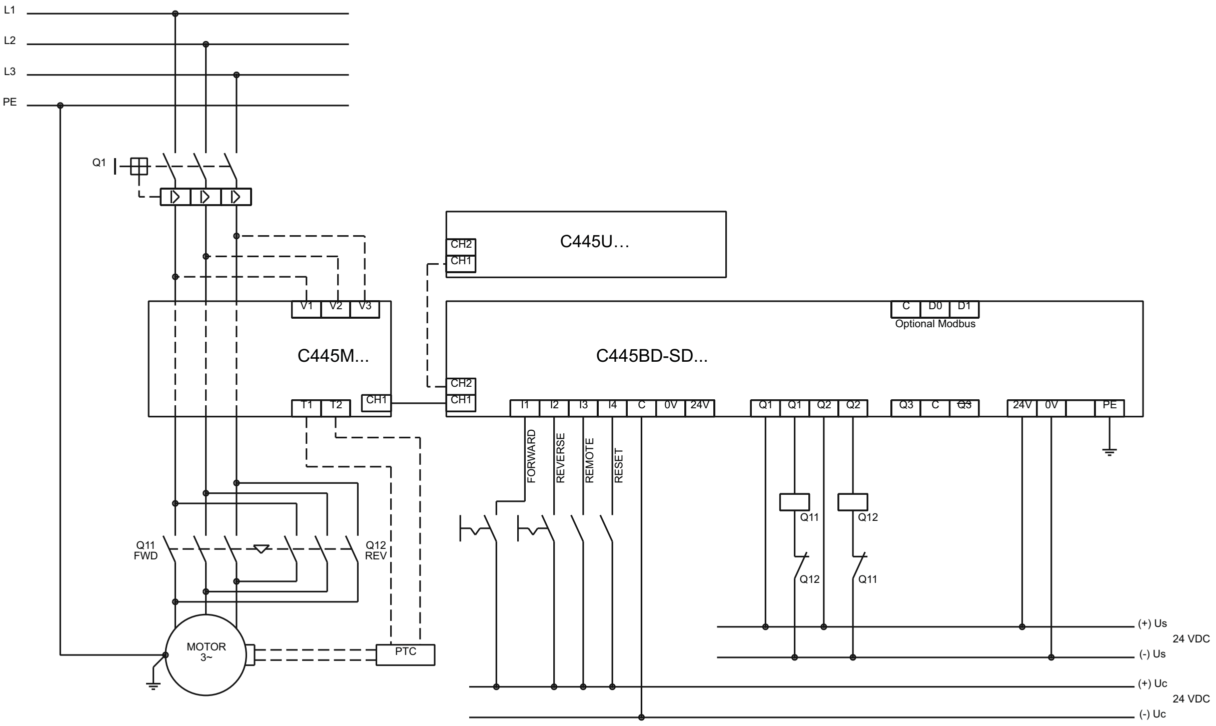


Figure 71. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

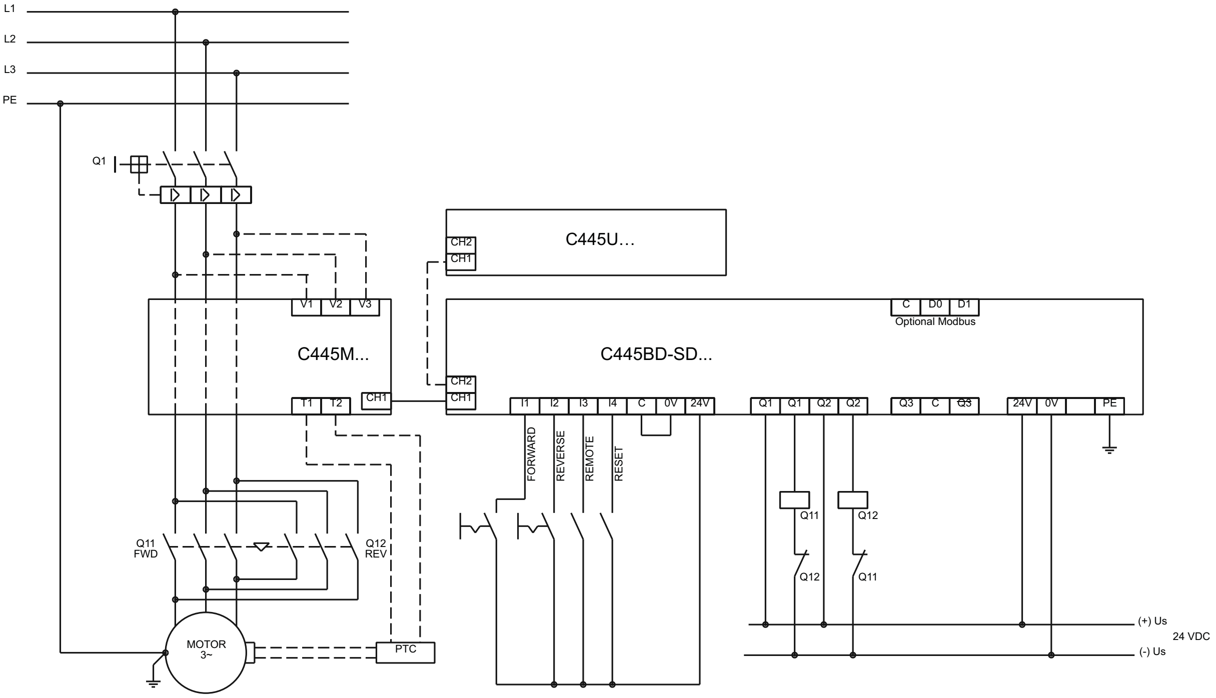
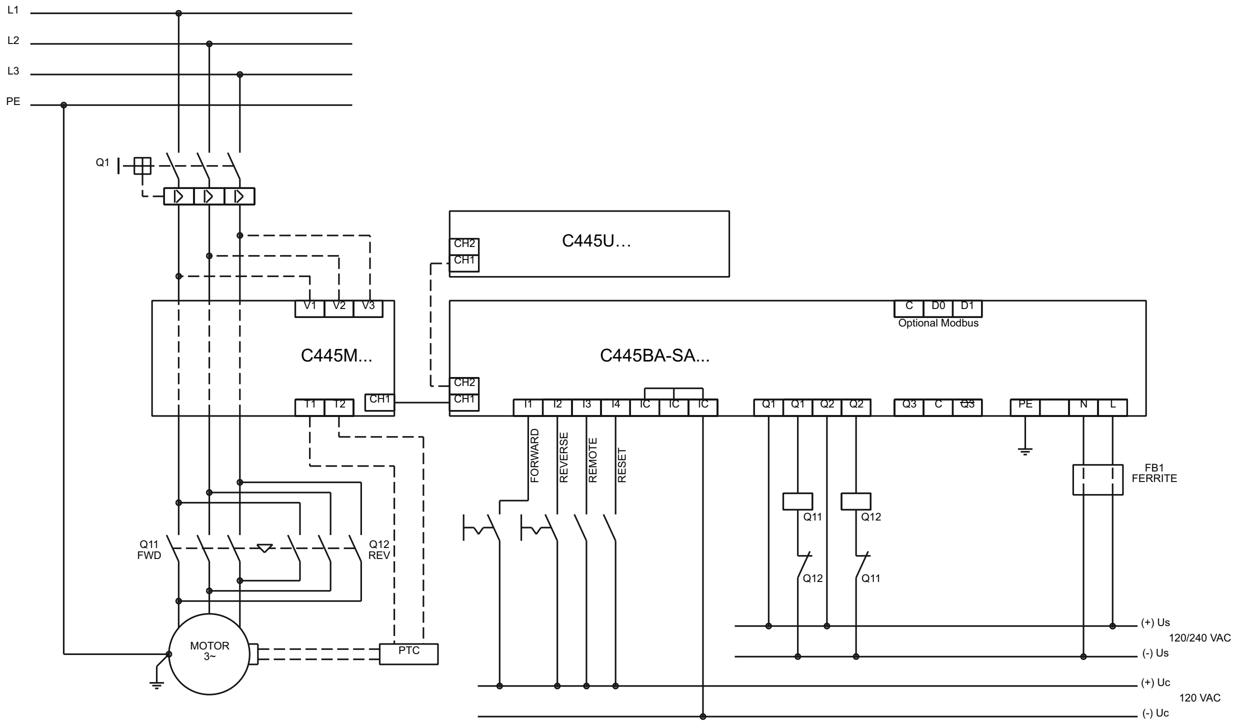


Figure 72. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. Output 3 may be used as a general purpose output for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input and 3-wire control is not allowed for this operation mode. When power is applied to Input 3, the C445 will be in Remote mode.
4. If Fieldwire is the Remote control source, 3-wire control is allowed and Input 3 is the Permissive Input.
5. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Star/Delta Operation Mode

Description

The Star/Delta starter control provides the logic to control a Star/Delta connected motor.

C445 outputs:

- Q1 output – star/delta motor starter LINE coil (NO)
- Q2 output – star/delta motor starter DELTA coil (NO)
- Q3 output – star/delta motor starter STAR coil (NO)

A STOP command deactivates all contactor controls effectively dropping out the motor.

A START command activates the STAR contactor control then activates the LINE contactor control after the Network Contactor Delay expires initiating a start in the STAR winding configuration. This parameter can be found in the Operation Mode category in the Power Xpert *in*Control Software Tool.

Switching to Delta: The control will switch to delta when the control detects the motor is up to speed or when the Maximum Star Winding Time expires. The STAR contactor control will first be deactivated. The DELTA contactor control will then be activated after the net delay time expires and current readings = 0. The Maximum Star Winding Time parameter can be found in the Operation Mode category in the Power Xpert *in*Control Software Tool.

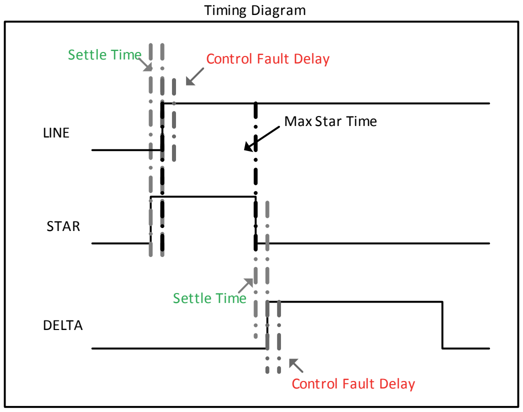
The control will set MOTOR1 as the active motor parameters when starting in the star configuration and will set MOTOR2 as the active motor parameters when running in the delta configuration.

The C445 will issue a control fault when:

- Run command is active and phase voltage is present with no phase current detected after delay expires
- Stop command active and current detected after delay expires

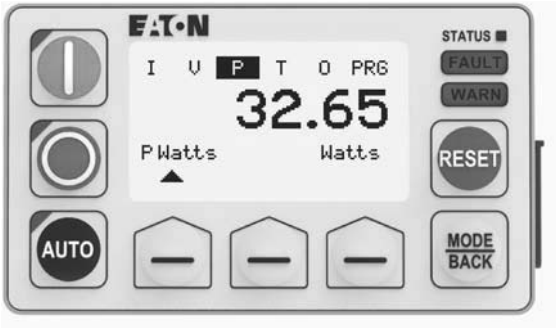
Note: Even with the control fault disabled, the C445 will NOT transition to the delta winding until current readings in star decrease to zero.

Figure 73. Timing Diagram for the Star/Delta Operation Mode



Recommended User Interface Options for the Star/Delta Operation Mode

Figure 74. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Star/Delta. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Star/Delta if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Star/Delta Operation Mode and the C445 sources of control.

Table 14. Star/Delta Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. A setting of "0" disables this protection.	R/W
Network Contactor Settle Time	704	Settle delay time before 2nd contactor is activated – ensures the first contactor is sealed in before applying the line	R/W
Maximum Star Winding Time	705	Maximum time the control will stay on the star winding before transitioning to the delta winding in 100ms	R/W
Motor#1 Overload FLA Scaled	900	This parameter is to set the overload full load amp rating when on the star winding	R/W
Motor#2 Overload FLA Scaled	901	This parameter is to set the overload full load amp rating when on the delta winding	R/W
Motor Overload Trip FLA	500	This parameter contains the active motor overload FLA (will contain the motor1 setting when on the star winding and the motor2 setting when on the delta winding)	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The star/delta motor starter profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0	0 = Stop command, de-activate all control outputs 1 = Run1 command, begin start sequence
Bit 2	This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.
Bit 3	0 = No action 1= Reset fault (will clear fault provided condition has cleared)
Bit 5	0 = No action 1= The C445 will issue a "Test Trip" fault causing the Outputs 1-3 control relays to open

Control Status Word

The control status word of the direct motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0	0 = Stopped (No active Run1 command) 1= Running1 (Run1 command is present)
Bit 2	0 = local control source active 1= remote control source is active
Bit 3	0 = no fault present 1= C445 fault present
Bit 4	0 = no warning present 1= C445 warning present
Bit 5	0 = no inhibit present 1= C445 control inhibit present
Bit 6	0 = C445 not ready (fault and/or inhibit present) 1= C445 ready for control (No fault or inhibit present)
Bit 7	0 = motor is not up to speed (AtRef) 1= C445 has detected motor is up to speed on delta winding (AtRef)

Two conditions will set the AtRef bit, signaling the motor is up to speed.

- After transitioning to the delta winding, if motor current increases above 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- After transitioning to the delta winding, if motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Star/Delta Operation Mode

Figure 75. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

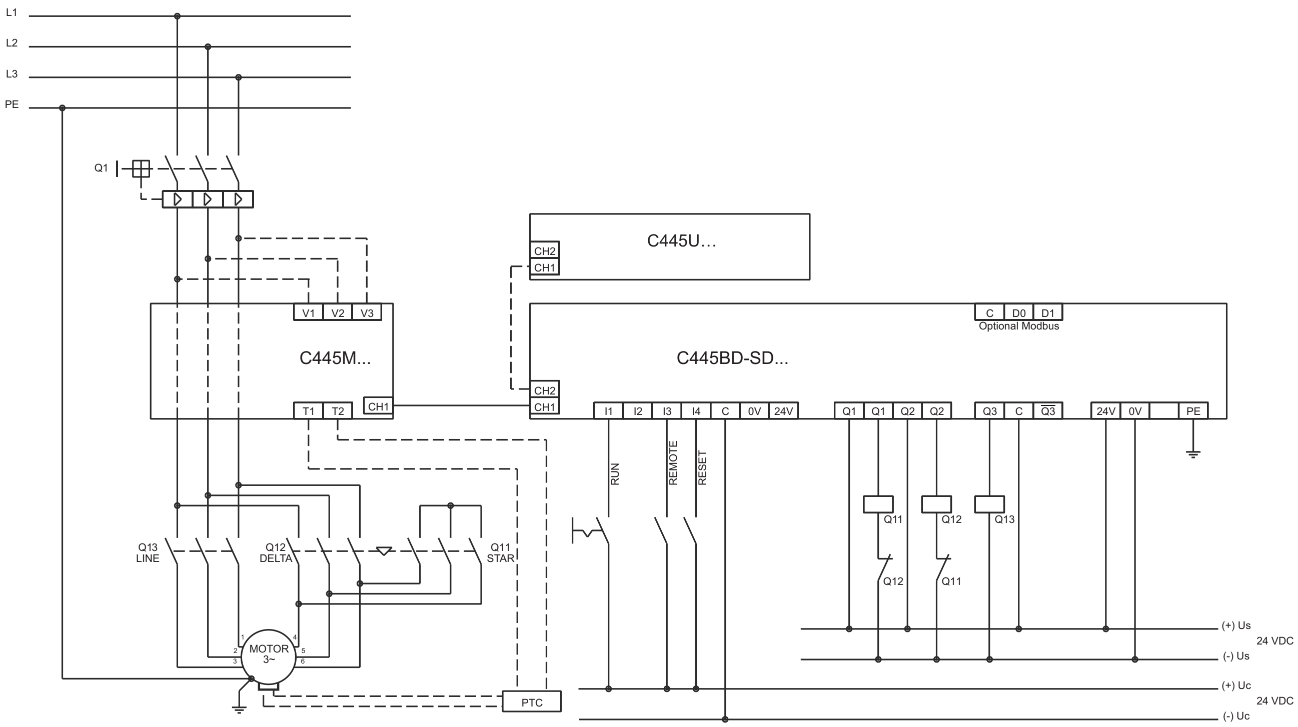


Figure 76. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

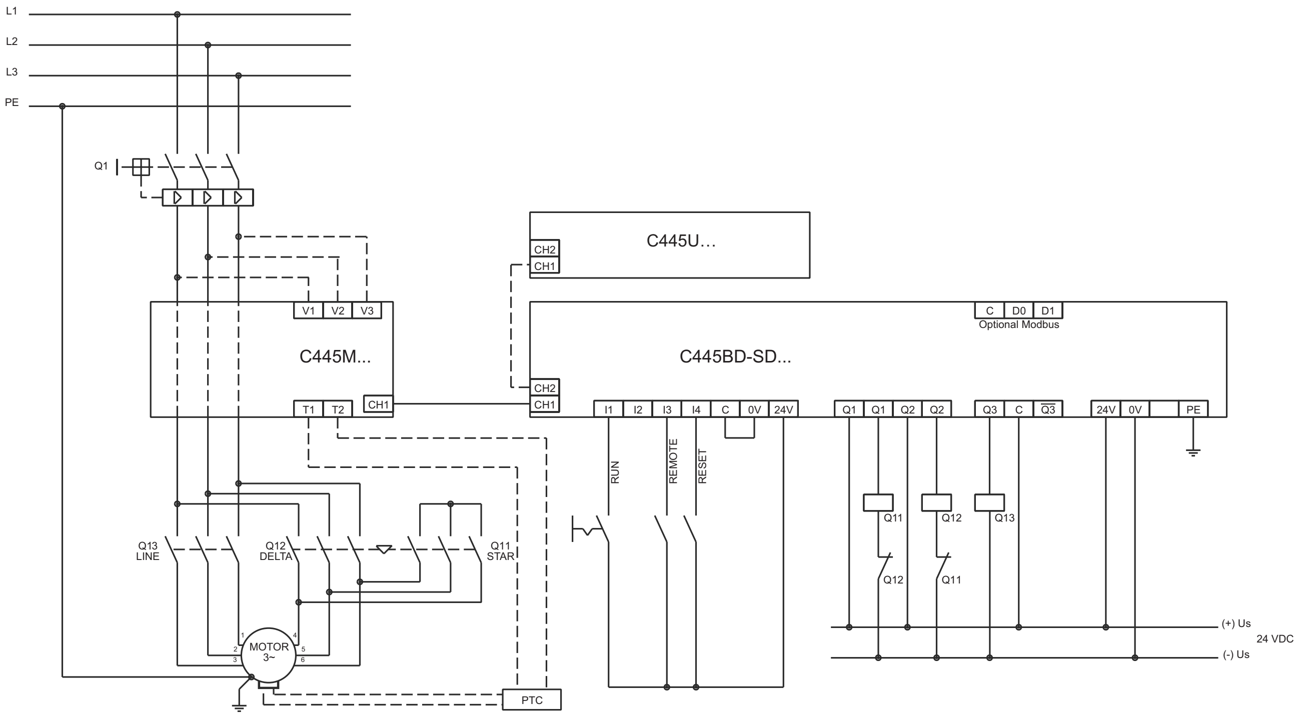
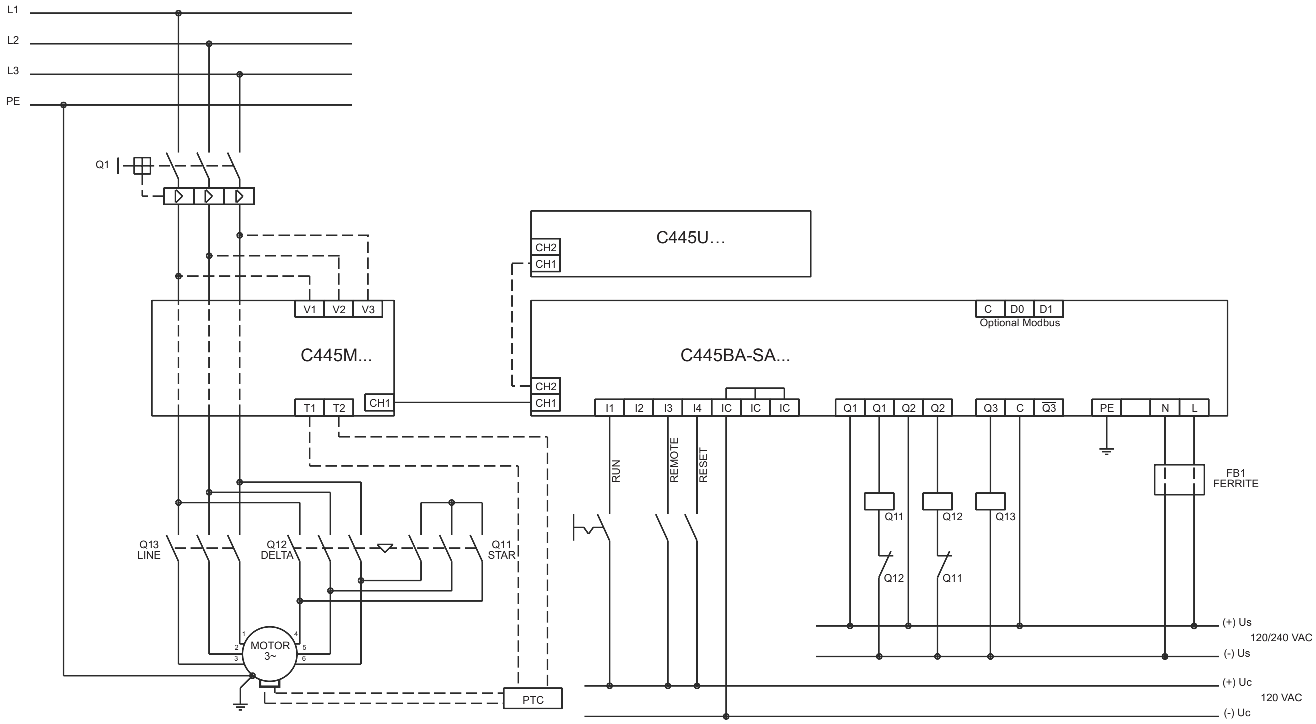


Figure 77. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. No outputs may be used as general purpose outputs for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If Fieldwire is the Remote control source and 2-wire control (default) is selected, Inputs 2 and 3 are unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.
6. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Two Speed Two Winding Operation Mode

Description

The two speed motor starter operation mode accepts off/slow/fast commands to control two speed motor applications. A run slow command will activate Output 1(slow). A run fast command will activate Output 2(fast). A stop command de-activates both of the outputs.

When transitioning from fast → slow, the C445 will de-activate Output 2(fast) and will delay activating Output 1(slow) until the Control Switching Time expires, allowing the motor time to slow down before transitioning to the slow speed. The Control Switching Time parameter can be found in the Operation Mode category in the Power Xpert *in*Control Software Tool.

The C445 will issue a control fault when:

- The RunSlow or RunFast command is active and phase voltage is present and no phase current is detected.
- A Stop command is active and current is detected.

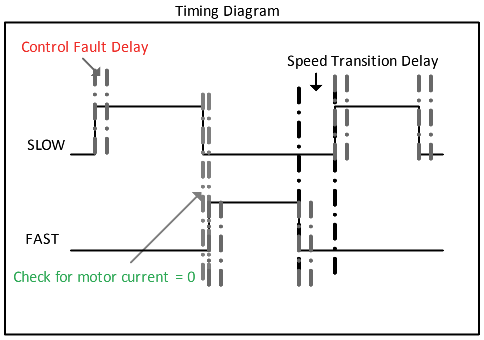
Note: Even with the control fault disabled, after de-activating the present speed, the C445 will NOT transition to the new speed until current readings decrease to zero.

- Outputs 1 and 2 will be de-activated anytime the C445 experiences a fault/inhibit condition.
- Output 1 – slow starter coil (NO)
- Output 2 – fast starter coil (NO)
- Output 3 – open for user configuration and function can be selected by the user.

The AtRef (At Reference) bit in the Motor Control Status register is set based on the following two conditions. At Reference signals that the motor is up to speed.

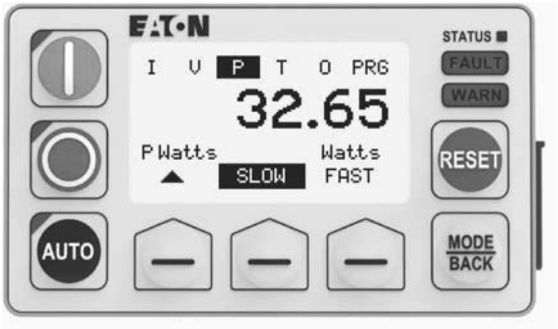
1. If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
2. If motor current exceeds 30% of the active overload FLA rating and remains until after the Motor State Transition to Run Delay from Start time expires the motor is determined to be up to speed and the AtRef bit will be set. This time delay parameter can be found in the General Protections category in the Power Xpert *in*Control Software Tool.

Figure 78. Timing Diagram for the Two Speed Operation Mode



Recommended User Interface Options for the Two Speed Two Winding Operation Mode

Figure 79. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Two Speed Two Winding. The screen provides selection and indication of Slow/Fast status. Use the soft keys to select Slow or Fast before pressing the Start button. When running, the highlighted selection indicates speed. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Two Speed if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Two Speed Two Winding Operation Mode and the C445 sources of control.

Table 15. Two Speed Two Winding Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. Setting of "0" disables protection.	R/W
Control Switch Time Delay	703	Time delay when transitioning from fast → slow. Delay to allow motor to slow before transitioning to the slow output	R/W
Motor#1 Overload FLA Scaled	900	Parameter to set overload full load amps for slow motor winding	R/W
Motor#2 Overload FLA Scaled	901	Parameter to set overload full load amps for fast motor winding	R/W
Motor Overload Trip FLA	500	Parameter holds active motor overload fla rating (will contain the motor1 setting when on the slow winding and the motor2 setting when on the fast winding)	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The two speed motor starter profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0/1 00 = Stop command, de-activate all control outputs
01 = Run Slow command, activate Output 1
10 = Run Fast command, activate Output 2
11 = Unknown command, No action

Bit 2 This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1= The C445 will issue a "Test Trip" fault causing the Outputs 1 & 2 control relays to open.

Control Status Word

The control status word of the two speed motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0/1 00 = Stopped (No active Run commands)
01 = Running1 (Run Slow command is active)
10 = Running2 (Run Fast command is active)

Bit 2 0 = local control source active
1 = remote control source is active

Bit 3 0 = no fault present
1 = C445 fault present

Bit 4 0 = no warning present
1 = C445 warning present

Bit 5 0 = no inhibit present
1 = C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1 = C445 ready for control (No fault or inhibit present)

Bit 7 0 = motor is not up to speed (AtRef)
1 = C445 has detected motor is up to speed (AtRef)

Two conditions will set the AtRef bit, signaling the motor is up to speed.

- If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- If motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Two Speed Two Winding Operation Mode

Figure 80. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

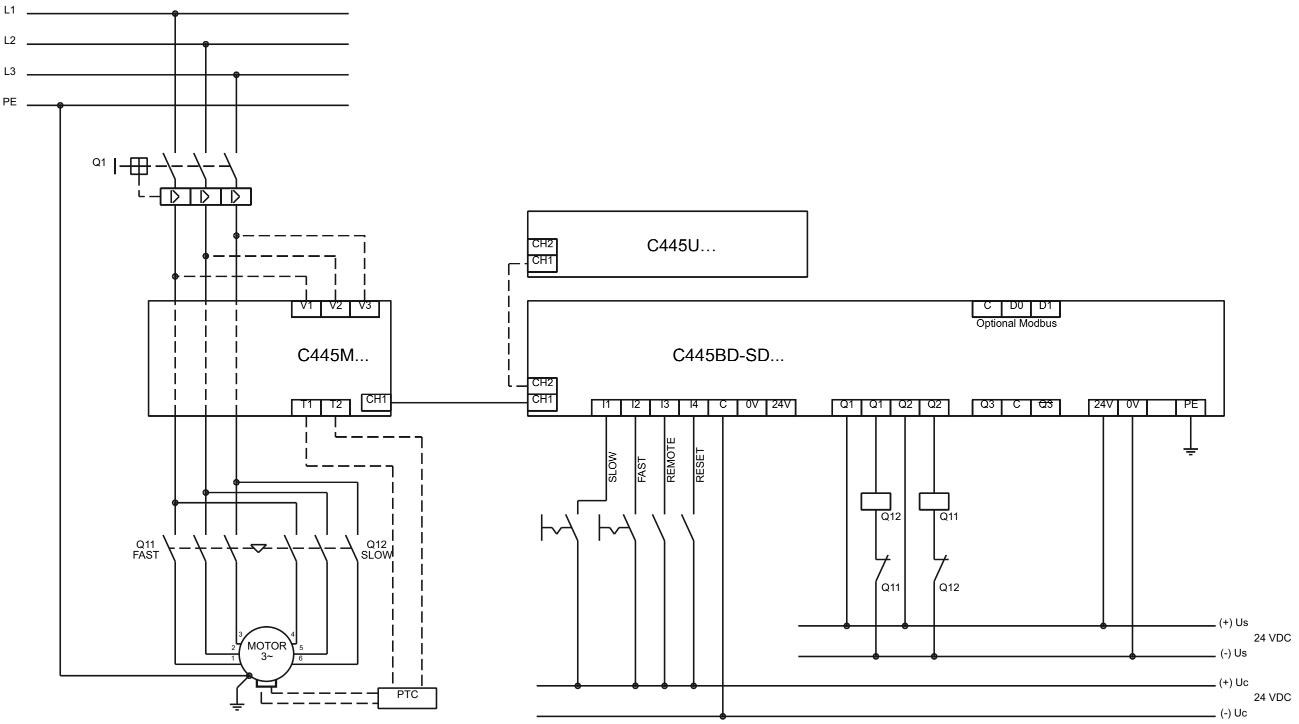


Figure 81. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

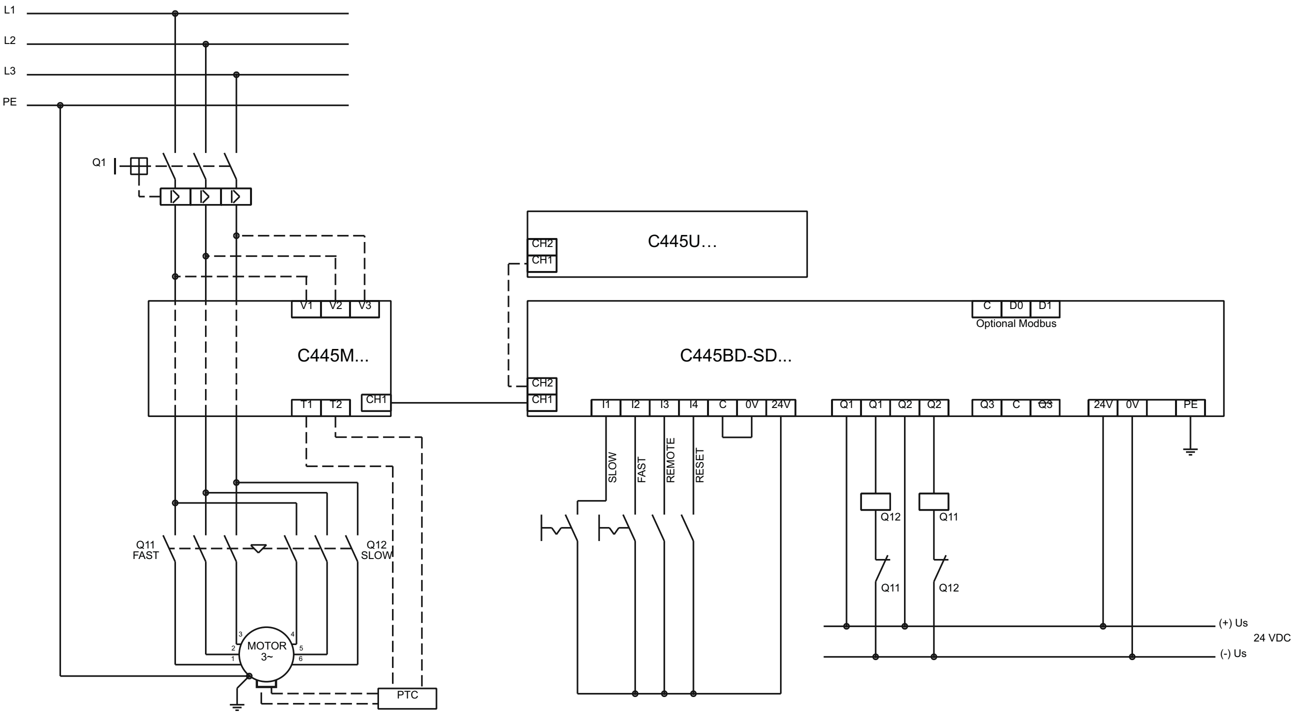
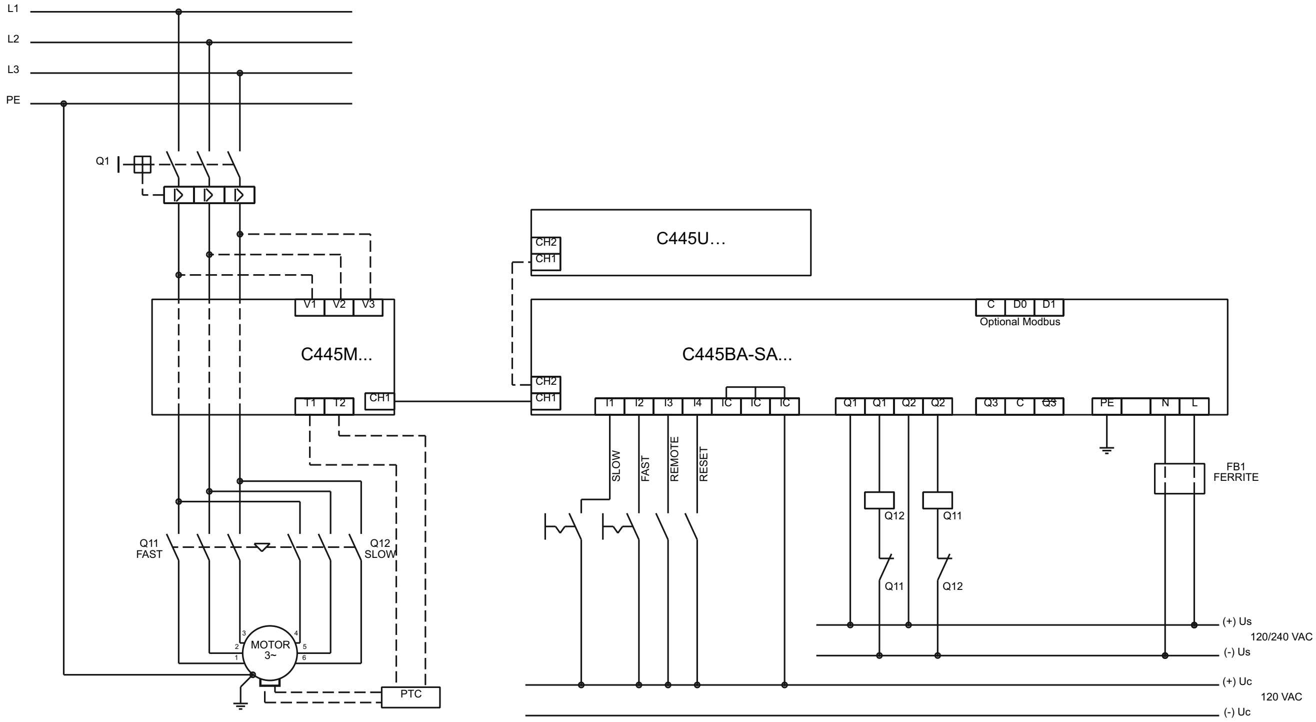


Figure 82. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. Output 3 may be used as a general purpose output for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input and 3-wire control is not allowed for this operation mode. When power is applied to Input 3, the C445 will be in Remote mode.
4. If fieldwire is the Remote control source, 3-wire control is allowed and Input 3 is the Permissive Input.
5. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Two Speed Dahlander Operation Mode

The Two Speed Dahlander motor starter operation mode accepts OFF/SLOW/FAST commands to control two speed motor applications. A RUN SLOW command will activate Output 1(slow). A RUN FAST command will activate Output 3(net). Then after the Network Contactor Delay time expires, Output 2(fast) activates starting the motor on the fast winding. A STOP command de-activates all 3 outputs.

When transitioning from fast → slow, the C445 will de-activate both Output 2(fast) and Output 3(net) and will delay activating Output 1(slow) until the Control Switching Time Delay expires, allowing the motor time to slow down before transitioning to the slow speed.

The C445 will issue a control fault when:

- The RUN SLOW or RUN FAST command is active and phase voltage is present and no phase current is detected.
- A STOP command is active and current is detected.

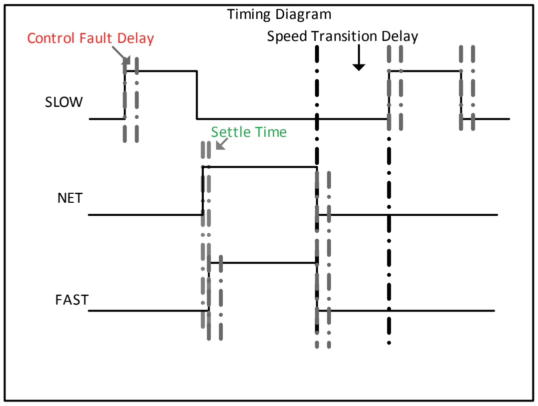
Note: Even with the control fault disabled, after de-activating the present speed, the C445 will NOT transition to the new speed until current readings decrease to zero.

- Outputs 1, 2 and 3 will be de-activated anytime the C445 experiences a fault/inhibit condition.
- Output 1 – SLOW STARTER coil (NO)
- Output 2 – FAST STARTER coil (NO)
- Output 3 – NET STARTER coil (NO)

The AtRef (At Reference) bit in the Motor Control Status register is set based on the following two conditions. At Reference signals that the motor is up to speed.

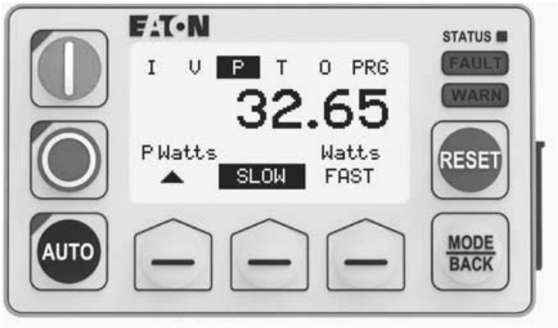
1. If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
2. If motor current exceeds 30% of the active overload FLA rating and remains until after the Motor State Transition to Run Delay from Start time expires the motor is determined to be up to speed and the AtRef bit will be set. This time delay parameter can be found in the General Protections category in the Power Xpert *in*Control Software Tool.

Figure 83. Timing Diagram for the Two Speed Dahlander Operation Mode



Recommended User Interface Options for the Two Speed Dahlander Operation Mode

Figure 84. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Two Speed Dahlander Mode. The screen provides selection and indication of Slow/Fast status. Use the soft keys to select Slow or Fast before pressing the Start button. When running, the highlighted selection indicates speed. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Two Speed if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Two Speed Dahlander Operation Mode and the C445 sources of control.

Table 16. Two Speed Dahlander Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. Setting of "0" disables protection.	R/W
Control Switch Time Delay	703	Time delay when transitioning from fast → slow. Delay to allow motor to slow before transitioning to the slow output (in 10ms)	R/W
Network Contactor Settle Time	704	Settle delay time before 2nd contactor is activated – ensures the net contactor is sealed in before activating the fast output (in 10ms)	R/W
Motor#1 Overload FLA Scaled	900	Parameter to set overload full load amps for slow motor winding	R/W
Motor#2 Overload FLA Scaled	901	Parameter to set overload full load amps for fast motor winding	R/W
Motor Overload Trip FLA	500	This parameter contains the active motor overload FLA rating (will contain the motor1 setting when on the slow winding and the motor2 setting when on the fast winding)	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The two speed Dahlander motor starter profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0/1	00 = Stop command, de-activate all control outputs 01 = Run Slow command, activate Output 1 10 = Run Fast command, activate Outputs 2 & 3 11 = Unknown command, No action
Bit 2	This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.
Bit 3	0 = No action 1= Reset fault (will clear fault provided condition has cleared)
Bit 5	0 = No action 1= The C445 will issue a "Test Trip" fault causing the Outputs 1-3 control relays to open.

Control Status Word

The control status word of the two speed Dahlander motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0/1	00 = Stopped (No active Run commands) 01= Running1 (Run Slow command is active) 10= Running2 (Run Fast command is active)
Bit 2	0 = local control source active 1= remote control source is active
Bit 3	0 = no fault present 1= C445 fault present
Bit 4	0 = no warning present 1= C445 warning present
Bit 5	0 = no inhibit present 1= C445 control inhibit present
Bit 6	0 = C445 not ready (fault and/or inhibit present) 1= C445 ready for control (No fault or inhibit present)
Bit 7	0 = motor is not up to speed (AtRef) 1= C445 has detected motor is up to speed (AtRef)

Two conditions will set the AtRef bit, signaling the motor is up to speed.

- If motor current first exceeds 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- If motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Two Speed Dahlander Operation Mode

Figure 85. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

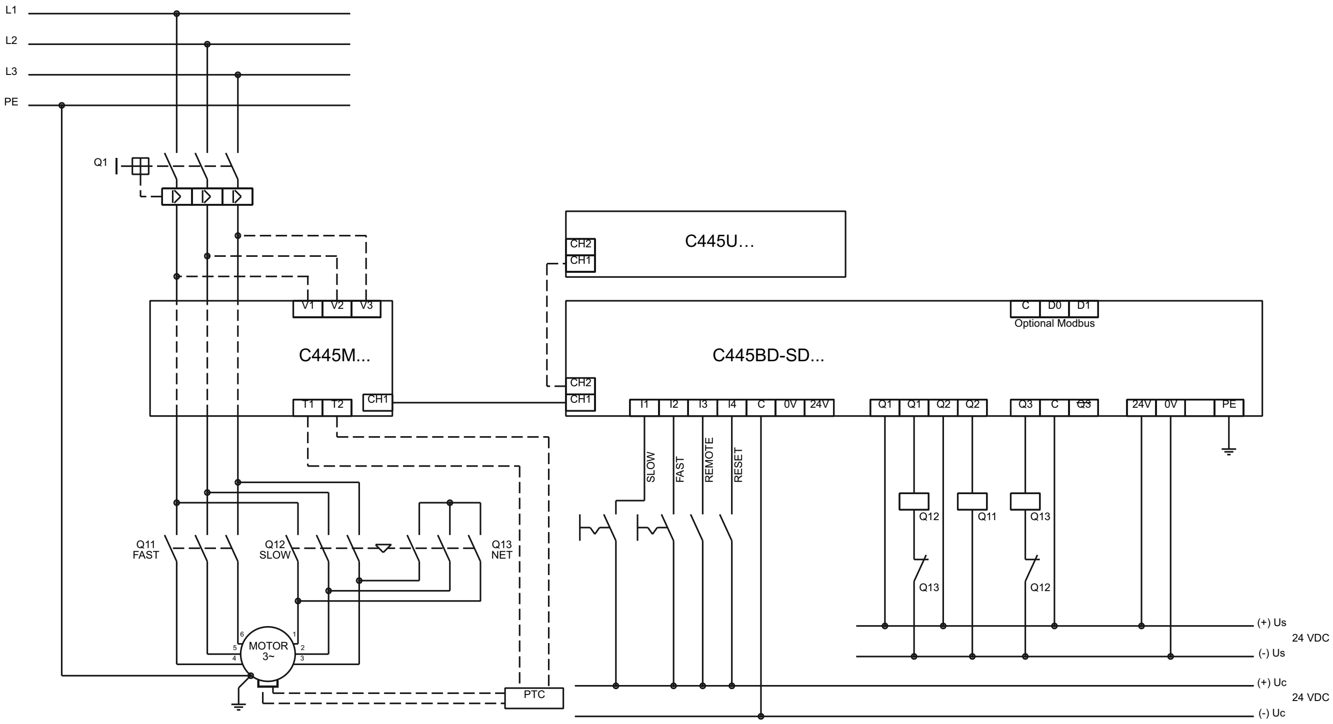


Figure 86. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

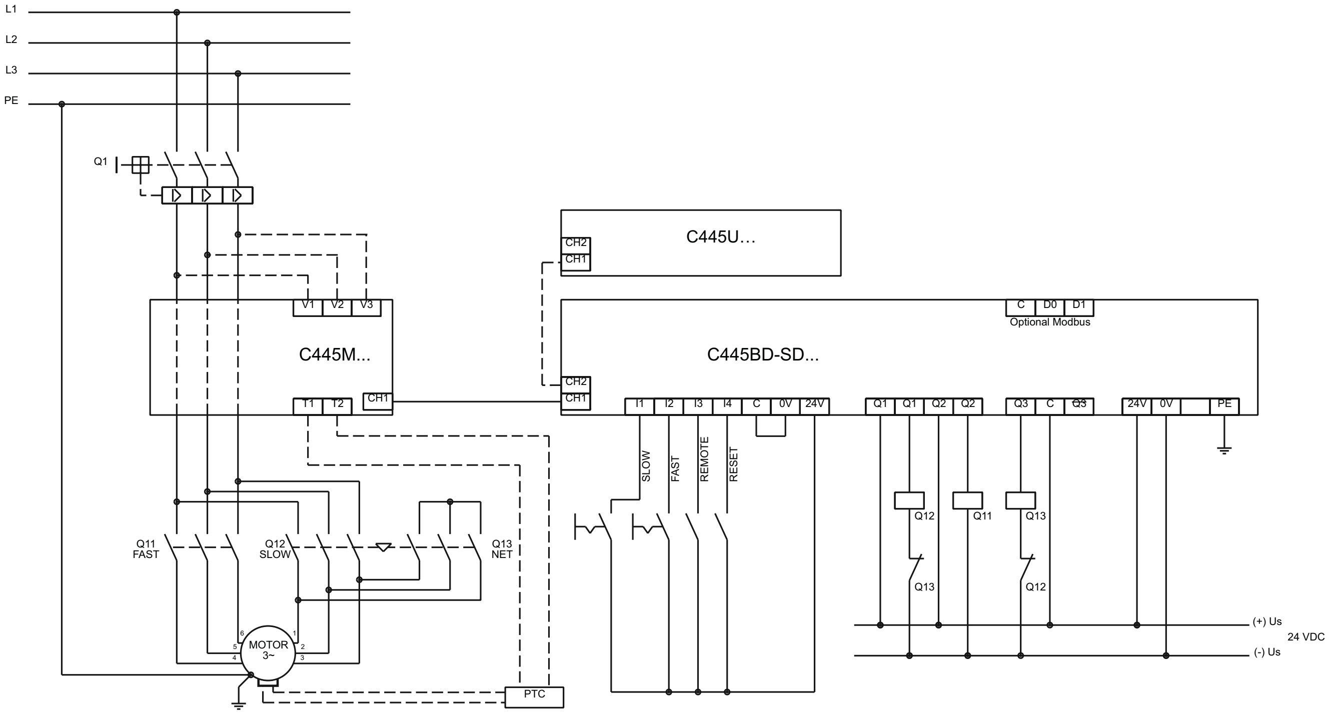
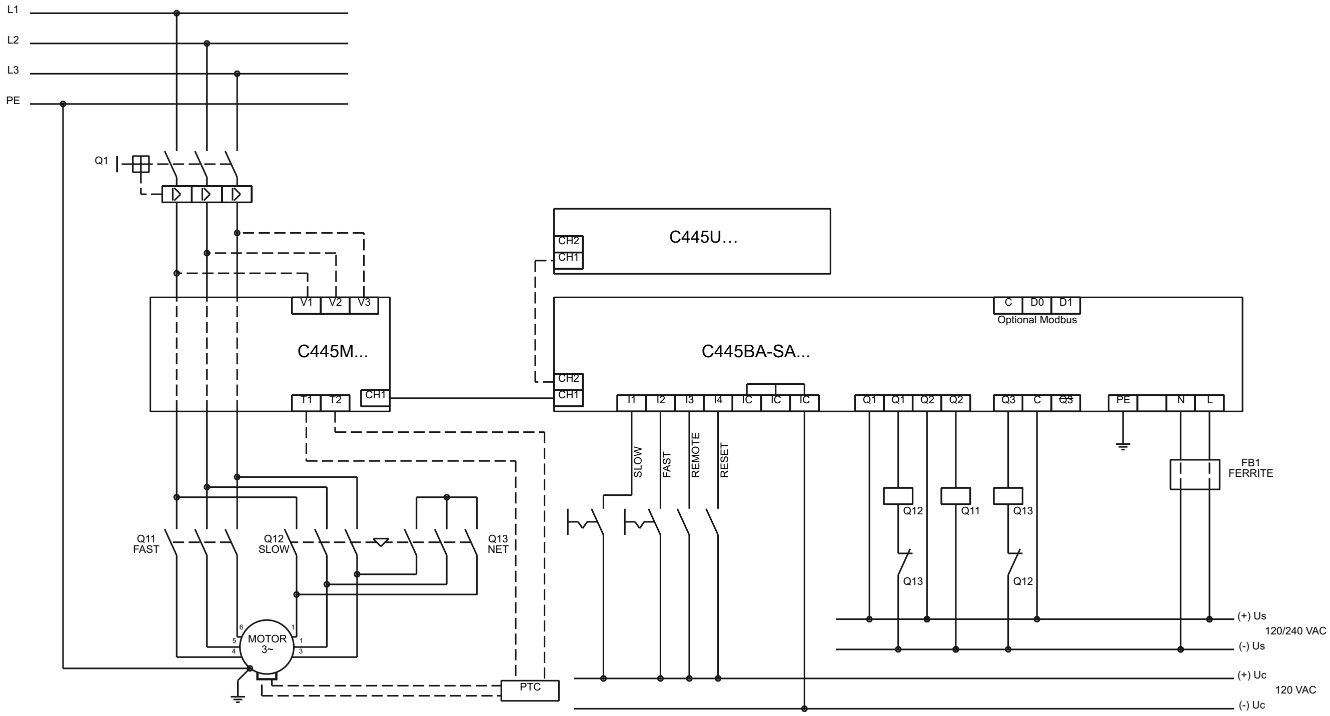


Figure 87. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. No outputs may be used as general purpose outputs for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input and 3-wire control is not allowed for this operation mode. When power is applied to Input 3, the C445 will be in Remote mode.
4. If fieldwire is the Remote control source, 3-wire control is allowed and Input 3 is the Permissive Input.
5. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Auto Transformer Operation Mode

The auto transformer reduced voltage motor starter profile accepts start/stop commands to control motors wired in a reduced voltage auto transformer configuration. When a start command is received Output 3(star) will be activated. Then after the Network Contactor Delay time expires, Output 1(start) activates starting the motor with the reduced voltage from the auto transformer. When the C445 detects the motor is up to speed or the Maximum Star Winding Time expires, whichever occurs first, the Network Contactor Delay timer is started and Output 3 is de-activated. After the Network Contactor Delay time expires, Output 2(run) also activates, which transitions the transformer to full voltage. After a second Network Contactor Delay time expires, Output 1(start) de-activates placing the control into full voltage run mode.

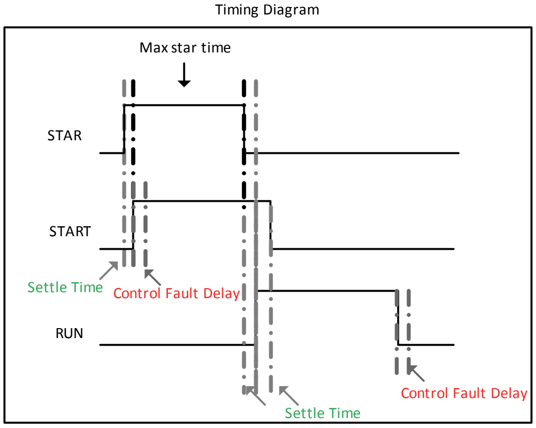
The C445 will issue a control fault when:

- A Run1 command is active and phase voltage is present and no phase current is detected after the Control Switching Time expires.
- A Stop command is active and current is detected after the Control Switching Time expires.

Outputs 1, 2 and 3 will be de-activated anytime the C445 experiences a fault/inhibit condition.

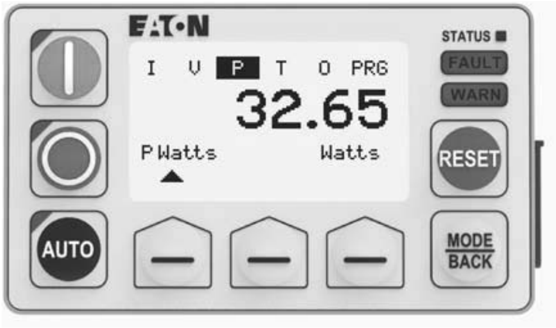
- Output 1 – auto transformer reduced voltage starter START coil (NO)
- Output 2 – auto transformer reduced voltage starter RUN coil (NO)
- Output 3 – auto transformer reduced voltage starter STAR coil (NO)

Figure 88. Timing Diagram for the Auto Transformer Operation Mode



Recommended User Interface Options for the Auto Transformer Operation Mode

Figure 89. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Auto Transformer Mode. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Auto Transformer if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the auto transformer reduced voltage motor starter control profile and the C445 sources of control.

Table 17. Auto Transformer Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
*C445 Active Operation Mode	700	Parameter selects control profile; Set to "6" for auto transformer reduced voltage motor starter	R/W
Control Fault Delay	701	Delay time from change in command before a control fault is issued. Setting of "0" disables this protection.	R/W
Network Contactor Settle Time	704	Settle delay time before second contactor is activated – ensures the first contactor is sealed in before applying the line (in 10 ms)	R/W
Maximum Star Winding Time	705	Maximum time the control will stay on the reduced voltage output before transitioning to full voltage (in 100 ms)	R/W
Motor#1 Overload FLA Scaled	900	Parameter to set motor nameplate full load amp rating for overload and motor protections	R/W
Motor#2 Overload FLA Scaled	901	Not used	R/W
Motor Overload Trip FLA	500	Parameter holds active motor overload FLA rating (will contain the motor1 setting)	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired motor protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired motor protections warnings	R/W
*C445 Local Source Selector	711	See Section – C445 Local/Remote Control Source Selection	R/W
C445 Remote Source Selector	712	See Section – C445 Local/Remote Control Source Selection	R/W

Fieldbus Control Word

The auto transformer reduced voltage motor starter profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0 0 = Stop command, de-activate all control outputs
1 = Run1 command, begin start sequence

Bit 2 This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1= The C445 will issue a "Test Trip" fault causing the Outputs 1-3 control relays to open

Control Status Word

The control status word of the auto transformer reduced voltage motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0 0 = Stopped (No active Run1 command)
1= Running1 (Run1 command is present)

Bit 2 0 = local control source active
1= remote control source is active

Bit 3 0 = no fault present
1= C445 fault present

Bit 4 0 = no warning present
1= C445 warning present

Bit 5 0 = no inhibit present
1= C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1= C445 ready for control (No fault or inhibit present)

Bit 7 0 = motor is not up to speed (AtRef)
1= C445 has detected motor is up to speed on delta winding (AtRef)

Two conditions will set the AtRef bit, signaling the motor is up to speed.

- After transitioning to the full voltage output, if motor current increases above 115% of the active overload FLA rating and then decreases back below 115% of the active overload FLA rating, it is determined the motor has come up to speed and the AtRef bit will be set.
- After transitioning to the full voltage output, if motor current exceeds 30% of the active overload FLA rating and remains until after the start delay time expires the motor is determined to be up to speed and the AtRef bit will be set.

Wiring Diagrams for the Auto Transformer Operation Mode

Figure 90. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

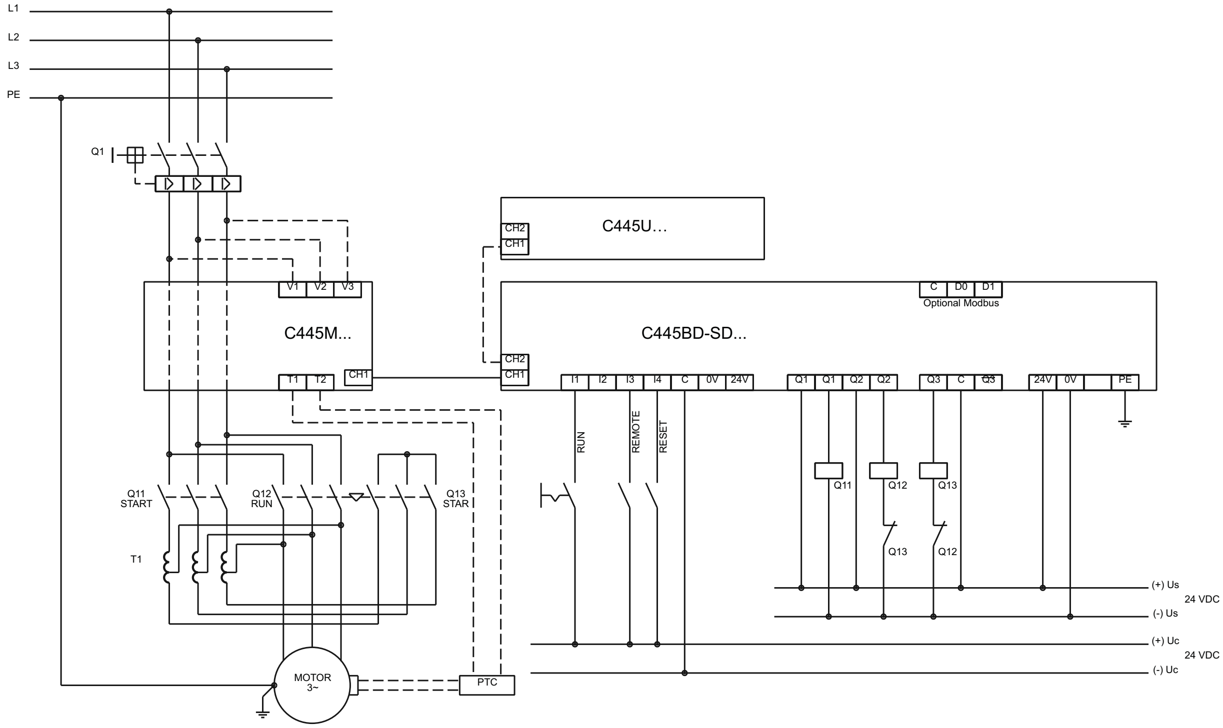


Figure 91. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

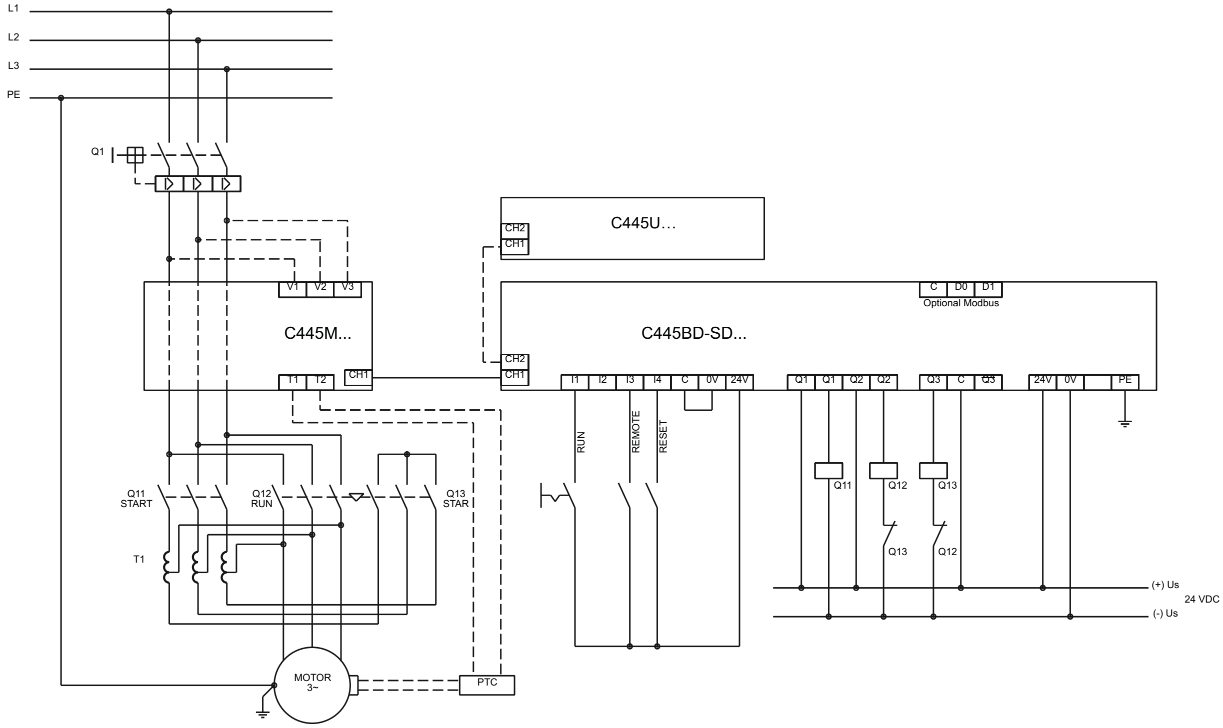
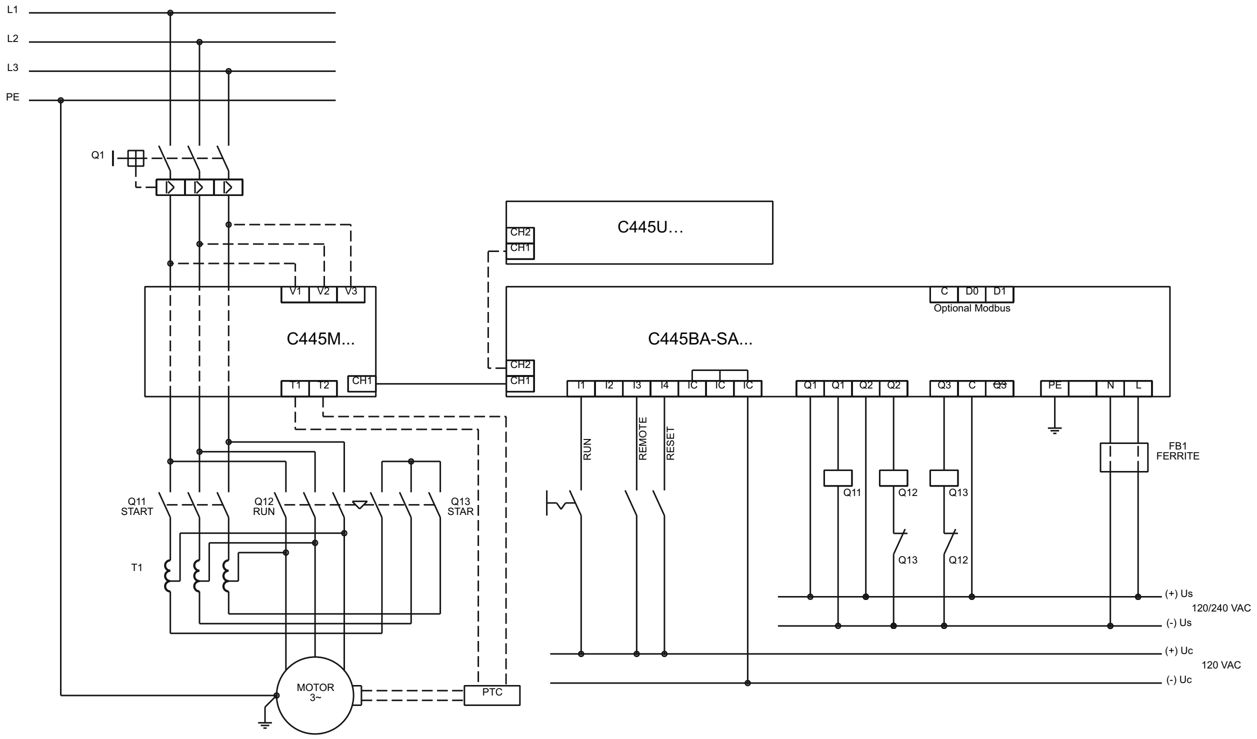


Figure 92. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs.
2. No outputs may be used as general purpose outputs for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If Fieldwire is the Remote control source and 2-wire control (default) is selected, Inputs 2 and 3 are unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.
6. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.

Solenoid Valve Operation Mode

The Solenoid Valve operation mode accepts energize/de-energize commands to open/close a solenoid controlled valve. The control can be adapted to both normally open & normally closed valves. An energize command will activate the Output 1. A de-energize command will de-activate Output 1. Limit switches can be used to provide feedback to the C445 indicating when the valve reaches open/closed positions.

Solenoid parameters:

- Solenoid Non-energized state
- Solenoid Open Delay
- Solenoid Close Delay

In this mode, inputs can used to provide feedback on when the valve reaches the open/closed positions. If this feedback is provided, C445 will issue a control fault if the commanded state does not match the feedback signal. The parameter "Feedback Signal Source" selects where the inputs are wired to the C445. Options include the Base Control Module, the Control User Interface or to a controller where they are sent to the C445 via a communication network. For all three locations these input feedback signals may be wired, the actual input or bit is pre-defined for each as follows.

- 0 – No Feedback Source
- 1 – Base Control Module: Input 2 (open), Input 3 (closed)
- 2 – Control User Interface (C445UC..): Input 2 (open), Input 3 (closed)
- 3 – Input Register 602 from a controller: Bit 1 (open) and Bit 2 (closed)

The C445 will issue a control fault when:

- Both closed and open feedback is detected

Normally closed valve

- An Energize command is active and no open feedback is detected
- A De-energize command is active and no closed feedback is detected

Normally open valve

- An Energize command is active and no closed feedback is detected
- A De-energize command is active and no open feedback is detected

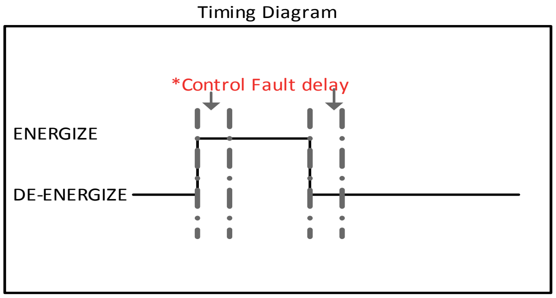
Output 1 will be de-activated when the C445 experiences a fault/inhibit condition.

Output 1 – solenoid coil (NO)

Output 2 – open for user configuration and their function can be selected by the user.

Output 3 – open for user configuration and their function can be selected by the user.

Figure 93. Timing Diagram for the Solenoid Valve Operation Mode



*Normal state = Closed
De-energize to energize transition(open delay active)
Energize to de-energize transition (close delay active)

*Normal state = Open
De-energize to energize transition(close delay active)
Energize to de-energize transition (open delay active)

Recommended User Interface Options for the Solenoid Valve Operation Mode

Figure 94. C445UM: Monitoring User Interface

The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start and Stop buttons are enabled in Solenoid Valve Mode. Users may optionally disable local start or reset functionality if desired.

C445UM may still be used in Solenoid Valve if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Solenoid Valve Operation Mode and the C445 sources of control.

Table 18. Solenoid Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Solenoid Open Time Delay	708	Time for the solenoid to reach it's open position, control fault is masked during this time. A setting of "0" disables control fault protection for opening.	
Solenoid Close Time Delay	709	Time for the solenoid to reach it's closed position, control fault masked during this time. A setting of "0" disables control fault protection for closing.	
Solenoid Non-energized State	710	Non energized state of the solenoid valve 0 – normally closed (default 1 – normally open	R/W
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired protection warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Feedback Signal Source Selector	713	Input source of the feedback signals 0 – No feedback source 1 – User interface inputs 2 – Base control inputs 3 – Fieldbus parameter	R/W
C445 Q2 Output function select ①	716	Output 2 user function selection	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W
FieldBus Input Feedback Register	602	Feedback input parameter to write the status of the feedback signals when limit switches are connected to the inputs	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The solenoid valve control profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0 0 = De-energize command, de-activate Output 1
1 = Energize command, activate Output 1

Bit 2 This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1= The C445 will issue a "Test Trip" fault causing t he Output 1 control relay to open.

Control Status Word

The control status word of the reverser motor starter profile can be accessed over the fieldbus network.

Status Bits

Bit 0 0 = De-energize (No active energize command)
1= Energize (Energize command is active)

Bit 2 0 = local control source active
1= remote control source is active

Bit 3 0 = no fault present
1= C445 fault present

Bit 4 0 = no warning present
1= C445 warning present

Bit 5 0 = no inhibit present
1= C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1= C445 ready for control (No fault or inhibit present)

Bit 7 0 = valve is in not desired end position
1= valve is in desired end position

The following conditions will set the InPos bit in the status word, signaling the valve has reached the desired end position.

Normally closed valve

- Energize command is active and open feedback detected
- De-energize command is active and Closed feedback detected

Normally open valve

- Energize command is active and closed feedback detected
- De-energize command is active and open feedback detected.

Wiring Diagrams for the Solenoid Valve Operation Mode

Figure 95. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

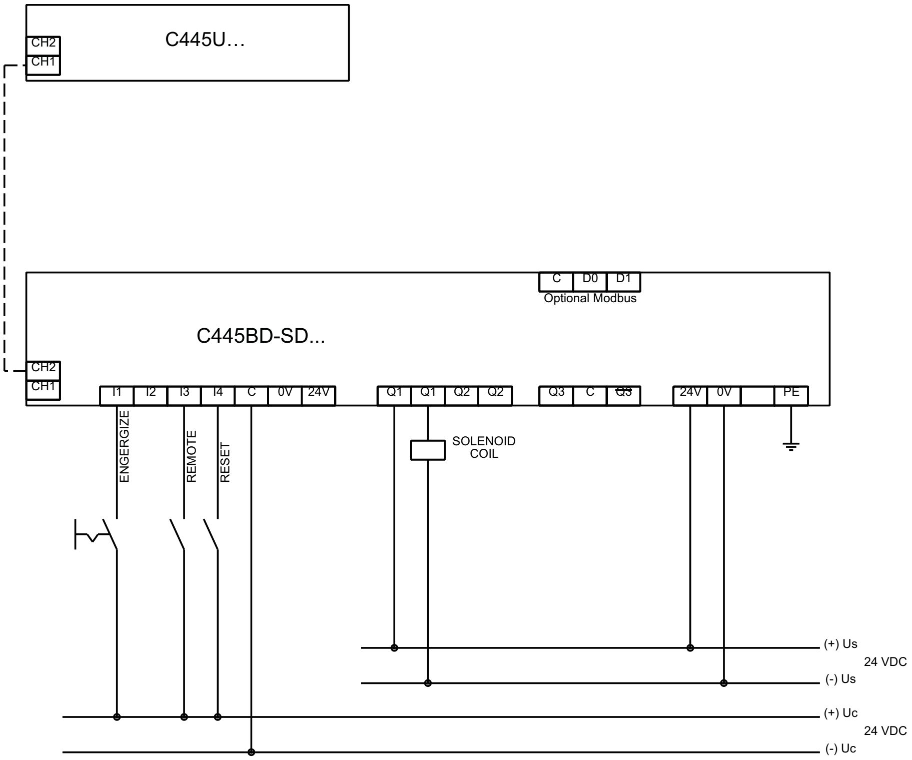


Figure 96. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

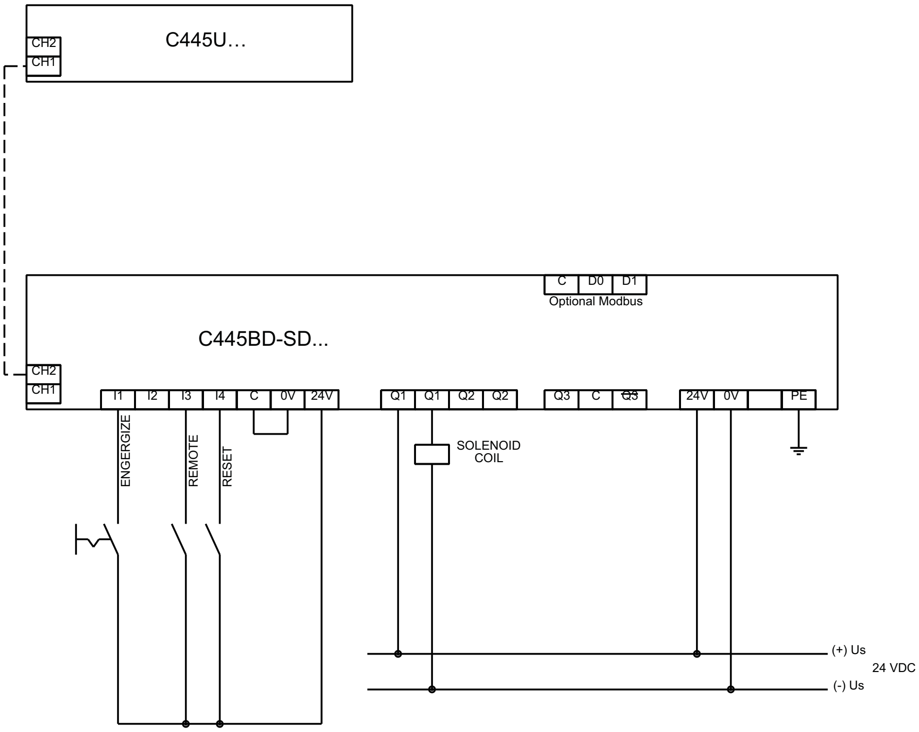
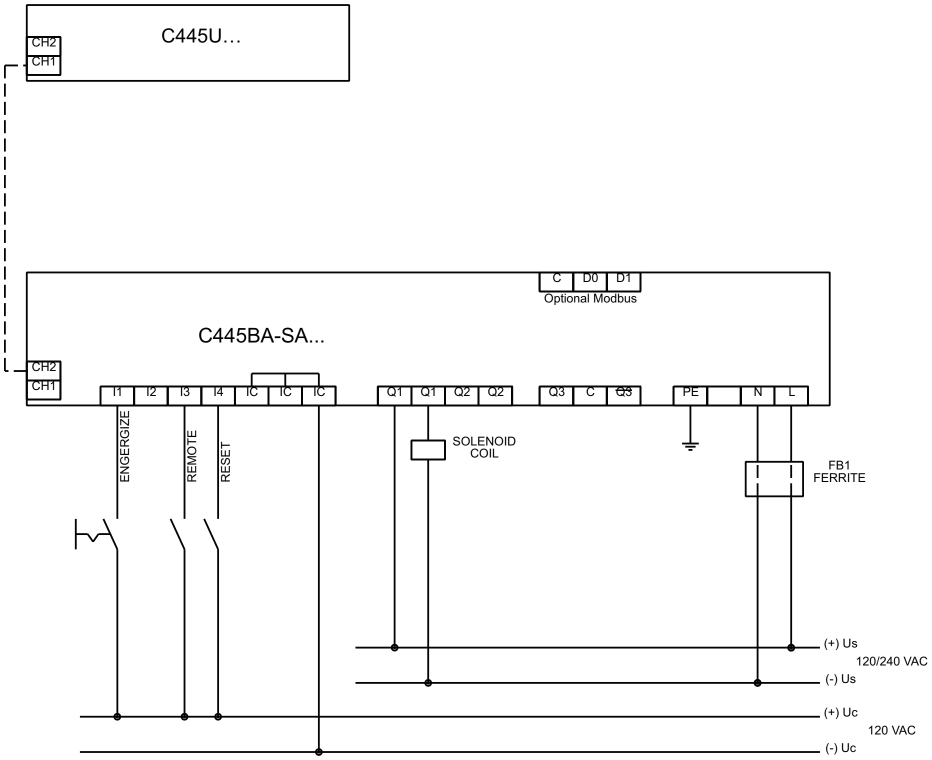


Figure 97. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. the inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs or can be selected as the feedback source for the solenoid limit switches.
2. Outputs 2 and 3 may be used as a general purpose outputs for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If fieldwire is the Remote control source and 2-wire control (default) is selected, Inputs 2 and 3 are unused by this operation mode. They can be used as general purpose or selected as the feedback source for the solenoid limit switches.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.
6. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.
7. C445UC... control user interfaces offer 4 additional 24 Vdc digital inputs for general purpose use. Inputs 2 and 3 can be selected as the feedback source for the solenoid limit switches.

MCCB Feeder Operation Mode

The MCCB feeder operation mode has two modes of operation with actuation and without actuation.

When MCCB actuation is enabled, it provides remote control capability for MCCB installed with motor operators. A close command will activate Output 1 for the programmed pulse width providing a close signal to the motor operator. An open command will activate Output 2 for the programmed pulse width providing an open signal to the motor operator.

MCCB parameters:

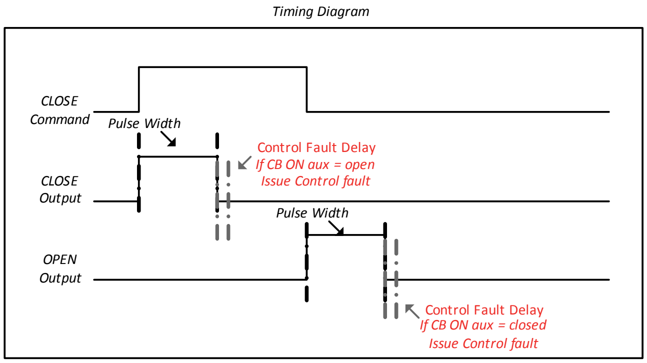
- MCCB Actuation Enable
- Actuation Pulse Width

CB On & CB Alarm auxiliary relays provide feedback, reporting MCCB feeder open, close, & trip status.

In this mode, inputs can used to provide feedback on CB On and Alarm status. If this feedback is provided, C445 will issue a control fault if the commanded state does not match the feedback signal. The parameter "Feedback Signal Source" selects where the inputs are wired to the C445. Options include the Base Control Module, the Control User Interface or to a controller where they are sent to the C445 via a communication network. For all three locations these input feedback signals may be wired, the actual input or bit is pre-defined for each as follows.

- 0 – No Feedback Source
- 1 – Base Control Module: Input 2 (CB On), Input 3 (CB Alarm)
- 2 – Control User Interface (C445UC..): Input 2 (CB On), Input 3 (CB Alarm)
- 3 – Input Register 602 from a controller: Bit 1 (CB On) and Bit 2 (CB Alarm)

Figure 98. Timing Diagram for MCCB Feeder Operation Mode



The C445 will issue a control fault when:

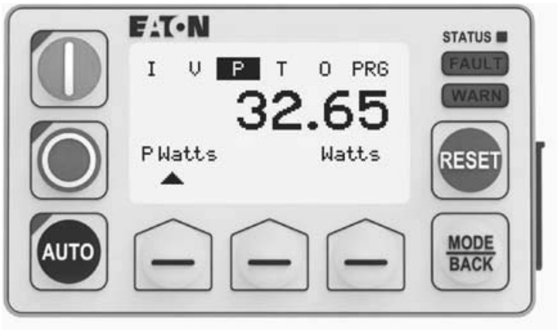
- An Open command is active and the CB On feedback input is true.
- The CB On & CB Alarm feedback inputs are both "high" at same time.
- Current is detected after an open command.
- A Close command is active and the CB On feedback input is false.

When the C445 experiences a fault/inhibit condition Output 2 will be activated for the programmed pulse width to open the breaker feeder.

- Output 1 – close control (NO)
- Output 2 – open control (NO)
- Output 3 – open for user configuration and their function can be selected by the user.

Recommended User Interface Options for the MCCB Feeder Operation Mode

Figure 99. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start (Close) and Stop buttons are enabled in MCCB Feeder Mode. Users may optionally disable local Start (Close) or reset functionality if desired.

C445UM may still be used in MCCB Feeder if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the MCCB Feeder Operation Mode and the C445 sources of control.

Table 19. MCCB Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. Setting of "0" disables protection.	R/W
MCCB Actuation Enable	705	Enable/disables the actuation control for the MCCB feeder control profile	R/W
Actuation Pulse Width	706	Minimum required motor operator control signal pulse width (in 1ms)	R/W
Motor#1 Overload FLA Scaled	900	Parameter can be used to set load limits	R/W
Motor Overload Trip FLA	500	Parameter holds the active load rating	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Feedback Signal Source Selector	713	Input source of the feedback signals 0 – No feedback source 1 – User interface inputs 2 – Base control inputs 3 – Fieldbus parameter	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W
FieldBus Input Feedback Register	602	Feedback input parameter to write the status of the feedback signals when MCCB aux switches are connected to the inputs	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The MCCB feeder control profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0/1 0 = Open command, activate Output 2 for pulse width
1 = Close command, activate Output 1 for pulse width

Bit 2 This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1 = The C445 will issue a "Test Trip" fault causing the Output 2 control relay to produce an output pulse to open the MCCB feeder.

Control Status Word

The control status word of the MCCB feeder control profile can be accessed over the fieldbus network.

Status Bits

Bit 0 0 = Open (open command is active
1= Close (close command is active)

Bit 1 0 = circuit breaker not in tripped position (CB alarm = false)
1= circuit breaker in tripped position (CB alarm = true)

Bit 2 0 = local control source active
1= remote control source is active

Bit 3 0 = no fault present
1= C445 fault present

Bit 4 0 = no warning present
1= C445 warning present

Bit 5 0 = no inhibit present
1= C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1= C445 ready for control (No fault or inhibit present)

Bit 7 0 = MCCB feeder is in open/tripped position (CB on = false)
1= MCCB feeder is in closed position (CB on = true)

Wiring Diagrams for the MCCB Feeder Operation Mode

Figure 100. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

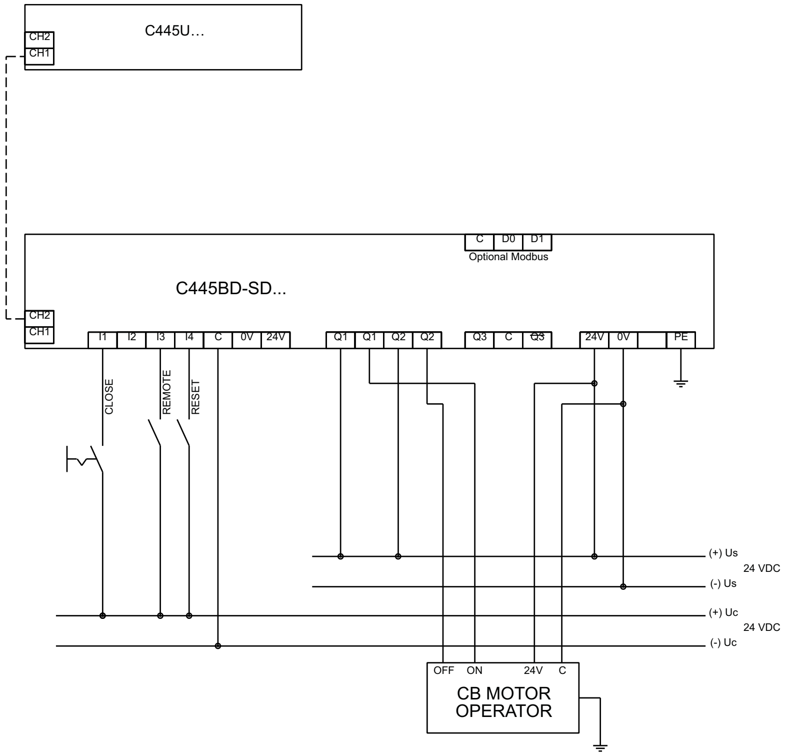


Figure 101. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

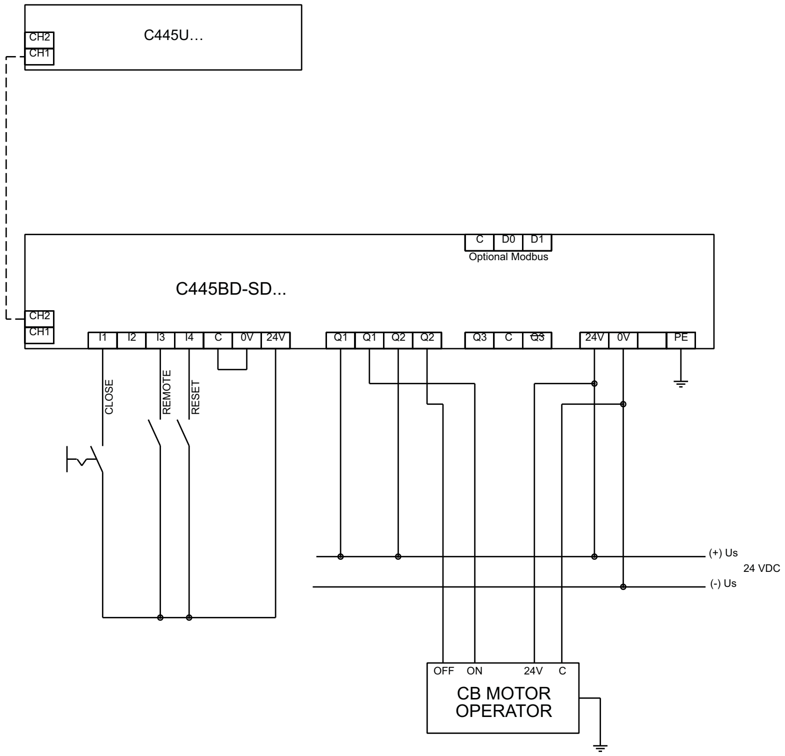
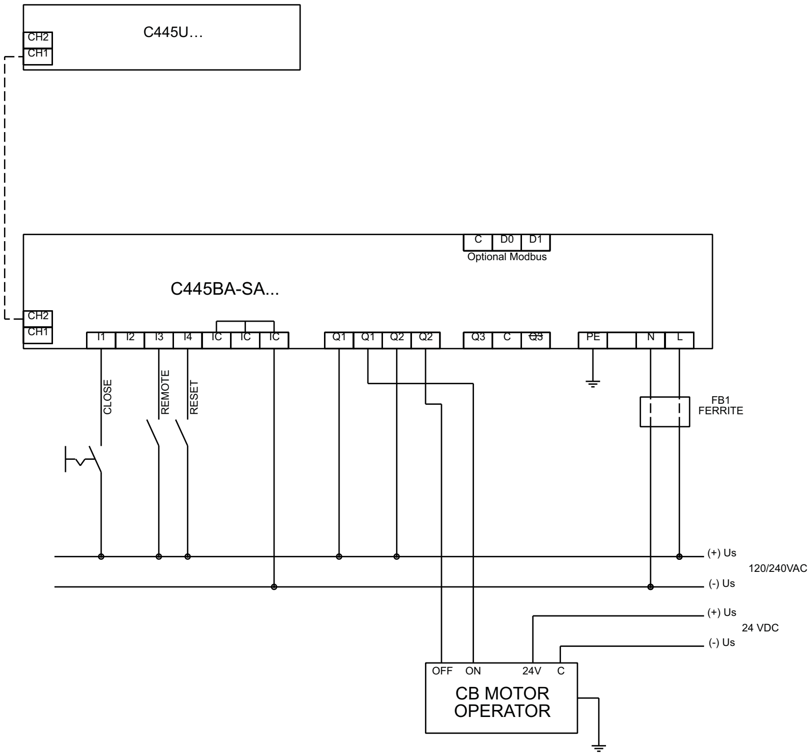


Figure 102. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs or can be selected as the feedback source for the CB aux contacts.
2. Output 3 may be used as general purpose output for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If fieldwire is the Remote control source and 2-wire control (default) is selected, Inputs 2 and 3 are unused by this operation mode. They can be used as general purpose or selected as the feedback source for the CB aux contacts.
5. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.
6. C445UC... control user interfaces offer 4 additional 24 Vdc digital inputs for general purpose use. Inputs 2 and 3 can optionally be used as the feedback source for the CB aux contacts.

Contactor Feeder Operation Mode

The Contactor Feeder operation mode accepts open/close commands to control the contactor in a feeder application.

A close command will activate Output 1. An open command will de-activate Output 1.

- In this mode, an input can be used to accept feedback on contactor on status from an Aux contact. If this feedback is provided, C445 will issue a control fault if the commanded state does not match the feedback signal. The parameter "Feedback Signal Source" selects where the inputs are wired to the C445. Options include the Base Control Module, the Control User Interface or to a controller where they are sent to the C445 via a communication network. For all three locations these input feedback signals may be wired, the actual input or bit is pre-defined for each as follows.
- 0 – No Feedback Source
- 1 – Base Control Module: Input 2 (Aux On)
- 2 – Control User Interface (C445UC..): Input 2 (Aux On)
- 3 – Input Register 602 from a controller: Bit 1 (Aux On)

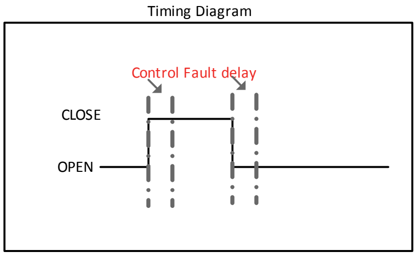
The C445 will issue a control fault when:

- An Open command active and the Aux On feedback input is true.
- Current is detected after an open command.
- A Close command is active and the Aux On feedback input is false.

When the C445 experiences a fault/inhibit condition Output 1 will be de-activated to open the feeder.

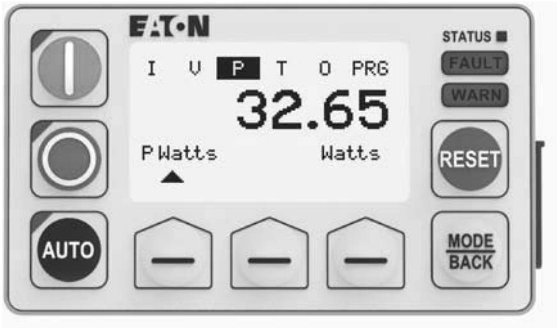
- Output 1 – feeder contactor coil (NO)
- Outputs 2 and 3 – open for user configuration and their function can be selected by the user.

Figure 103. Timing Diagram for the Contactor Feeder Operating Mode



Recommended User Interface Options for the Contactor Feeder Operating Mode

Figure 104. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. If selected as a local control source, the User Interface Start (Close) and Stop buttons are enabled in Contactor Feeder Mode. Users may optionally disable local start (close) or reset functionality if desired.

C445UM may still be used in Contactor Feeder if the User Interface is not the local control source. Start, Stop and Auto buttons will be disabled. If pressed, the screen will notify the user that this functionality is not enabled. Control Status LEDs indicating running, stopped and Auto status will still function.

Control Settings

The following parameters are used to configure the Contactor Feeder Application Mode and the C445 sources of control.

Table 20. Contactor Feeder Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Control Fault Delay	701	Delay time before a control fault is issued. Setting of "0" disables protection.	R/W
Motor#1 Overload FLA Scaled	900	This parameter can be used to set load limits	R/W
Motor Overload Trip FLA	500	This parameter contains the active load rating	R
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired protections warnings	R/W
C445 Local Source Selector ①	711	Select the Local Control source.	R/W
C445 Remote Source Selector	712	Select the Remote Control source.	R/W
C445 Feedback Signal Source Selector	713	Input source of the feedback signals 0 – No feedback source 1 – User interface inputs 2 – Base control inputs 3 – Fieldbus parameter	R/W
C445 Q2 Output function select ①	716	Output 2 user function selection	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W
FieldBus Input Feedback Register	602	Feedback input parameter to write the status of the feedback signals when aux switches are connected to the inputs.	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The contactor feeder control profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 0	0 = Open command, de-activate Output 1 1 = Close command, activate Output 1
Bit 2	This bit can be used to switch between Local and Remote from the network when the Allow Remote Control Switch parameter is enabled.
Bit 3	0 = No action 1= Reset fault (will clear fault provided condition has cleared)
Bit 5	0 = No action 1 = The C445 will issue a "Test Trip" fault de-activating the Output 1 control dropping out the contactor feeder.

Control Status Word

The control status word of the contactor feeder control profile can be accessed over the fieldbus network.

Status Bits

Bit 0	0 = Open (open command is active 1= Close (close command is active)
Bit 2	0 = local control source active 1= remote control source is active
Bit 3	0 = no fault present 1= C445 fault present
Bit 4	0 = no warning present 1= C445 warning present
Bit 5	0 = no inhibit present 1= C445 control inhibit present
Bit 6	0 = C445 not ready (fault and/or inhibit present) 1= C445 ready for control (No fault or inhibit present)
Bit 7	0 = feeder not in closed position (aux on = false) 1= feeder is in closed position (aux on = true)

Wiring Diagrams for the Contactor Feeder Operation Mode

Figure 105. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

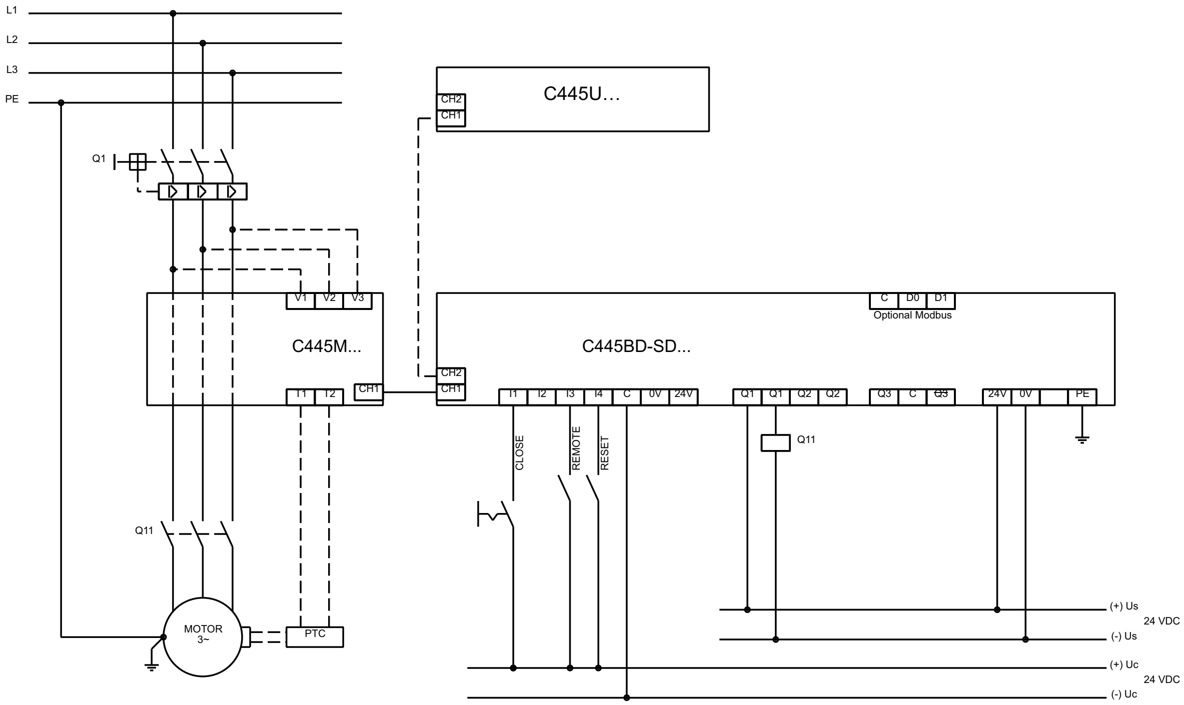


Figure 106. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

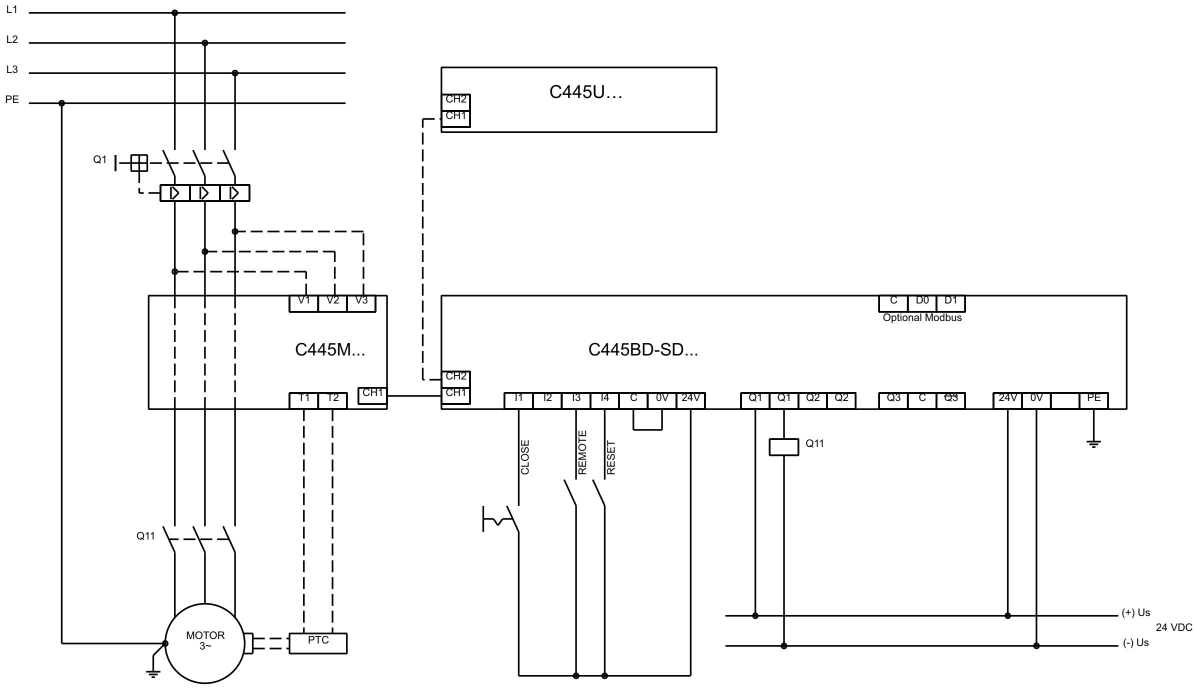
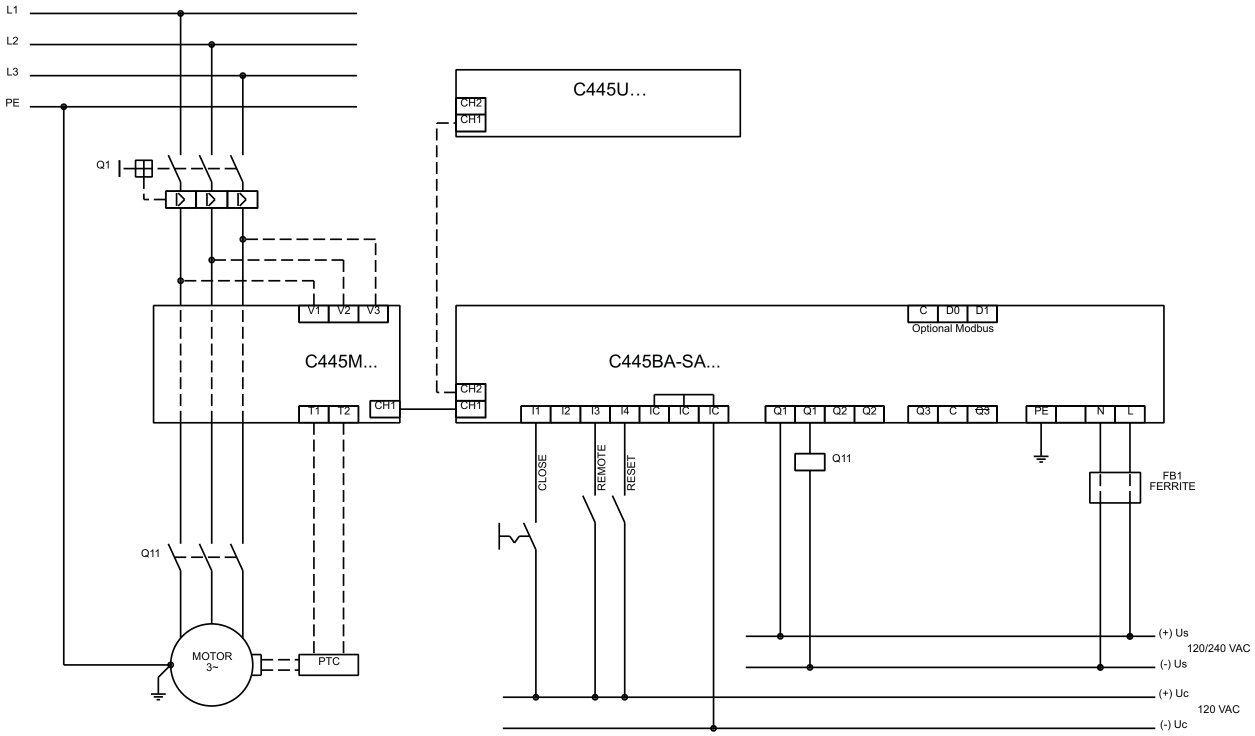


Figure 107. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



Notes:

1. The inputs on the Base Control Module are only used by this Operation Mode if Fieldwire is selected for one of the control sources. If Fieldwire is not the Local or Remote control source, all 4 inputs may be used as general purpose inputs or can be selected as the feedback source for the feeder's aux_on contact.
2. Outputs 2 and 3 may be used as general purpose outputs for this Operation Mode.
3. If Fieldwire is the Local control source, Input 3 is the Remote input. When power is applied to Input 3, the C445 will be in Remote mode.
4. If Fieldwire is the Remote control source and 2-wire control (default) is selected, Inputs 2 and 3 are unused by this operation mode. Either may be used as the feedback source for the feeder's aux_on contact.
5. Fusing: Although C445 product listings do not require fusing on the high impedance line voltage measurement inputs, it may be necessary to provide overcurrent protection of the supply leads in accordance with applicable final installation specific local, state and national electrical codes.
6. C445UC... control user interfaces offer 4 additional 24 Vdc digital inputs for general purpose use. An input can also be used as the feedback source for the feeder's aux_on contact.

General Purpose Input / Output Operation Mode

The C445 can operate as general purpose I/O providing the user 4 discrete inputs and 3 discrete outputs that can be controlled over a fieldbus network.

The inputs on the Base Control Module are not used by this Operation Mode. All 4 inputs may be used as general purpose inputs.

No User Interface overlays are supported by this operation mode.

Outputs 1, 2 and 3 – open for user configuration and their function can be selected by the user.

Control Settings

The following parameters are used to configure the General Purpose IO Operation Mode and the C445 sources of control.

Table 21. Configuration Parameter

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode	R/W
Trip Enable Bit Field	1000-1001	Trip (Fault) protection enable bits Set bits to enable desired protections	R/W
Warn Enable Bit Field	1002-1003	Warning protection enable bits Set bits to enable desired protection warnings	R/W
C445 Local Source Selector ①	711	Set to “1 no local control	R/W
C445 Remote Source Selector	712	Set to “1” Fieldbus is remote control	R/W
C445 Q1 Output function select ①	715	Output 1 user function selection	R/W
C445 Q2 Output function select ①	716	Output 2 user function selection	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W

Note

① Soft reset (power cycle) required for changes to these parameters to take effect.

Fieldbus Control Word

The General Purpose IO control profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 3	0 = No action 1= Reset fault (will clear fault provided condition has cleared)
Bit 5	0 = No action 1 = The C445 will issue a “Test Trip” fault (general purpose outputs are not affected by Test Trip)

Control Status Word

The control status word of the General Purpose IO profile can be accessed over the fieldbus network.

Status Bits

Bit 2	0 = local control source active 1= remote control source is active
Bit 3	0 = no fault present 1= C445 fault present
Bit 4	0 = no warning present 1= C445 warning present
Bit 5	0 = no inhibit present 1= C445 control inhibit present
Bit 6	0 = C445 not ready (fault and/or inhibit present) 1= C445 ready for control (No fault or inhibit present)

General Field Output Control Word

The general purpose output can be activated/de-activated over a fieldbus network.

Output Control Bits

Bit 0 0 = de-activate the Output 1
1= activate the Output 1

Bit 1 0 = de-activate the Output 2
1= activate the Output 2

Bit 2 0 = de-activate the Output 3
1= activate/set the Output 3

Bit 3 0 = No action
1= Output 3 latching relay reset

Note: The Outputs can be configured to be controlled by any of the bits of this control word. The above designations are showing the most common usage.

General Input Status Word

The general purpose inputs status over a fieldbus network.

Input Status Bits

Bit 0 0 = base unit input 1 off
1= base unit input 1 on

Bit 1 0 = base unit input 2 off
1= base unit input 2 on

Bit 2 0 = base unit input 3 off
1= base unit input 3 on

Bit 3 0 = base unit input 4 on
1= base unit input 4 off

Bit 4 0 = control user interface input 1 off
1= control user interface input 1 on

Bit 5 0 = control user interface input 2 off
1= control user interface input 2 on

Bit 6 0 = control user interface input 3 off
1= control user interface input 3 on

Bit 7 0 = control user interface input 4 off
1= control user interface input 4 on

Stand Alone Ground Fault Module

Description

The C445 system may be configured as a standalone system whereas only ground fault monitoring and indication is enabled. In such a configuration, a C445B… base module is coupled to an External Ground Fault Module connected to the appropriate sized CT to transmit monitoring information via a network. A C445M… measurement module and/or a C445UM user interface module may be added to provide local indication, control, and protection.

C445 outputs:

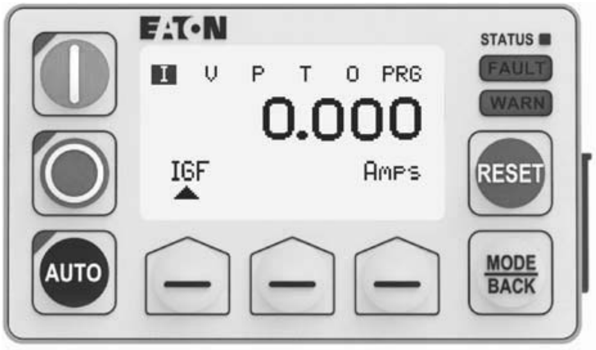
- Output 1 and 2 are general purpose outputs
- Output 3 is default as the ground current trip relay

When the C445 Motor Management relay is powered on for the first time with the External Ground Fault Module, output 3 will default as the ground trip relay.

If a different output relay is desired for this operation, outputs 1, 2 and 3 – open for user configuration and their function can be selected by the user.

Recommended User Interface Options for the Stand Alone Ground Fault Module Mode

Figure 108. C445UM: Monitoring User Interface



The Monitoring User Interface can be used with any operation mode. In Stand Alone Ground Fault Mode, the Start and Stop buttons will be disabled. If a user presses a Control button, the screen will notify them that the functionality is not enabled. The Reset button will still function but can be disabled if desired in User Interface Settings. Monitoring, Navigation, and Parameter settings are all available. Test Trip is also available in PRG R Service.

Table 22. Stand Alone Ground Fault Module Configuration Parameters

Configuration Parameter	Modbus Register	Description	Read/Write
Active Operation Mode ①	700	This parameter selects the Operation Mode.	R/W
Trip Enable Bit Field	1000–1001	Trip (Fault) protection enable bits Set bit #3 to enable protection.	R/W
Warn Enable Bit Field	1002–1003	Warning protection enable bits Set bit #3 to enable protection warning.	R/W
GF Trip Level Scaled	1060	Ground Fault Trip Level, if exceeded, will generate a trip of the motor following the Ground Fault Trip Delay time.	R/W
GF Alarm Level Scaled	1061	Ground Fault Alarm Level, if exceeded, will generate a warning following the Alarm Delay Time.	R/W
GF Protection Start Delay	1062	Delay when motor is first started to inhibit raising a ground fault trip condition until this time expires.	R/W
GF Trip Debounce	1063	Ground current must exceed threshold for debounce time before a trip occurs.	R/W
GF Protection Inhibit Current	1064	Ground Fault Protection Inhibit Current, if selected the GF Inhibit will be used.	R/W
GF Trip Delay	1093	Delay Trip, once trip is detected, the delay timer starts and when expired will fault the C445.	R/W
C445 Local Source Selector ①	711	Set to "1 no local control	R/W
C445 Remote Source Selector ①	712	Set to "1" Fieldbus is remote control	R/W
C445 Q1 Output function select ①	715	Output 1 user function selection	R/W
C445 Q2 Output function select ①	716	Output 2 user function selection	R/W
C445 Q3 Output function select ①	717	Output 3 user function selection	R/W

Note

① Requires soft reset.

Fieldbus Control Word

The Stand Alone Ground Fault Module profile will accept the following control commands over a fieldbus network.

Control Bits

Bit 3 0 = No action
1= Reset fault (will clear fault provided condition has cleared)

Bit 5 0 = No action
1 = The C445 will issue a "Test Trip" fault causing the ground current trip relay (Output 3 default) to close.

Control Status Word

The control status word of the Stand Alone Ground Fault Module profile can be accessed over the fieldbus network.

Status Bits

Bit 2 0 = Local control source active
1 = Remote control source active

Bit 3 0 = No fault present
1= C445 fault present

Bit 4 0 = No warning present
1= C445 warning present

Bit 5 0 = No inhibit present
1= C445 control inhibit present

Bit 6 0 = C445 not ready (fault and/or inhibit present)
1= C445 ready for control (No fault or inhibit present)

Chapter 6—Motor Protection

Introduction

The Power Xpert C445 is capable of providing fully configurable intelligent motor protection. Programming the numerous protection parameters can be accomplished through a variety of methods including the monitoring user interface, Power Xpert *in*Control Software tool, communication networks, or built-in Web Pages (Ethernet options only).

⚠ WARNING

The C445 may reset at any time enabling a motor start.

The Base Control Module monitors motor current, supply voltage, power, and frequency to provide advanced motor protection. The software contained in the Base Control Module is central to the monitoring of a wide range of motor and load functionality. In this section, various features and protection options are described.

The purpose of this section is to provide detailed information regarding the trip and alarm thresholds and time delays of the warning functions of the monitoring user interface, Power Xpert *in*Control Software tool, communication networks, or built-in Web Pages (Ethernet options only).

Configuration Parameter Locking

The configuration parameters can be locked for three sets of registry values.

- Motor-running Lock
- Administrator Lock
- USB Lock

Each lock will prevent the changing of select parameters unless a password is entered. A password may be created for each lock separately using any number from 1 to 4,294,976,295. Setting the password to 0 will result in the lock being disabled.

⚠ CAUTION

Record all passwords in a safe location. Once a password has been set it cannot be displayed. If a password is forgotten the only method of resetting the password(s) is a factory reset.

For a list of the parameters that will be included for each of the three locks, refer to **Appendix D** – Modbus Register Map.

Motor Running Lock

When the motor is commanded to run and/or there is motor current flowing, this feature will lock selected parameters. Any attempt to write values to those parameters will be ignored. An error exception code will be returned to the sender. Reading the values is allowed. When parameters are not locked, reads and writes follow normal behaviors.

Using the C445UM user interface or the Power Xpert *in*Control Software Tool, navigate to the following parameter:

- Param Lock – to set the password (default 0). Register 5009
- Param Lock – to login (enter password). Register 5010.

Note: The Motor Running Lock parameter Param Lock will display a value of 0 if a no password has been programmed into the unit (default). If the C445 has been programmed with a password, a value of 0 will be displayed if logged out, or a value of 4,294,976,295 will be displayed when logged in, in order to obscure the set password value.

Administrator Lock

This feature sets an administrative password to lock selected parameters. Any attempt to write values to locked parameters will be ignored. An error exception code will be returned to the sender. Reading the values is allowed. When parameters are not locked, reads and writes follow normal behaviors.

Using the C445UM user interface or the Power Xpert *in*Control Software Tool, navigate to the following parameter. Password settings are in the PRG → Security menu in C445UM.

Admin Password – to set the password (default 0). Register 5000

Admin Password – to login (enter password). Register 5002

Note: The Administrator Password parameter Admin Password will display a value of 0 if a no password has been programmed into the unit (default). If the C445 has been programmed with a password, a value of 0 will be displayed if logged out, or a value of 4,294,976,295 will be displayed when logged in, in order to obscure the set password value.

USB Lock

This feature sets a password on USB communication access. Other communications are not locked.

Any attempt to write values to locked parameters will be ignored. An error exception code will be returned to the sender. Reading the values is allowed. When parameters are not locked, reads and writes follow normal behaviors.

Using the C445UM user interface or the Power Xpert *in*Control Software Tool, navigate to the following parameter. Password settings are in the PRG → Security menu in C445UM.

USB Password – to set the password (default 0). Register 5004

USB Password – to login (enter password). Register 5006

Note: The USB Password parameter USB Password will display a value of 0 if a no password has been programmed into the unit (default). If the C445 has been programmed with a password, a value of 0 will be displayed if logged out, or a value of 4,294,976,295 will be displayed when logged in, in order to obscure the set password value.

Fault Trip, Fault No Trip and Fault Warning

A Fault Trip event occurs when any enabled protective parameter causes motor stoppage. A Fault Trip must be corrected or cleared, before the C445 can enable return to running operation.

A Fault No Trip event may be configurable for all protections or combination of protections. When "Fault No Trip" is configured for a protection, the C445 shall perform the same protection logic as a "Fault trip" except the C445 shall not stop the motor when the fault is issued.

A Fault Warning message will remain as long as the fault condition is active. When the condition clears the Fault Warning message is removed. A Fault Warning reset is not required. There are five protection Fault Warnings that will change to Fault Trip status if the RUN command is active during the time in which Fault Warning occurs.

- Backspin
- Undervoltage
- Overvoltage
- Voltage Imbalance
- Starts Per Hour

All other protections have Fault Trip parameters that may be enabled or disabled. Any parameter set to Fault and Fault No Trip will require a reset when the trip condition occurs. Fault Trip parameters may be configured to enable an automatic restart when the Fault Trip condition clears or is reset. Motor status will indicate a Fault trip or Fault Warning condition. Then the Active Fault and Active Inhibit registers will indicate the reason for the motor stop.

Fault Trip and Fault No Trip are both written to the fault queue and both appear in the Fault Snapshot. Warnings are not written to the queue or the snapshot.

Register 312: Active Fault will indicate faults that must be cleared. Both user interface families will indicate a fault or warning condition is present with the FAULT/WARN LEDs. The C445UM monitoring user interface will also immediately provide a complete fault description with access to the trip snapshot and fault queue.

Note: Register 312: Active Fault and Value 25: Communication Loss on Active Fieldbus, may be configured to stop the operation of the C445 but not cause a fault. In this case when communications resume, the C445 will not need to be reset.

This behavior can also be modified in the user interface by going to PRG → Operation Mode → Comm Loss Behavior and Comm Idle Behavior.

Motor Control Operation

The Base Control Module monitors the motor during periods of normal operation (see **Table 23**). Normal operation includes the Start cycle, Run cycle, and Stop cycle. A Fault Trip event prior to the RUN command will prevent a motor start. A Fault Trip event during the Start cycle will abort the Start attempt, and a Fault Trip event during RUN will cause a motor coast-to-stop. For example, the mains voltage may dip due to the starting load imposed by the motor Start cycle. If the dip causes a Fault Trip, the Start cycle will be aborted and the motor will coast-to-stop.

Note: The thermal overload and residual ground fault functions are active at all times.

Start Cycle and Transition Timing

Motor Start, Motor Stop, and Motor Transition parameters are used by the C445 to recognize modes of operation for protection functions. The Transition Threshold does not control any external devices, but only changes protection/operation parameters based on Start or Run profiles. The following figure shows an example of how the C445 recognizes the stages in a normal operating-cycle current profile. Initially, the motor is stopped and the current is zero. As long as the C445 is not in a Fault Trip condition, it will permit contactor energization by closing its trip contact in series with the contactor coil. The contactor can be energized by the operator or by a Modbus command. The C445 recognizes a motor Start when it measures motor current exceeding 30% of the FLA setting. A motor Stop is recognized when the current falls below 5% of FLA. During the Start cycle the C445 detects a transition point, when the large starting currents have fallen below a transition level. The parameters that control the transition profile are defined below.

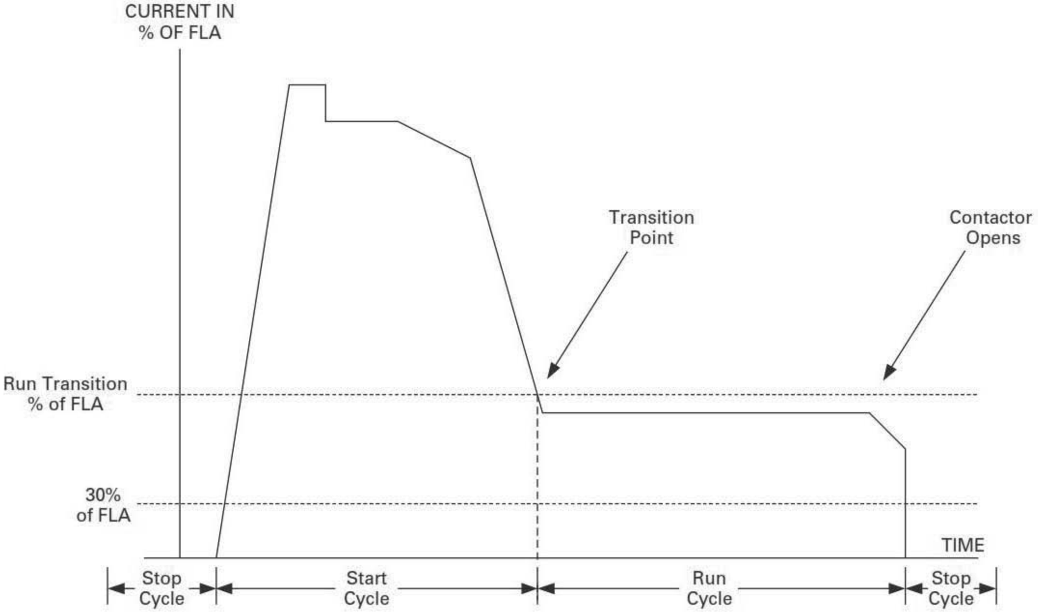
Note: The C445 transition from the Start cycle to the Run cycle is based on set time or current value, whichever occurs first.

Note: The start cycle time limit is also used as the stall inhibit time. See Stall protection for details.

Table 23. Parameters That Control the Transition Profile

Parameter	Units	Increment	Minimum	Maximum	Default	Notes
Motor Transition Threshold Percent	%	1%	25	200	115%	Modbus Register = 1086
Motor Start Threshold Percent	%	1%	1	100	30%	Modbus Register = 1084
Motor Stop Threshold Percent	%	1%	1	50	5%	Modbus Register = 1085
Start Cycle Time	s	1%	2	360	10%	Modbus Register = 1078

Figure 109. Start Cycle and Transition Timing



Motor Thermal Overload

The Overload function models the thermal characteristics of a motor and generates a Fault Trip event that de-energizes the motor before motor damage will occur. This is intended to protect the motor and power wiring from excessive current. Trip curves are defined by applicable agency standards. The trip class for any particular Overload class is user adjustable. When the FLA is entered for the motor, the thermal capacity value will be calculated to model the motor temperature during motor operation. Thermal capacity can be characterized by the calculated value representing the relative position with regard to the Trip Class curve. For example; a motor running at a thermal capacity value of 85% is much closer to an Overload Fault Trip than the same motor running at a thermal capacity value of 25%.

The following items are associated with the electronic Overload function of the C445.

- An Overload Fault Trip will occur when the calculated thermal capacity reaches 100%.
- An Overload Fault Trip cannot be cleared by power cycling the device – the thermal capacity calculated value is stored in non-volatile memory.
- Two thermal capacity models are used. One model is enabled while the coil is energized (motor is running) and a second model is enabled while the coil is de-energized (motor stopped). The second model has a longer time constant.
- A RESET button is located on the Base Control Module and the User Interface. Depressing this button will clear any Overload fault that has been latched, but is no longer present (thermal capacity must be less than 100%). Resets can also be initiated through the communication port.
- An auto-reset option is available. This provision enables the unit to automatically reset when the fault has cleared.

⚠ CAUTION

In the Auto Reset mode, caution must be exercised to assure that any restart occurs in a safe manner. Auto Reset mode should not be used in environments where excessive restart attempts may cause component damage and/or create unsafe conditions.

Figure 110. Overload Trip Curves—Cold Coil (–40 °C to +60 °C)

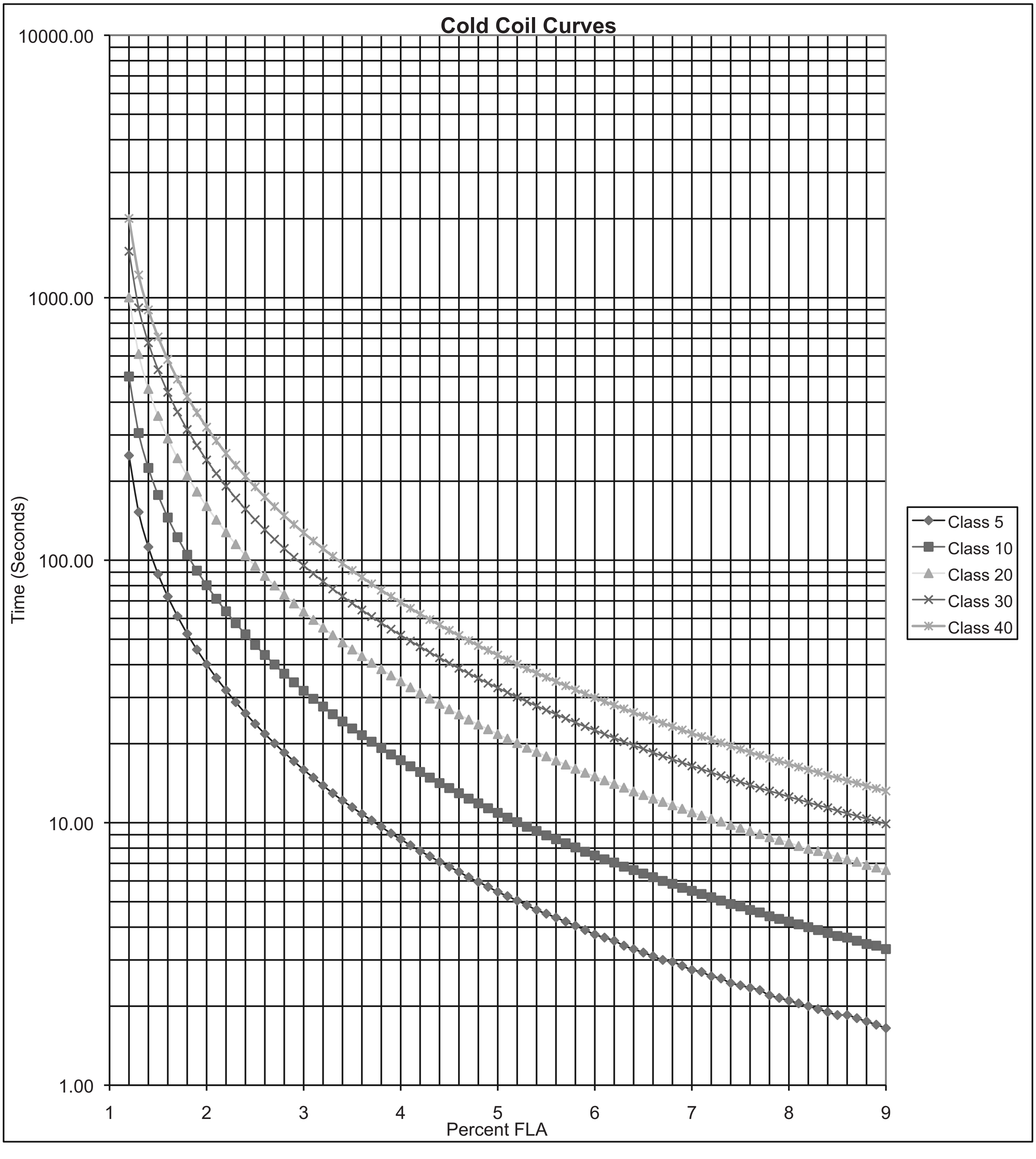
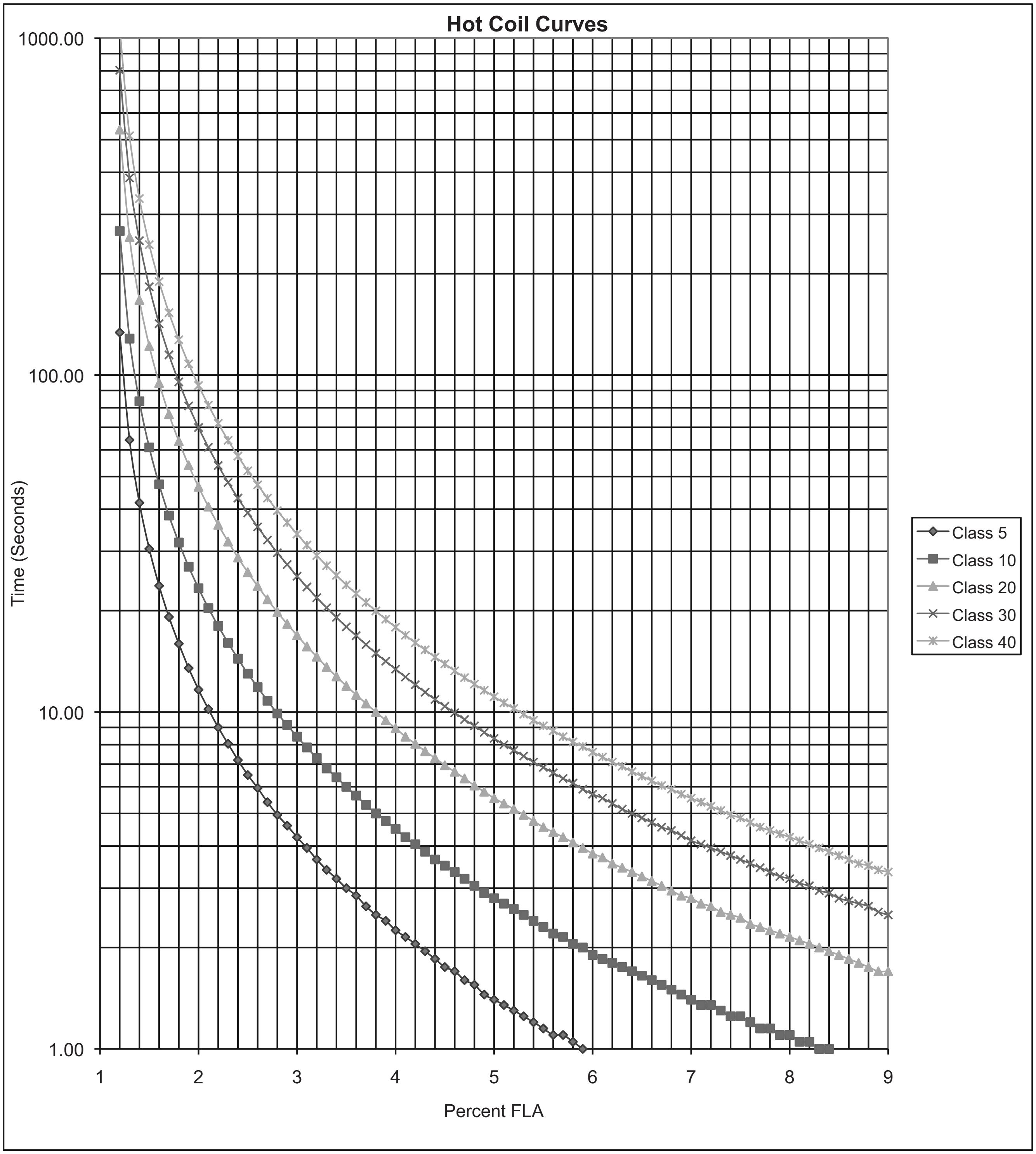


Figure 111. Overload Trip Curves—Hot Coil (–40 °C to +60 °C)



The thermal overload is designed to protect the motor from overheating caused by excessive current. If the motor is overloaded, the current level may rise above motor FLA and heats the motor.

The FLA sets the trip threshold and the trip class (5 to 40) is set with Overload Trip Class.

The trip class settings of the C445 motor management relay are suitable for both normal start-ups as well as for heavy duty starting. The Trip Class setting enables a particular tripping characteristic to be selected. These are the following:

⚠ CAUTION

The motor, the wiring diameter and the switching device(s) must be suitable for the selected Trip Class.

⚠ CAUTION

The current-dependent protective device must be selected so that not only is the motor current monitored but the blocked motor is switched OFF within the temperature rise time.

The thermal memory and the reset inhibit time are saved to the non-volatile memory. Cycling power on the device will NOT clear the thermal Fault Trip nor reset the thermal capacity stored in non-volatile memory. These values are reloaded when the device boots and the timer is restarted at the full reset time. This means if the 3 minute inhibit timer has been running for two minutes, cycling power will require the user to wait the full three minutes before a reset can clear the overload fault.

Note: The trip curves are based on a 115% Service Factor rating.

Application Configuration

Basic Parameters

Application dependent parameters need to be configured so that the monitoring and protection functions can be implemented.

The C445UM Monitoring User Interface and Power Xpert *in*Control software tool both walk users through an easy Setup Wizard for these parameters.

Table 24. Basic Parameters

Parameter	Units	Increment	Minimum	Maximum	Default	Notes
FLA Motor1	amps	1	1 ①	65535 ①	101 ①	ModBus Register = 900
FLA Motor2	amps	1	1 ②	65535 ②	101 ②	ModBus Register = 901
Trip Class		1	5	40	5	ModBus Register = 1004
Rated Voltage	volts	1	100	5000	480	ModBus Register = 903
HP Motor1	hp	1	1	500000	2000	ModBus Register = 909
HP Motor2	hp	1	1	500000	2000	ModBus Register = 911
Rated Frequency	Hz	1	50	60	60	ModBus Register = 904
Phase Order			ABC	ACB	ABC	
Watts Motor1	watts					
Watts Motor2	watts					

Notes

① These values may change depending on MM selection.

② These values may change depending on MM use.

Advanced Parameters

Application dependent parameters are required for some advanced applications. Users must set PT or CT Ratios if external CTs or PTs are used. Additionally, users who want to utilize motor torque and efficiency monitoring should set Motor Rated Speed and Motor Rated Stator Resistance for higher accuracy.

Table 25. Advanced Parameters

Parameter	Units	Increment	Minimum	Maximum	Default	Notes
CT Ratio – Primary	amps	1	1		1	Modbus Register = 918
CT Ratio – Secondary	amps	1	1		1	Modbus Register = 919
PT Ratio Primary	V	1	1		1	Modbus Register = 920
PT Ratio Secondary	V	1	1		1	Modbus Register = 921
Motor Rated Speed Motor1	RPM	1	300	3600	1750	Modbus Register = 914
Motor Rated Speed Motor2	RPM	1	300	3600	1750	Modbus Register = 915
Motor Rated Stator Resistance	ohms	1	1	0	280	Modbus Register = 917

Overview of Protection Features

In general, motor protection features will be controlled by a number of user settable parameters. The possible parameters are as follows.

- Fault Trip Enable—Any Fault Trip can be turned ON or OFF.
- Fault Trip Level—Level of a measurement element that will begin the timing of the delay (start or run).
- Fault Trip Delay—These delays prevent momentary disturbances in the system from causing nuisance trips by allowing the C445 to "ride though" temporary Fault Trip events.
- Fault Warning Enable—Any trip warning can be turned ON or OFF.
- Fault Warning Level—Level of a measurement element that will begin the timing of the delay (start or run).
- Fault Warning Delay—This delay parameter prevents momentary disturbances in the system from causing nuisance Fault Warning messages. One parameter is used for all Fault Warnings. Note that Fault Warnings will expire when the fault condition(s) is no longer active.
- Start Delay—An option on selected protection types that will inhibit a fault trip condition during the motor starting cycle.

The Fault Trip and Fault Warning protective functions are organized into 4 categories:

- Current Based
- Voltage Based
- Power Based
- Advanced Protection and Monitoring Algorithms
  - Voltage Loss Restart
  - Motor Torque
  - Motor Efficiency
  - Energy Deviation

Current Based Protection Parameters

Table 26. Current Based Protections

Fault Code	Protection	Action	Default Status	Fault Action		Motor FLA			Delay (Seconds)		
				Units	Note	Min.	Max.	Default	Min.	Max.	Default
19	Thermal Overload	Fault Trip	Enabled	Amps	C445MA2P4…	0.3	2.4	0.3	Class 5	Class 40	Class 5
					C445MA005…	1	5	1	Class 5	Class 40	Class 5
					C445MA032…	4	32	4	Class 5	Class 40	Class 5
					C445MA045…	5.6	45	5.6	Class 5	Class 40	Class 5
					C445MB072…	9	72	9	Class 5	Class 40	Class 5
					C445MC090…	11	90	11	Class 5	Class 40	Class 5
					C445MC136…	17	136	17	Class 5	Class 40	Class 5
					C445...ext	ext	800	ext	Class 5	Class 40	Class 5
		Fault Warning	Disabled	%		1	100	90	0	0	0
7	Instantaneous Overcurrent	Fault Trip	Disabled	% FLA		50	400	400	0.001	2	2
		Fault Warning	Disabled	% FLA		50	400	400	0.2	5	2
8	Jam	Fault Trip	Disabled	% FLA		50	400	400	1	60	10
		Fault Warning	Disabled	% FLA		50	400	400	0.2	5	2
20	Stall	Fault Trip	Disabled	% FLA		50	400	200	0	0	0
14	Undercurrent	Fault Trip	Disabled	% FLA		10	90	50	1	60	20
		Fault Warning	Disabled	% FLA		10	90	50	0.2	5	2
6	Current Unbalance	Fault Trip	Enabled	%		1	60	15	1	60	15
		Fault Warning	Disabled	%		1	60	15	0.2	5	2
10	Phase Loss	Fault Trip	Enabled	%		60	60	60	2	2	2
4	Ground Fault (earth) (Debounce time is in milliseconds)	Fault Trip	Enabled	Amps	C445MA2P4…	0.12	2.4	1	0	60,000	5,000
					C445MA005…	0.25	5	3	0	60,000	5,000
					C445MA032…	1 ①	9.6	3	0	60,000	5,000
					C445MA045…	1 ①	13.5	3	0	60,000	5,000
					C445MB072…	3 ①	21.6	3	0	60,000	5,000
					C445MC090…	3	27	3	0	60,000	5,000
					C445MC136…	34	40.8	34	0	60,000	5,000
					C445...ext	30% of CT Primary	50% of CT Primary	50% of CT Primary	0	60,000	5,000

Note

① ABC wiring recommended.

Voltage Based Protection Parameters

Table 27. Voltage Based Protections

Fault Code	Protection	Action	Default Status	Fault Action				Delay (Seconds)		
				Units	Min.	Max.	Default	Min.	Max.	Units
21	Phase Rotation	Fault Trip	Disabled		ABC	ACB	ABC	0	0	0
11	Phase Loss	Fault Trip	Disabled	%	70	70	70	2	2	2
2	Overvoltage	Fault Trip	Disabled	%	90	150	110	1	60	20
		Fault Warning	Disabled	%	90	150	110	0.2	5	2
1	Undervoltage	Fault Trip	Disabled	%	10	100	90	1	60	20
		Fault Warning	Disabled	%	10	100	90	0.2	5	2
	Voltage Loss Auto	Auto Restart	Disabled	Seconds	0.1	0.4	0.2	0	0	0
	Voltage Loss Short				0.2	5.0	0.4	0.1	500.0	1.0
	Voltage Loss Long				0	3600	4	1	3600	10
11	Voltage Unbalance	Fault Trip	Disabled	%	2	20	6	1	60	20
		Fault Warning	Disabled	%	2	20	6	0.2	5	2
13	Hz Deviation (Slow)	Fault Trip	Disabled	0.01 Hz	10	500	10	1	60	20
		Fault Warning	Disabled	0.01 Hz	10	500	10	0.2	5	2
12	Hz Deviation (Fast)	Fault Trip	Disabled	0.01 Hz	2	200	10	0.02	60	1
		Fault Warning	Disabled	0.01 Hz	2	200	10	0.2	5	2

Power Based Protection Parameters

Table 28. Power Based Protections

Fault Code	Protection	Action	Default Status	Fault Action				Delay (Seconds)		
				Units	Min.	Max.	Default	Min.	Max.	Units
16	Low Power	Fault Trip	Disabled	%	0	200	50	1	60	20
		Fault Warning	Disabled	%	0	200	50	1	60	2
15	High Power	Fault Trip	Disabled	%	–200	200	110	1	60	20
		Fault Warning	Disabled	%	–200	200	110	1	60	2
9	Power Factor Deviation (High)	Fault Trip	Disabled	0.01%	–10000	10000	10000	1	60	20
		Fault Warning	Disabled	0.01%	–10000	10000	10000	1	60	2
9	Power Factor Deviation (Low)	Fault Trip	Disabled	0.01%	–10000	10000	0	1	60	20
		Fault Warning	Disabled	0.01%	–10000	10000	0	1	60	2

Advanced Protection

Voltage Loss Restart

Voltage Loss Restart allows users to select how the C445 unit responds to a mains voltage dip or interruption. The feature is designed to safely reclose any contactor(s) that have opened during the voltage loss event. To use Voltage Loss Restart, traditional undervoltage protection must be disabled by the user.

Voltage Loss Restart provides three behaviors based on the duration of the event. The Auto-time interval uses no delay. C445 will hold its output shut throughout the auto-time interval so that the contactor will close as soon as enough current is available (assuming it has dropped out due to the dip). No time delay is used in Auto Time because the voltage dip is considered short enough to avoid out of sync restarting of the motor. The short- and long-time intervals both have settable restart delays. These delays should be used to prevent out-of-phase restarting. Both interval periods and delays can be set individually to each motor, additionally allowing staggering of restarts within the facility. If a second mains failure, with duration of less than the Auto-time interval, occurs within 1s after the first mains failure, a delayed restart shall be executed, respecting the delayed restart timeout and resetting to the beginning of the start sequence.

Two conditions must be present for C445 to execute or hold a command to close the contactor based on the Voltage Loss Restart Logic.

1. C445 must remain powered. If C445 is powered off 120 Vac CPTs from the same mains voltage source as the motor, control power to the device will also drop during the event. C445's ability to remain powered in this condition depends on the duration and severity of the Voltage Event. C445 will remain powered for Control Power dips not exceeding 50% of nominal (120 Vac) for at least 400 milliseconds. For C445 to remain powered beyond these conditions, a separate power source and or/UPS device must be used.
2. There must be a run signal present. Voltage Loss Restart is designed to safely re-start motors. C445 will not re-start a motor if no run signal is present. For this reason, Voltage Loss Restart should not be used with fieldwire control that relies on the contactor coil as a holding circuit because the run signal would drop out with the contactor. If you are using Voltage Loss Restart with Fieldwire control in C445, use the following fieldwire control options:
    a 2-Wire Control: A Hand/Off/Auto (HOA) switch with a maintained Run (Hand) signal.
    b 3-Wire Control: Any use of 3-Wire control will work with Voltage Loss Restart as long as the unit remains powered. 3-Wire control uses a dedicated start input and a separate Permissive (stop) Input. The start input can be momentary or maintained, eliminating the need for a holding circuit when a momentary input is used.

Traditional Undervoltage and Voltage Loss Restart Parameters ①

Table 29. Undervoltage

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
1	Undervoltage	Fault Trip	1028	%	10	100	90	1	60	20	1031
		Fault Warning	1029	%	10	100	90	0.2	5	2	1079
		Start Trip Delay		Delay Fault Trip at Startup				0	60	20	1030

Note

① Turn off traditional undervoltage protection if planning to use Voltage Loss.

Table 30. Voltage Loss Restart

Fault Code	Protection	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
	Voltage Loss Auto	1034	Seconds	0.1	0.4	0.2	0	0	0	
	Voltage Loss Short	1037	Seconds	0.2	5.0	0.4	0.1	500.0	1.0	1035
	Voltage Loss Long	1040	Seconds	0	3600	4	1	3600	10	1039
	Voltage Loss Level	1032	%	65	90	70	0	0	0	
	Voltage Return Level	1033	%	80	100	90	0	0	0	

Voltage Loss Auto

A command to automatically pull a contactor back in to restart a motor in the event of an undervoltage condition.

No time delay is used in Voltage Loss Restart Auto Time mode as the voltage dip is considered to be short enough to avoid out of sync restart of the motor.

Operation

Main Voltage dips below Voltage Loss Level setting.

- Voltage Loss Level is user-definable but can be set as low as 65% (default 70%)
- Contactor may drop out from voltage dip (assuming no 3rd party device is used to hold it in).

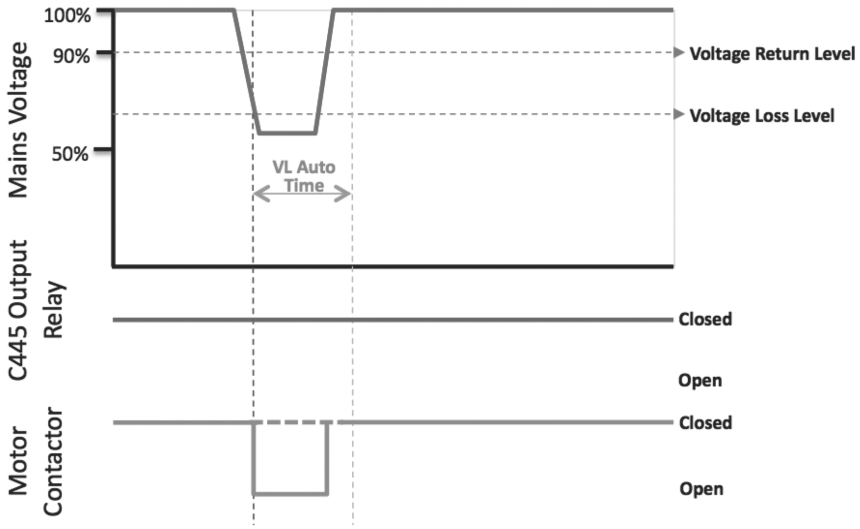
Example #1

Mains voltage returns above Voltage Return Level setting in <200 ms (default) ~ 12 Cycles.

Contactor re-closes and motor restarts automatically with no time delay. This is accomplished by holding the start-circuit aux relay closed during the Auto Time voltage loss duration.

Note: In the event of very short voltage drops, the contactor may or may not open. This is dependent on contactor specifications and power to the coil.

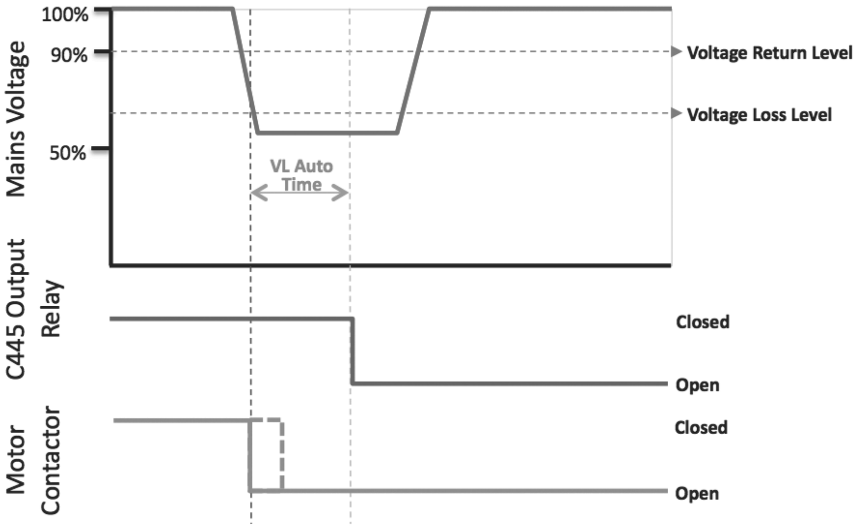
Figure 112. Example #1: Auto-Time—Mains Voltage Returns Before Auto Time Expires



Example #2

Mains voltage does not return above Voltage Return Level setting in <200 ms (default) ~ 12 Cycles. In this case the contactor does not re-close.

Figure 113. Example #2: Auto-Time—Mains Voltage Does Not Return Before Auto Time Expires



Voltage Loss Short

The Voltage Loss Short setting is a command to automatically reclose a contactor to restart a motor in the event of an undervoltage condition that has exceeded the VL Auto Time duration, if enabled. A user configurable time delay is available to prevent out of sync starting of motors. Time delays for multiple motors monitored by multiple C445 units can be staggered to avoid brownouts from all motors restarting together based on a common undervoltage condition.

Operation

Mains voltage dips below the Voltage Loss Level setting for longer than Auto time. The contactor remains open, and C445's relay output opens when Auto time expires. If voltage returns to the Voltage Return Level within the Short Time setting, C445 will close its relay output to restart the motor after a specified delay.

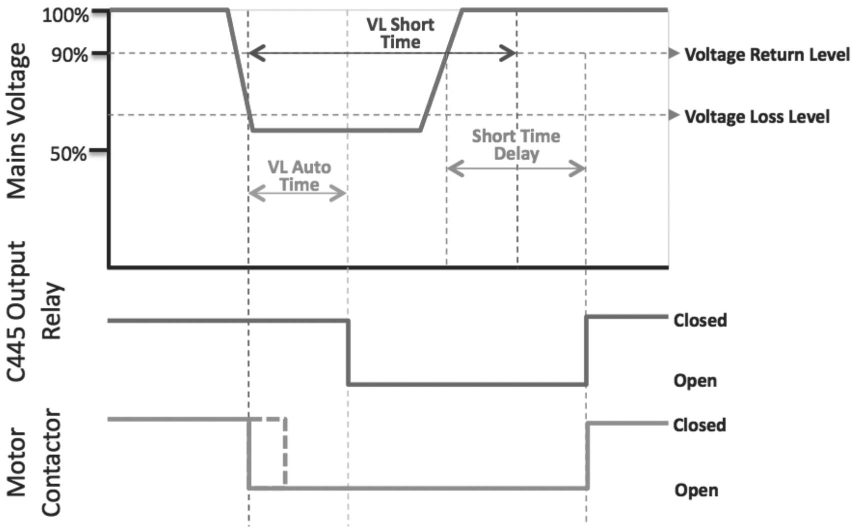
Note: C445 must maintain control power to execute short time behavior. If the relay powers down, the C445 will not execute restart logic. See beginning of section for more information.

Example #3

Main voltage returns above Voltage Return Level setting in <VL Short Time. Short Delay Time begins counting. Once the time delay has expired, the contactor is pulled back in and motor is restarted.

Note: A run signal must be present for restart to occur. If there is a run permissive in the circuit, it must also remain active.

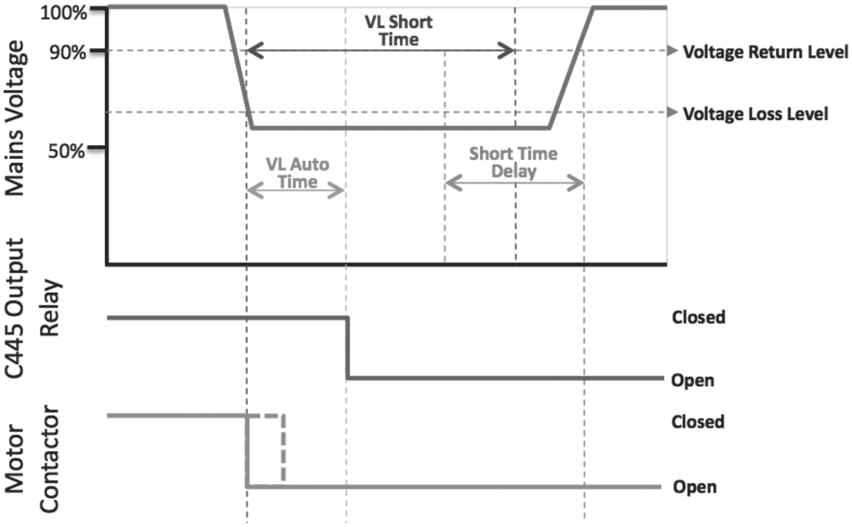
Figure 114. Example #3: Short-Time—Mains Voltage Returns Before Short Time Expires



Example #4

Main voltage does not return above Voltage Return Level setting in <VL Short Time. Contactor does not re-close.

Figure 115. Example #4: Short-Time—Mains Voltage Does Not Return Before Short Time Expires



Voltage Loss Long

The Voltage Loss Long setting is a command to automatically pull a contactor back in to restart a motor in the event of an undervoltage condition that has exceeded the Short Time duration. A user configurable time delay is available to prevent out of sync starting of motors. In addition to having the ability to vary Short Time delays for multiple motors, a second timer can be utilized after Long Time to further avoid brownouts from motors restarting together based on a common undervoltage condition. Any voltage loss longer than Long Time will require the user to manually go through the restart sequence.

Operation

Main voltage remains below Voltage Loss Level setting for longer than Voltage Loss Short Time. The contactor and C445 relay output remain open. C445 will close its relay output to pull in the contactor if Voltage Return level is seen within the Long Time interval.

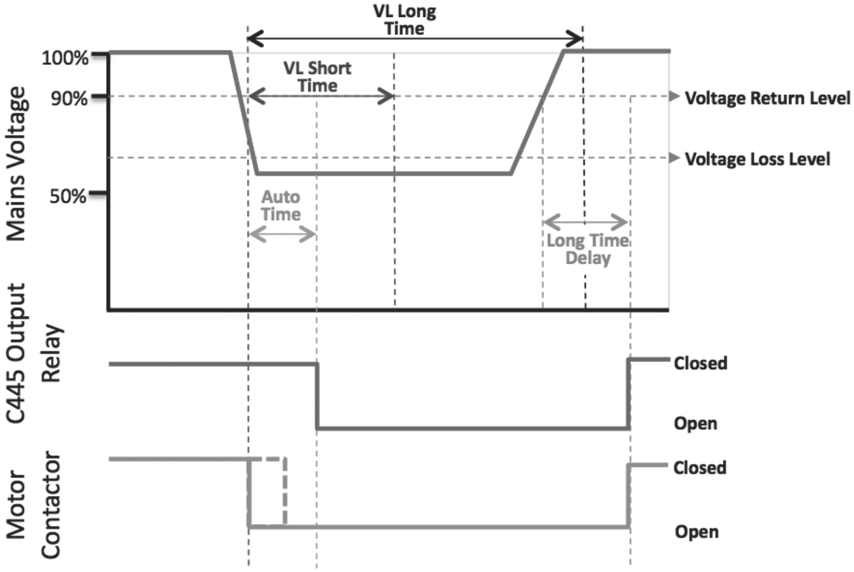
Note: C445 must maintain control power to execute short time behavior. If the relay powers down, the C445 will not execute restart logic. See beginning of section for more information.

Example #5

Main voltage returns above Voltage Return Level setting in <VL Long Time. Long Delay Time begins counting. Once time delay has expired, contactor is pulled back in and motor is restarted.

Note: A run signal must be present for restart to occur. If there is a run permissive in the circuit, it must also remain active.

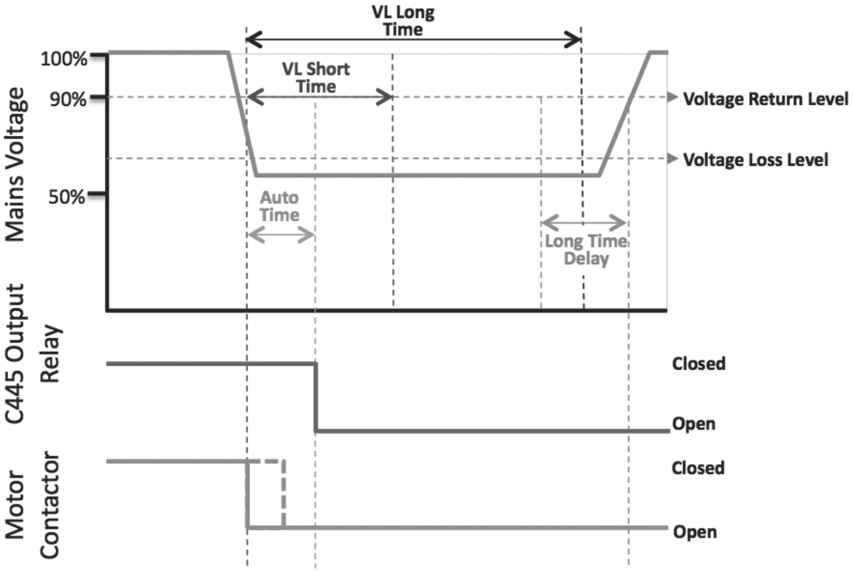
Figure 116. Example #5: Long-Time—Mains Voltage Returns Before Long Time Expires



Example #6

Mains voltage does not return above Voltage Return Level setting in <VL Long Time. Contactor does not re-close and voltage loss restart has ended. User must manually go through restart sequence once voltage returns.

Figure 117. Example #6: Long-Time—Mains Voltage Does Not Return Before Long Time Expires



Protection and Monitoring

The C445 Base Control Module monitors several parameters for motor protection. There are several ways to monitor parameters.

- The Monitoring User Interface
- Power Xpert *in*Control
- Over the communication network of choice
- Web pages

Trip Protection will stop the motor if select parameter values exceed set limits. There are data log records created and stored in non-volatile memory. These snapshots can be analyzed to determine the cause of failure. After a trip has occurred, a reset feature may be configured to attempt to reset the motor.

Advanced Protection Parameters

This table contains parameters that are applicable to all protections but are related to more advanced behavior.

Table 31. Protections

Parameter	Units	Min.	Max.	Default	Modbus Register	Notes
Auto Reset Delay	Sec	0	3600	180	1075	Time delay after a Fault Trip event occurs an auto-reset will be attempted
Backspin Inhibit Time	Sec	0	3600	0	1077	Anti-backspin inhibit time before a reset is allowed
Reset On Power Up		Enable	Disable	Disable	1076	Enabled; perform a fault reset on power up Disabled; no action
Auto Reset Enable		Disable	Enable	Disable	1072	Disabled; no auto reset functionality Enabled; auto reset functionality is based on trip auto-reset bit selections
Auto Reset Types					1073	Select Fault Trip Parameters to Auto Reset
Trip Enable		Checked	Unchecked	Unchecked	1000	User input bit field that is used to enable or disable a protection function trip
Warning Enable		Checked	Unchecked	Unchecked	1002	Only protections enabled by checking the associated box will provide a warning when that condition occurs
Positive Temperature Coefficient (PTC) (option)					376	0 = No Fault
						1 = Overtemp
						2 = Shorted
						3 = Open
						Fault Trip Code 22

Motor Protection

The motor protections functions that are listed in this section monitor motor current (average, minimum, or maximum phase currents) to detect various motor running faults.

These protections functions may be disabled during a start. These protections are also disabled if the maximum phase current is less that 50% of the Motor FLA set-point.

Note: For protections functions to operate appropriately, the motor FLA must be configured for the application.

Users can easily customize protection settings in the protection menu of the Monitoring User Interface or of Power Xpert *in*Control.

To enable/disable individual trip and warning protections, navigate to Protections → General → Trip Enable / Warning Enable.

To customize protection levels and delays for each protection feature, navigate to the category of that protection in Protections → Current / Voltage / Power / Frequency / Ground Fault.

Fault Warnings

Fault Warnings in many cases react to the same parameter values as Fault trips. Fault Warning events display the fault information but do not trip the controlled device. Similar to Fault Trips, Fault Warnings are subject to delay times noted in Modbus register 1079. This register sets the delay times for all Fault Warnings in all fault warnings protections.

Table 32. Fault Warnings

			Fault Action			
Protection	**Action**	**Modbus**	**Units**	**Min.**	**Max.**	**Default**
Fault Warning	Alarm Delay	1079	ms	20	5000	2000

Motor Thermal Overload

The Overload function models the thermal characteristics of a motor and generates a Fault Trip event that de-energizes the motor before motor damage will occur. This is intended to protect the motor and power wiring from excessive current. Trip curves are defined by applicable agency standards. The trip class for any particular Overload class is user adjustable.

Table 33. Overload

Fault Code	Protection	Action	Default Status	Fault Action Units	Note	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default
19	Thermal Overload	Fault Trip	Enabled	amps	C445MA2P2…	0.3	2.4	0.3	Class 5	Class 40	Class 5
					C445MA005…	1	5	1	Class 5	Class 40	Class 5
					C445MA032…	4	32	4	Class 5	Class 40	Class 5
					C445MA045…	6	45	6	Class 5	Class 40	Class 5
					C445MB072…	9	72	9	Class 5	Class 40	Class 5
					C445MC090…	11	90	11	Class 5	Class 40	Class 5
					C445MC136…	17	136	17	Class 5	Class 40	Class 5
					C445…ext	ext	800	ext	Class 5	Class 40	Class 5
		Fault Warning	Disabled	%		1	100	90			
	Overload Reset Threshold			%	C445…	1	99	75			

Instantaneous Overcurrent

The Instantaneous Overcurrent protection monitors the maximum phase current of the motor and will trip the motor if the current exceeds the set threshold. The Instantaneous Current protection is active when the motor is energized but does have a separate Start delay to account for high starting currents that are characteristic of high efficiency induction motors.

Table 34. Instantaneous Overcurrent

Fault Code	Protection	Action	Modbus	Fault Action Settings Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
7	Instantaneous Overcurrent	Fault Trip	1012	% FLA	50	400	400	1	2000	2000	1015
		Fault Warning	1013	% FLA	50	400	400	200	5000	2000	1079
		Fault Trip Delay		At powerup				0	18000	0	1014

Jam

The C445 will monitor the average RMS value of the three phase currents. If the RMS value rises above the threshold for the required length of time a Fault is detected and the unit will trip. The Jam settings will only be active during the Motor Running state.

Table 35. Jam

Fault Code	Protection	Action	Modbus	Fault Action				Delay (Seconds)			
				Units	Min.	Max.	Default	Min.	Max.	Default	Modbus
8	Jam	Fault Trip	1008	% FLA	50	400	400	1	60	5	1010
		Fault Warning	1009	% FLA	50	400	400	0.2	5	2	1079

Stall

The Stall protection monitors the average phase current as a percentage of FLA of the motor and will trip the motor if the current exceeds the set threshold. The Stall protection is only active as the motor transitions from the Starting to Running states.

Table 36. Stall ①

Fault Code	Protection	Action	Modbus	Fault Action				Delay (Seconds)			
				Units	Min.	Max.	Default	Min.	Max.	Default	Modbus
20	Stall	Fault Trip	1007	% FLA	50	400	200	0	0	0	

Note

① Only active during transition from start cycle to run cycle.

Current Unbalance

Current unbalance is defined using the following equation:

$$\% \text{ Current Unbalance} = 100 \times \left[\frac{\text{max(Phase Irms) - min(Phase Irms)}}{\text{avg(Phase Irms)}} \right]$$

The C445 will monitor the Current Unbalance. If the value exceeds the threshold for the required length of time a fault is detected and the unit will trip. The Current Unbalance protection is enabled only in the Motor Running state.

Modifying the TRIP ENABLE/DISABLE register will enable or disable the Current Unbalance protection feature.

Table 37. Current Unbalance

Fault Code	Protection	Action	Modbus	Fault Action				Delay (Seconds)			
				Units	Min.	Max.	Default	Min.	Max.	Default	Modbus
6	Current Unbalance	Fault Trip	1018	%	1	60	15	1	60	15	1020
		Fault Warning	1019	%	1	60	15	0.2	5	2	1079

Current Phase Loss

The Current Phase Loss protection monitors the current unbalance of the motor and will trip the motor if the unbalance exceeds the set threshold. The Current Phase Loss protection is active when the motor is in the Running state.

If a C445 relay is commissioned to monitor an AC motor, the current must be fed on all three poles to prevent early tripping.

Measurement Precondition Imax>50% of FLA, Imin<25% of FLA, No V Phase Loss (or no voltage option)

Measurement Parameter Current unbalance percent

Table 38. Current Phase Loss

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
5	Current Phase Loss	Fault Trip	1016	%	60	60	60	2	2	2	1017

Undercurrent

Undercurrent Trip Level protection monitors the three phase currents and will fault if the measured current drops below the set threshold.

Table 39. Undercurrent

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
14	Undercurrent	Fault Trip	1021	% FLA	10	90	50	1	60	20	1023
		Fault Warning	1022	% FLA	10	90	50	0.2	5	2	1079

Ground Fault

The Residual Ground Fault protection monitors the ground current of the motor and will trip the motor if the ground current exceeds the set threshold. The Ground Fault protection is always active.

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Table 40. Ground Fault

Fault				Fault Action					Delay (Seconds)			
Code	**Protection**	**Action**	**Modbus**	**Units**	**Frame**	**Min.**	**Max.**	**Default**	**Min.**	**Max.**	**Default**	**Modbus**
4	Ground Fault (earth)	Fault Trip	1060	amps	C445MA2P4…	0.12	2.4	1	1	60	5	1063
					C445MA005…	0.25	5	3	1	60	5	1063
					C445MA032…	1 ①	9.6	3	1	60	5	1063
					C445MA045…	1 ①	13.5	3	1	60	5	1063
					C445MB072…	3 ①	21.6	3	1	60	5	1063
					C445MC090…	3	27	3	1	60	5	1063
					C445MC136…	34	40.8	34	1	60	5	1063
					C445M…EXT	30% of CT Primary	50% of CT Primary	50% of CT Primary	1	60	5	1063
		Fault Warning	1061								2	1079
		Fault Trip Delay				At powerup			0	5	0	1062
		Use Fault Trip Inhibit	1064			Disable	Enable	Disable				
		Fault Trip Inhibit - Run	1065	%		25	100	50	0	0	0	

Note

① ABC wiring recommended.

Note: Refer to Chapter 10 for information concerning the External Ground Fault module and the Pulse Detect Ground Fault feature.

Supply Protection

The C445 monitors the supply voltage to the motor for the faults described below. These protections are only available if the C445 Measurement Module has the voltage option.

Users can easily customize protection settings in the protection menu of the Monitoring User Interface or of Power Xpert *in*Control.

To enable/disable individual trip and warning protections, navigate to Protections → General → Trip Enable / Warning Enable.

To customize protection levels and delays for each protection feature, navigate to the category of that protection in Protections → Current / Voltage / Power / Frequency / Ground Fault

When the Supply fault is enabled in Trip mode, the C445 will trip if a Voltage fault is detected when the motor is running. In this mode, a Start will be inhibited if the fault condition is present. Starts will be allowed as soon as the fault condition is cleared.

Users may also optionally inhibit starting based on presence of a voltage fault. To inhibit starting based on voltage faults, enable “Inhibit Start on Voltage Fault” in the Protections → General menu.

Undervoltage

The Undervoltage protection monitors the minimum phase voltage of the motor and will trigger a fault if the voltage drops below the set threshold. The Undervoltage protection is active when the motor is in the Running state. When the Low Voltage Start Inhibit Enable is set, the Undervoltage will prevent a start into an under voltage condition as determined by the Undervoltage Start Inhibit Level.

Table 41. Undervoltage

				Fault Action				Delay (Seconds)			
Fault Code	**Protection**	**Action**	**Modbus**	**Units**	**Min.**	**Max.**	**Default**	**Min.**	**Max.**	**Default**	**Modbus**
1	Undervoltage	Fault Trip	1028	%	10	100	90	1	60	20	1031
		Fault Warning	1029	%	10	100	90	0.2	5	2	1079
		Start Trip Delay		Delay Fault Trip at Startup				0	60	20	1030

Overvoltage

The Overvoltage protection monitors the maximum phase voltage of the motor and will trip the motor if the voltage exceeds the set threshold. The Overvoltage protection is active when the motor is in the Running state.

Table 42. Overvoltage

				Fault Action				Delay (Seconds)			
Fault Code	**Protection**	**Action**	**Modbus**	**Units**	**Min.**	**Max.**	**Default**	**Min.**	**Max.**	**Default**	**Modbus**
2	Overvoltage	Fault Trip	1025	%	90	150	110	1	60	20	1027
		Fault Warning	1026	%	90	150	110	0.2	5	2	1079

Voltage Unbalance

Voltage Unbalance is estimated using the following equation.

$$\%\text{PhaseUnbalance} = 100 \times \left[\frac{\text{max(Phase Vrms) - min(Phase Vrms)}}{\text{avg(Phase Vrms)}} \right]$$

The Voltage Unbalance protection monitors the voltage unbalance percentage of the supply and will trip the motor if the voltage exceeds the set threshold. The Voltage Unbalance protection is active when the motor is in the energized state. When the Voltage unbalance Start Inhibit protection is enabled, the Undervoltage protection will prevent a start into an unbalanced condition as determined by the Unbalance Start Inhibit Level.

Table 43. Voltage Unbalance

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
11	Voltage Unbalance	Fault Trip	1043	%	1	20	6	1	60	20	1045
		Fault Warning	1044	%	1	20	6	0.2	5	2	1079

Voltage Phase Loss

The Voltage Phase Loss protection monitors the phase voltage of the motor and will trip the motor if the voltage falls below 70% of the nominal mains voltage.

Table 44. Voltage Phase Loss

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
11	Voltage Phase Loss	Fault Trip	1041	%	70	70	70	2	2	2	1042

Phase Rotation

The Phase Sequence protection monitors the sequence of the supply. A fault will be generated if the supply sequence does not match the configured setting. The phase sequence protection is always active.

Table 45. Voltage Phase Rotation

Fault Code	Protection	Action	Modbus	Fault Action Units	Value	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
21	Phase Rotation	Fault Trip	1024		0	Off	1	0	0	0	
					1	ABC	1	0	0	0	
					2	ACB	1	0	0	0	

Power Factor Deviation

The Power Factor (PF) Deviation protection monitors the PF (supply side) of the load and will trip the motor if the measured deviation from rated exceeds the set threshold.

The power factor deviation protection is active when the motor is in the running state.

Measurement Precondition Vavg > 40 volts RMS & Iavg RMS > 50% of FLA.

Table 46. PF Deviation

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
9	Power Factor Deviation Low	Fault Trip	1056	%	–10000	10000	0	1	60	20	1059
		Fault Warning	1058	%	–10000	10000	0	1	60	2	1079
9	Power Factor Deviation High	Fault Trip	1055	%	–10000	10000	10000	1	60	20	1059
		Fault Warning	1057	%	–10000	10000	10000	1	60	2	1079

Frequency Deviation (Slow)

The Frequency Deviation (Slow) protection monitors the line frequency of the supply and will trip the motor if the deviation from rated exceeds the set threshold. The Frequency Deviation protection is active when the motor is in the Energized state.

Protections → Frequency → Frequency Deviation Slow

Table 47. Hz Dev – Slow

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
13	Hz Deviation (Slow)	Fault Trip	1069	0.01 Hz	10	500	10	1	60	20	1071
		Fault Warning	1070	0.01 Hz	10	500	10	1	60	2	1079

Frequency Deviation (Fast)

The Frequency Deviation (Fast) protection monitors the line frequency of the supply and will trip the motor if the deviation from rated exceeds the set threshold. The Frequency Deviation protection is active when the motor is in the Energized state.

Protections → Frequency → Frequency Deviation Fast

Table 48. Hz Dev – Fast

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
12	Hz Deviation (Fast)	Fault Trip	1066	0.01 Hz	2	200	10	20	2000	1000	1068
		Fault Warning	1067	0.01 Hz	2	200	10	20	2000	2000	1079

Load Protection

Power-based protections provide superior protection for load-based conditions such as a dead-headed or starved pump.

Users can easily customize protection settings in the protection menu of the Monitoring User Interface or of Power Xpert *in*Control.

To enable/disable individual trip and warning protections, navigate to Protections → General → Trip Enable / Warning Enable.

To customize protection levels and delays for each protection feature, navigate to the category of that protection in Protections → Current / Voltage / Power / Frequency / Ground Fault

Undercurrent

The Undercurrent protection monitors the average current of the motor and will trip the motor if the unbalance drops below the set threshold. The Undercurrent protection is active when the motor is in the Running state.

Table 49. Undercurrent

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
14	Undercurrent	Fault Trip	1021	% FLA	10	90	50	1	60	20	1023
		Fault Warning	1022	% FLA	10	90	50	1	60	2	1079

Low Power

The Low Power protection monitors the kW consumed (supply side) by the load and will trip the motor if the measured value is lower than the set threshold. The Low Power protection is active when the motor is in the Running state. The rated power is calculated from the rated HP input by the user.

Table 50. Low Power

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
16	Low Power	Fault Trip	1049	%	0	200	50	1	60	20	1051
		Fault Warning	1050	%	0	200	50	1	60	2	1079

High Power

The High Power protection monitors the kW consumed (supply side) by the load and will trip the motor if the measured value exceeds the set threshold. The High Power protection is active when the motor is in the Running state. The rated power is calculated from the rated HP input by the user.

Table 51. High Power

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
15	High Power	Fault Trip	1046	%	–200	200	110	1	60	20	1048
		Fault Warning	1047	%	–200	200	110	1	60	2	1079

Peak Demand Alarming

A utility company's bill is based on consumption (kWHr) and more typically on peak demand in the last month. In the US demand is typically calculated as the average kW in a 15 minute window. The peak demand is simply the maximum value of the calculated demand. Industrial users may have rather sophisticated load shedding and demand response processes running at the feeder level or higher.

The C445 will provide a simplified demand warning system that will provide the current demand estimate, a resettable peak demand (with date and time stamp) stored in nonvolatile memory, and a demand warning threshold. The time window for demand calculation will be adjustable to provide for more flexibility.

Table 52. Peak Demand

Fault Code	Protection	Parameter	Modbus	Fault Action Units	Min.	Max.	Default
	Peak Demand	Demand Window Duration	1054	Minutes	1	240	15
		Peak Demand Warning Threshold	1052	Watts			0
		Peak Demand		Watts			
		Present Demand		Watts			
		Demand Timestamp		Unix			

Chapter 7—Monitoring and Diagnostics

Methods for Monitoring

C445 makes it simple to access advanced diagnostics. On any network, or even with no networking at all—we make it easy to connect to your system.

The easiest way to access local monitoring is with the Monitoring User Interface (C445UM). The LCD screen provides large font monitoring of all parameters broken into simple menus of current, voltage, power, thermal and other system parameters. There is no setup or network required.

Another easy option is the free Power Xpert *in*Control software tool. Common operating parameters are in the Control/Monitor tab while other parameters related to current, voltage, power and system data are viewable in the Measurement tab. Connect to *in*Control using the Micro-USB port on the user interface or Base Control module, or over ModbusTCP.

Users with the Ethernet option can also monitor data live over webpages: Simply enter the IP address of the device in your browser window.

Another way to monitor operating parameters from a C445 is via a fieldbus network from the system controller. If a fieldbus network such as EtherNet/IP, Modbus serial, Modbus TCP or PROFIBUS are being used for control, the master controller on these networks can monitor operating parameters constantly with other input and output polled/cyclic data or via specific one-time acyclic/explicit messages only when an event occurs.

The C445 supports both implicit polled messages as well as explicit messages of all operating parameters on EtherNet/IP.

The C445 supports acyclic DPV1 messages on PROFIBUS as well as cyclic messages used for control and monitoring on a constant basis. All operating parameters are supported for both types of messages.

For Modbus serial and Modbus TCP, all parameters including all operating parameters are available to monitor. **Appendix E** contains a complete list of all parameters and their associated Modbus register address.

An operator interface or HMI device can also be used to monitor operating parameters from a C445 via any of the above supported fieldbus networks.

Monitoring Parameters

A list and description of the available operating parameters for monitoring is shown below.

Table 53. Current Based Monitoring

Parameter Name	Range/Units	Description
I Phase A (L1)	Depends on frame size (amps)	Phase A (L1) motor current. 2% accuracy within 30–125% of FLA.
I Phase B (L2)	Depends on frame size (amps)	Phase B (L2) motor current. 2% accuracy within 30–125% of FLA.
I Phase C (L3)	Depends on frame size (amps)	Phase C (L3) motor current. 2% accuracy within 30–125% of FLA.
Average Current	Depends on frame size (amps)	Average motor current. 2% accuracy within 30–125% of FLA.
Current Unbalance	0–100%	Motor current unbalance percent
I Average % of FLA	0–720% of FLA (amps)	Average motor current as a percentage of FLA
Max Starting Current	Depends on frame size (amps)	Maximum motor starting current
GF Current RMS	Depends on frame size (amps), scaled via fieldbus	Motor ground fault current RMS. Accuracy meets UL-1053 / IEC Class II-B
I Phase A (L1) Scaled	Depends on frame size (amps, scaled)	Phase A (L1) motor current scaled. Scaled by parameter "I Scale Factor."
I Phase B (L2) Scaled	Depends on frame size (amps, scaled)	Phase B (L2) motor current scaled. Scaled by parameter "I Scale Factor."
I Phase C (L3) Scaled	Depends on frame size (amps, scaled)	Phase C (L3) motor current scaled. Scaled by parameter "I Scale Factor."
Average Current Scaled	Depends on frame size (amps, scaled)	Average motor current scaled. Scaled by parameter "I Scale Factor."
I Scale Factor		Motor current scale factor

Table 54. Voltage Based Monitoring

Parameter Name	Range/Units	Description
L1-L2	0–690 V; max 4,160 V with PT ratios	Supply line-to-line voltage AB (L1-L2). 2% accuracy up to 690 Vac
L2-L3	0–690 V; max 4,160 V with PT ratios	Supply line-to-line voltage BC (L2-L3). 2% accuracy up to 690 Vac
L3-L1	0–690 V; max 4,160 V with PT ratios	Supply line-to-line voltage CA (L3-L1). 2% accuracy up to 690 Vac
Average Voltage	0–690 V; max 4,160 V with PT ratios	Supply line-to-line voltage average. 2% accuracy up to 690 Vac
Frequency	47–63 Hz (centi-Hz)	Supply frequency in centi-Hz
Phase Order	0: unknown; 1: ABC (L1-L2-L3); 2: ACB (L1-L3-L2)	Reports phase sequence of the line voltage
Voltage Unbalance	0–100%	Supply voltage unbalance percentage
L1-L2 Scaled	V, scaled	Supply line-to-line voltage AB (L1-L2) scaled
L2-L3 Scaled	V, scaled	Supply line-to-line voltage BC (L2-L3) scaled
L3-L1 Scaled	V, scaled	Supply line-to-line voltage CA (L3-L1) scaled
Average Voltage Scaled	V, scaled	Supply line-to-line voltage average scaled
Voltage Scale Factor		Voltage scale factor applied to scaled voltage measurements

Table 55. Power-Based Monitoring

Parameter Name	Range/Units	Description
Watts Total	Depends on frame size (watts)	Total real power. 5% accuracy.
VA Total	Depends on frame size (Volt-Amps)	Total apparent power. 5% accuracy.
VARS Total	Depends on frame size (Vars)	Total reactive power. 5% accuracy.
Power factor	0–100%, Scaled by 0.01% via fieldbus	Apparent power factor in percentage. 1% accuracy.
Speed RPM	Depends on motor (0.1 RPM)	Motor speed in RPM
Torque	Depends on motor (0.01 Nm)	Motor torque
Efficiency percent	PC tool in %, scaled by 0.01% via fieldbus	Motor efficiency in percentage
Real energy	Depends on frame size (0.1 kWh)	Real energy scaled. 5% accuracy.
Real energy (resettable)	Depends on frame size (0.1 kWh)	Real energy (resettable) scaled. 5% accuracy.
Apparent energy	Depends on frame size (0.1 kVAh)	Apparent energy scaled. 5% accuracy.
Apparent energy (resettable)	Depends on frame size (0.1 kVAh)	Apparent energy (resettable) scaled. 5% accuracy.
Reactive energy	Depends on frame size (0.1 kVARh)	Reactive energy scaled. 5% accuracy.
Reactive energy (resettable)	Depends on frame size (0.1 kVARh)	Reactive energy (resettable) scaled. 5% accuracy.
Current demand value	Depends on frame size (watts)	Latest estimate of the demand. 5% accuracy.
Demand (resettable)	Depends on frame size (watts)	Peak demand, user resettable. 5% accuracy
Peak demand time stamp	Time in seconds	Peak demand time stamp (in Unix time)
Demand window duration	Time in minutes	Demand window duration

Table 56. System Monitoring

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

Table 57. Faults and Events

Parameter Name	Range/Units	Description
Active fault	See **Table 58** below	Active fault
Active warning	See **Table 58** below	Active warning
Active inhibit	See **Table 58** below	Active inhibit
Fault queue—event order	See **Table 58** below	A list of the last 10 faults shown in the order they occurred. Most recent at top.

Table 58. Trip Snapshot Parameters

Parameter Name	Range/Units	Description
Snap shot phase A (L1) current	Depends on frame size (Amps)	Phase A (L1) RMS current at time of trip
Snap shot phase B (L2) current	Depends on frame size (Amps)	Phase B (L2) RMS current at time of trip
Snap shot phase C (L3) current	Depends on frame size (Amps)	Phase C (L3) RMS current at time of trip
Snap shot ground current	Depends on frame size (Amps)	Ground fault current RMS at time of trip
Snap shot frequency	47–63 Hz (centi-Hz)	Line frequency at time of trip scaled in centi-Hz
Snap shot thermal capacity	0–250%	Overload thermal capacity percent at time of trip
Snap shot voltage AB (L1-L2)	0–690 V; max 4,160 V with PT ratios	Voltage AB (L1-L2) RMS volts at time of trip
Snap shot voltage BC (L2-L3)	0–690 V; max 4,160 V with PT ratios	Voltage BC (L2-L3) RMS volts at time of trip
Snap shot voltage CA (L3-L1)	0–690 V; max 4,160 V with PT ratios	Voltage CA (L3-L1) RMS volts at time of trip
Snap shot VA	Depends on frame size (volt-amps)	Apparent power at time of trip
Snap shot watts	Depends on frame size (Watts)	Real power at time of trip
Snap shot power factor	0–100%, scaled by 0.01% via fieldbus	Power factor at time of trip

Table 59. PTC Status Bits

Value	Description
0	PTC OK—no fault
1	PTC over temperature fault
2	PTC shorted fault
3	PTC open fault

Table 60. Motor Control Status Bits

Value	Description	Coil
0	Running 1	4785
1	Running 2	4786
2	Remote enabled	4787
3	Faulted	4788
4	Warning	4789
5	Inhibited	4790
6	Ready	4791
7	Motor at speed	4792

Table 61. Active Fault, Warning and Inhibit Values

Value	Description
Active Fault	
0	No Faults
1	Under voltage
2	Over voltage
3	Reserved
4	Ground Current
5	Current phase loss
6	Current unbalance
7	Instantaneous over current
8	Jam
9	PF Deviation
10	Voltage phase loss
11	Voltage unbalance
12	Frequency deviation fast
13	Frequency deviation slow
14	Under current
15	High power
16	Low power
17	Contactor failure
18	Starts limit exceeded
19	Overload
20	Stall
21	Phase rotation mismatch
22	PTC - See PTC State for details
23	Under voltage restart
24	Measurement Module fault
25	Communication loss on active fieldbus
26	Measurement Module not available or communication loss with the module
27	User Interface not available or communication loss with the module
28	Test trip was triggered
29	Option Card not available or communication loss with the module
30	RTC / Backup Memory Option Board NV memory fail
31	Currently connected User Interface does not match with what was connected before
32	Currently connected Measurement Module does not match with what was connected before
33	Currently connected Option Card does not match with what was connected before

Table 61. Active Fault, Warning and Inhibit Values(Continued)

Value	Description
Active Fault, continued	
34	Measurement Module firmware is incompatible
35	User Interface firmware is incompatible
36	Ethernet Option Card firmware is incompatible
37	Profi Option Card firmware is incompatible
38	Ground Fault Module firmware is incompatible
39	Ground Fault Module communication loss
40	Ground Fault Module mismatch
41	Ground Fault Module CT open
42	Ground Fault Module CT shorted
43	Ground Fault Module CT no cal
44	HRGF Pulse Detect
200…	200–232 are logic engine faults
500	Internal - communication loss with Power Supply Board
501	Internal - Power Supply Board is not responding to SPI
502	Internal - Checksums in NV memory (FRAM) didn’t match during read (neither pair)
503	Internal - Checksums in NV memory (FRAM) didn't match during write (neither pair)
504	Internal - RTC / Backup Memory Option Card is missing
505	Internal - RTC / Backup Memory Option Card does not match actual
506	Internal - RTC / Backup Memory Option Card has NV Fault.
507	Internal - serial flash memory fault (Attempt Factory Reset first. Return to manufacturer if not cleared)
508	Internal - logic mapping error (Attempt factory reset)
509	Internal - UI NV memory error
510	Internal - Option card NV memory error
511	Internal Ground Fault Module NV memory error
1000…	1000–1049 Logic User faults
Active Warning	
0	No Warnings
1	Under voltage
2	Over voltage
3	Reserved
4	Ground Current
5	Current phase loss
6	Current unbalance
7	Instantaneous over current

Table 61. Active Fault, Warning and Inhibit Values(Continued)

Value	Description
Active Warning, continued	
8	Jam
9	PF Deviation
10	Voltage phase loss
11	Voltage unbalance
12	Frequency deviation fast
13	Frequency deviation slow
14	Under current
15	High power
16	Low power
17	Contactor failure
18	Starts limit exceeded
19	Overload
20	Stall
21	Phase rotation mismatch
22	PTC - See PTC State for details
23	Peak demand
24	Measurement Module warning
25	Real Time Clock requires setting (has not been set)
26	RTC Battery Low. Replacement is recommended
27	Device ambient temperature high
28	MM high ambient temperature
29	UI high ambient temperature
30	Option card high ambient temperature
31	Ground Fault Module high ambient temp
41	Ground Fault Module CT open
42	Ground Fault Module CT shorted
43	Ground Fault Module CT no cal
44	HRGF Pulse Detect
220…	220–232 are logic engine warnings
1000…	1000–1049 Logic User warnings

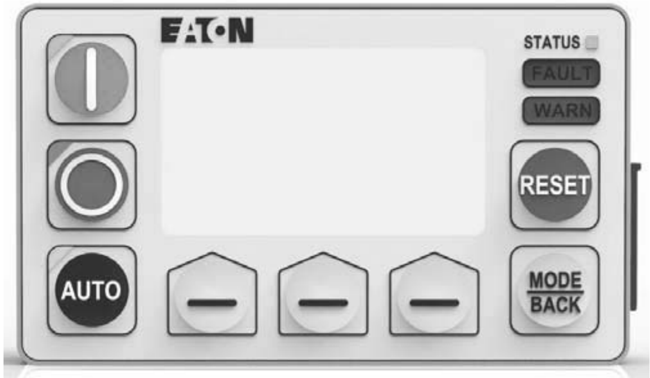
Table 61. Active Fault, Warning and Inhibit Values(Continued)

Value	Description
Active Inhibit	
0	No inhibits
1	Incorrect configuration. See configuration inhibit reason
2	A soft reset is required
3	Backspin prevention
4	Under voltage restart timer active
5	Control voltage is low
6	Under voltage condition
7	Voltage unbalance
8	Starts per hour limit has been exceeded
9	Over voltage condition
10	ELC Hardware mismatch
11	Run Interlock input open
1000…	1000–1049 Logic User inhibits

Chapter 8—C445UM Monitoring User Interface

C445UM Overview

Figure 118. C445UM



The monitoring user interface offers an easy way to access C445 safely from outside the enclosure door. Unlocking advanced functionality in an intuitive format, it is ideal for easy local diagnostics and commissioning with or without use of a network.

C445UM Catalog Numbers

Connect User Interface to the Base Control Module (C445B…) using *D77E*… cables in desired length.

Table 62. C445UM Catalog Numbers

Catalog Number	Description
C445UM	C445 Monitoring User Interface
D77E-QPIP13	Connection Cable, 13cm
D77E-QPIP25	Connection Cable, 25cm
D77E-QPIP100	Connection Cable, 100cm
D77E-QPIP200	Connection Cable, 200cm
D77E-QPIP300	Connection Cable, 300cm

C445UM Setup Wizard

The Setup Wizard sets basic system parameters required for optimal operation. The wizard prompts on first power-up and can also be accessed directly in:

PRG → Services → Run Wizard

Figure 119. C445UM Setup Wizard

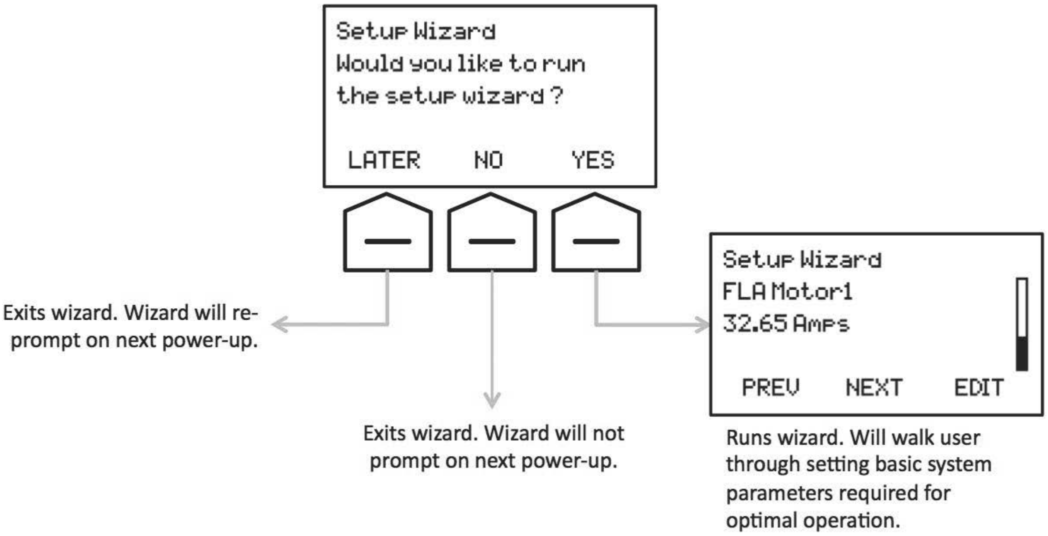
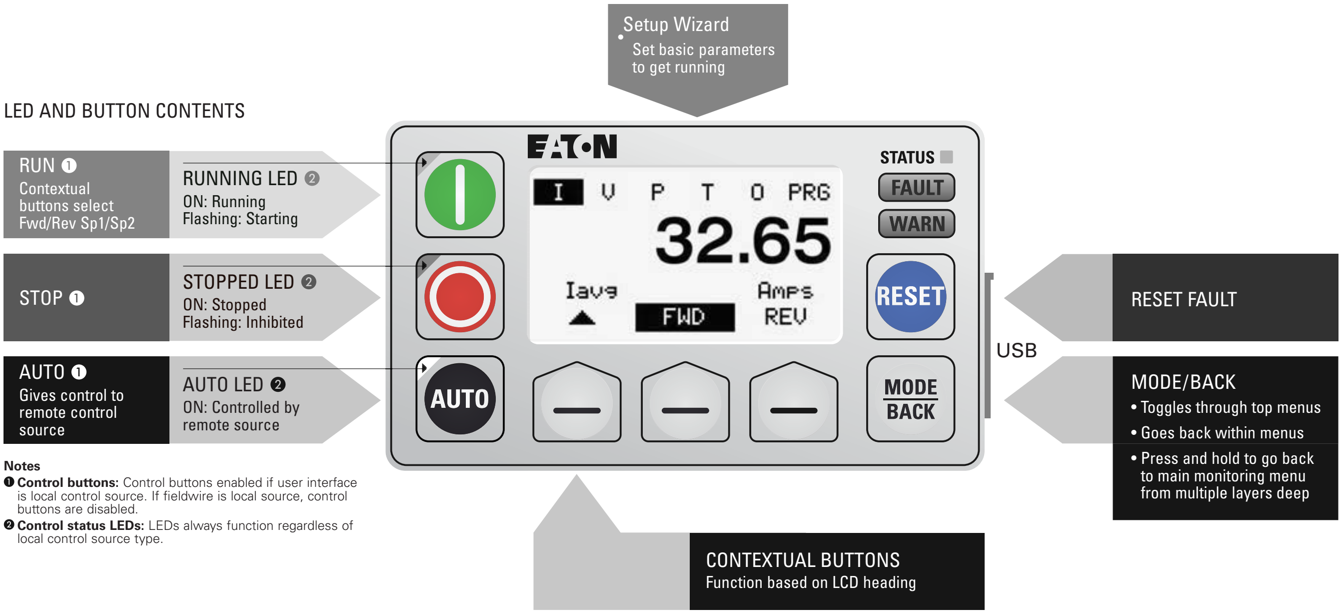


Table 63. C445UM Setup Wizard Parameters

Catalog Number	Default Settings
Operation Mode	Direct Online
Local Control Source	Auto Detect User Interface
Remote Control Source	Fieldbus
2-Wire/3-Wire	2-Wire
Trip Class	5
Motor FLA	Low Range of Connected Measurement Module
Motor Rated HP/Watts	20 HP / 14914 W
Motor Rated Speed	1750 RPM
Motor Rated Service Factor	1.15%
Motor Rated Voltage	480 V
Motor Rated Frequency	60 Hz
Motor Rated Power Factor	83.50%

C445UM LED and Button Overview

Figure 120. C445UM LED and Buttons



Notes

❶ **Control buttons:** Control buttons enabled if user interface is local control source. If fieldwire is local source, control buttons are disabled.

❷ **Control status LEDs:** LEDs always function regardless of local control source type.

C445UM Monitoring

Five monitoring menus provide easy access to critical system data.

I: Current Monitoring

V: Voltage Monitoring

P: Power Monitoring

T: Thermal Monitoring

O: Other System Monitoring

Figure 121. C445UM Monitoring Menus

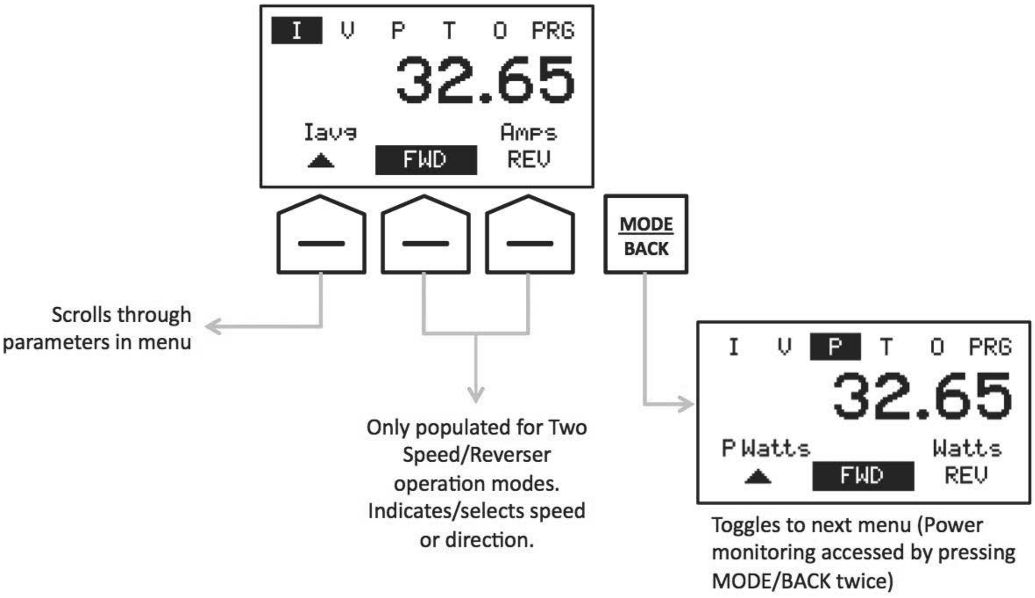


Figure 122. Monitoring Menu Data

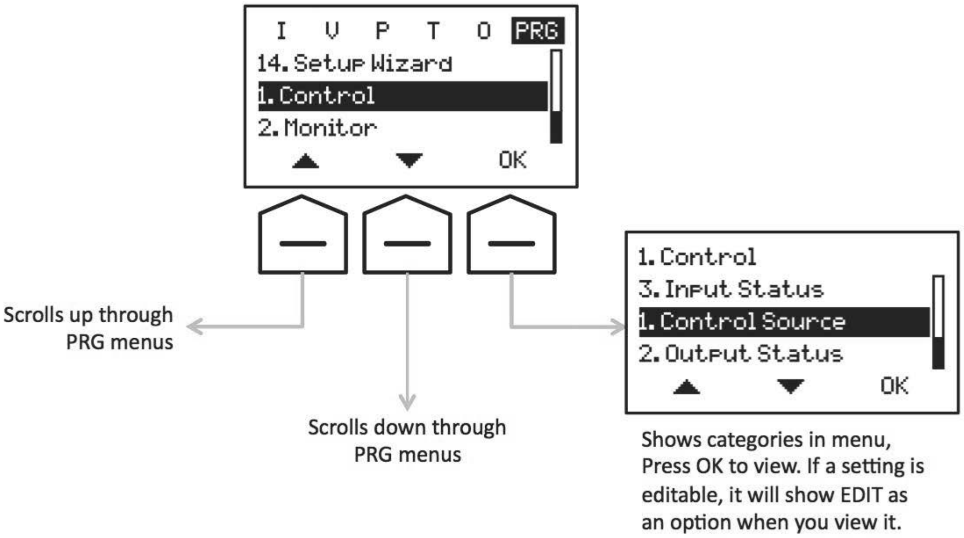
	Monitoring Menus: Press <MODE/BACK> to toggle through				
	I (Current)	**V** (Voltage)	**P** (Power)	**T** (Thermal)	**O** (Other)
Data in menu Use ▲ to scroll	Avg Current (Iavg)	Avg Voltage(Vavg)	Watts Total (P Watts)	Thermal Memory % (TM%)	Run Time* (Run Time)
	Iavg % of FLA (I%FLA)	Voltage Unbalance (VUnb)	Power Factor (PF)	Time to Reset (T to Rst)	# Motor Starts (#Starts)
	Current Unbalance (IUnb)	Phase Order (Ph Ord)	VA Total (P VA)	Thermal Capacity % (TC%)	Max. Starting I (MaxStart)
	Ground Fault Current (IGF)	Voltage L1-L2 (L1-L2)	VARs Total (P VARS)	PTC state (PTC)	Last Start Time (LastStart)
	I Phase A (IA)	Voltage L2-L3 (L2-L3)	Real Energy* (P kWh)		Frequency (Freq)
	I Phase B (IB)	Voltage L3-L1 (L3-L1)			RTC Time (RTC Time)
	I Phase C (IC)				IP Address (IP Addr)
					Operating Time* (Op Time)
					Contactor Ops Last Hr (Ctr Ops)
					Speed RPM (Speed)

*Resettable parameter—Users can reset to zero in PRG menu.

C445UM PRG Menu (Customizing Settings)

The last menu accessed by pressing *MODE/BACK* is the *PRG* menu. This menu provides an easy way to view or change any C445 setting. Everything is organized in simple menu groups. Some menus have an “Advanced” sub-menu for options not commonly used or customized.

Figure 123. C445UM Program Menu



Scrolls up through PRG menus

Scrolls down through PRG menus

Shows categories in menu, Press OK to view. If a setting is editable, it will show EDIT as an option when you view it.

The following table summarizes functions available in each PRG Menu.

Table 64. Program Menu Groups

	Program (PRG) Menu Groups				
Go here to …	**1. Control**	**4. Wiring Configuration**	**7. Protections**	**11. User Interface Settings**	**15. External I/O**
	See active control source Control relay outputs View digital input status View relay output status	Set single phase/3-phase Set CT ratios Set PT ratios	Enable/disable fault trips/fault no trips/fault warnings Customize protection thresholds and delays	Set screen idle behavior Contrast/brightness Set control button delays Change LED colors	ELC I/O status Ext I/O comm config ELC I/O setup config
	2. Monitor	**5. Operation Mode**	**8. Real Time Clock**	**12. Security**	**16. User Logic**
	Monitor voltage, current, power, system data (all monitoring values, not just favorites) Clear resettable monitor values	Select operation mode, local/remote control sources Set comm loss/idle behavior Select output functions Enable remote control source switch	Set time and time zone	Set passwords (local, admin, USB)	Logic run control Logic run status Error info
			9. Communications	**13. Services**	
			Configure Ethernet and Modbus settings (address, timeouts, baud rate, advanced, etc.)	Factory Reset Soft Reset Re-pair modules	
	3. Motor Configuration	**6. Faults and Events**	**10. System View**	**14. Launch Setup Wizard**	
	Set/view motor nameplate data (also in Setup Wizard)	View active fault/warning/inhibit View or clear fault queue and trip snapshot	View product details (serial number, firmware version, etc.)	Re-run Setup Wizard	

Customizing Settings in PRG Menu

Press OK to view any parameter in the PRG Menu. Editable parameters will show EDIT on the view screen. Select *EDIT*, use button options to modify, and select *SAVE*. To cancel an edit, press *MODE/BACK* instead of saving. There are multiple editing modes:

1. **Checkbox Options** – Checkboxes are used for a group of options where each item in that category can be turned on or off. A good example of this is *Trip Enable* in the Protections Menu. Each trip type (Overvoltage, Low Power, etc) can be individually enabled or disabled so each offers a check box editing feature. Pressing edit will provide button options to select a checked or unchecked box for each trip type.
2. **Scrolling Options** – If there are multiple, non-numerical setting options arrow buttons scroll through available settings. Select the desired option by simply pressing SAVE.
3. **Numerical Options** – Numerical parameters offer two editing modes:
    - **Numerical Edit Mode** – Provides two arrows to increment or decrement the entire value. This editing mode is default on pressing *EDIT*. Pressing and holding arrows will speed up the value changes.
    - **Digit Edit Mode** – Use digit mode by pressing and *holding* the *EDIT* button. This mode provides individual incrementing for each digit in the string. One arrow key will increment the digit selected. Incrementing is scrolling—In order to go from 4 to 1 for example, scroll through 9 and it will wrap back to the beginning. The second arrow key moves across digits for editing.

Lock Icon:

If an editable setting shows a lock icon, it cannot be edited for one of two reasons. First, password protection may be in place. In this case, pressing the lock button will prompt the user to login before allowing them to edit. Second, most settings are not editable while running and will show the lock. This default feature may be disabled by selecting the "Run Lock Override" parameter in the Advanced section of the Operation Mode category.

Soft Reset After Editing:

Changes to the device often require a Soft Reset before re-starting. In this case, an inhibit becomes active in the background (Stopped LED will start blinking). The inhibit screen will prompt the user soft reset with RESET button. This prompt will not appear while in the PRG menu because the user may want to set multiple items. See Faults and Events section for more information on Inhibit screens.

C445UM Fault and Event Diagnostics

Faults: When a fault occurs, the *FAULT* LED will light and a notification screen will provide fault description and access to fault diagnostics. Users can view the trip snapshot or fault queue right from the fault screen.

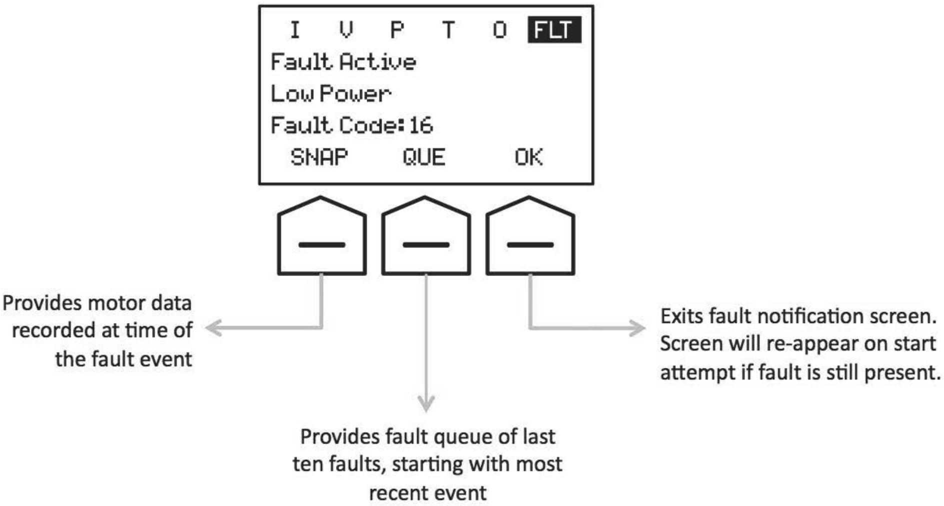
The FLT screen can be cleared by pressing *OK*, but the *FAULT* LED remains lit. Clear a fault by pressing *RESET*. A failed reset attempt is indicated by a blinking *FAULT* LED. This means the reset command was received by the device but the fault cannot be cleared because the condition is still present.

The active fault can also always be viewed via *PRG* → *Faults and Events* → *Active Fault*

Figure 124. C445UM Diagnostics

I V P T O FLT
Fault Active
Low Power
Fault Code: 16
SNAP QUE OK

Figure 125. C445UM Faults and Events



I V P T O FLT
Fault Active
Low Power
Fault Code: 16
SNAP QUE OK

Provides motor data recorded at time of the fault event

Provides fault queue of last ten faults, starting with most recent event

Exits fault notification screen. Screen will re-appear on start attempt if fault is still present.

Inhibits: An inhibit is a condition that occurs while stopped that will prevent starting. This could be a fault condition or a parameter change that requires soft reset or creates configuration conflicts.

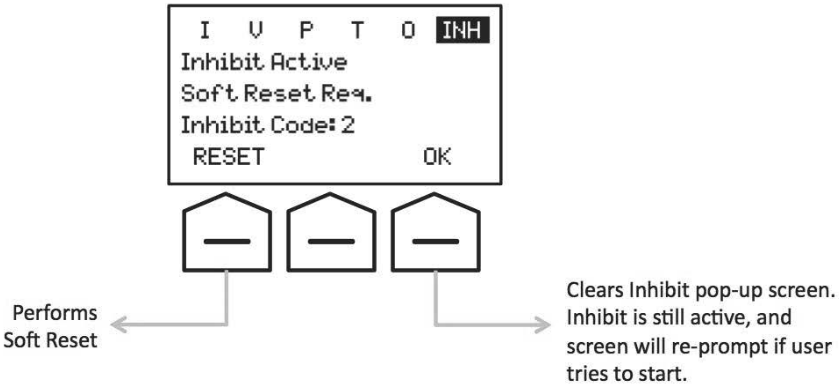
When an inhibit occurs, the stopped LED flashes and an Inhibit screen provides the reason. If an Inhibit is due to parameter changes requiring soft reset, the notification screen will provide a button to soft reset. If inhibit is due to a configuration problem, a button option provides details about the problem.

Inhibit notification screens will not appear within the PRG menu as the user may be changing multiple parameters and will only want to Soft Reset once. The screen will appear if the user takes any of the following actions:

1. Returns to the home monitoring screen by pressing *MODE/BACK*. Pressing *MODE/BACK* once steps out of each menu while pressing and holding will go immediately back to home.
2. Press the *START* button
3. Lets the idle timeout expire with "Return to Home Screen" enabled in timeout behavior (User Interface Settings)

The active inhibit can also always be viewed via *PRG → Faults and Events → Active Inhibit*

Figure 126. C445UM Inhibits



Performs Soft Reset

Clears Inhibit pop-up screen. Inhibit is still active, and screen will re-prompt if user tries to start.

Warnings – If an alarm condition is present, the *WARN* LED will light. There is no pop-up screen for a warning. To view the active warning, go to *PRG → Faults and Events → Active Warning*

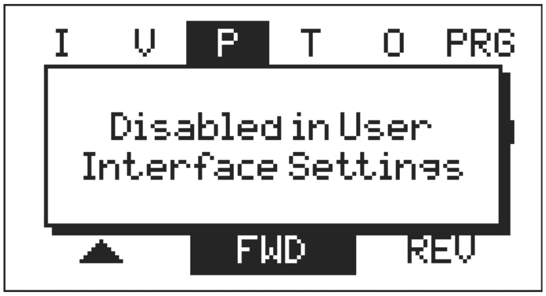
C445UM User Interface Settings

The monitoring user interface offers a number of customizable features. Navigate to *PRG → User Interface Settings* to view or change settings.

Control Button Enable/Disable—If the User Interface is the Local Control Source, control buttons are enabled. To prohibit local start, the start button can be disabled in *PRG → User Interface Settings → Enable Cntrl Buttons*

If the User Interface is not the Local Control Source (Local Control Source is set to “Fieldwire” or “No Local Control” OR Active Operation Mode is “Overload Only”), control buttons are disabled. If No Remote Control is set, the Auto button is disabled. Whether individually disabled or not used because the user interface is not a control source, the screen will notify the user if a button is not enabled when depressed:

Figure 127. C445UM Control Button Disabled Notification Screen



Disabled in User
Interface Settings

Reset Button Enable/Disable—*RESET* clears a fault. The User Interface *RESET* button is always enabled by default, even if the User Interface is not a Control Source. *RESET* does not stop the motor in a running condition, it simply clears the fault if the condition is no longer present. Users may also perform a reset over the Fieldbus network or with a Fieldwire input. If desired, the User Interface *RESET* button can be disabled. If depressed when disabled, the LCD screen will tell the user that the button is disabled.

PRG → User Interface Settings → Enable Cntrl Buttons

Button Debounce—Users can configure a debounce time for *START*, *STOP*, *AUTO* or *RESET* buttons. The button must be depressed for this time before the function actuates. This may be desired to prevent accidental actuation.

PRG → User Interface Settings → Advanced (UI Settings) → Start, Stop, Auto, Reset Debounce

LED Colors and Brightness— The User Interface provides control status LEDs indicating running, stopped and auto status. These status LEDs always function regardless of whether control buttons are enabled. Two additional LEDs indicate FAULT or WARN conditions.

Table 65. Running/Stopped/Auto LED Color Settings

Button	Options	Default
Run	RGAW	R
Stop	RGAW	G
Auto	AW	A

PRG → User Interface Settings → Advanced (UI Settings) → Start, Stop, Auto LED Color

The brightness setting of all LEDs can also be adjusted. One setting applies to all LEDs.

PRG → User Interface Settings → LED Brightness

LCD Settings—Users can customize screen brightness and contrast for the LCD screen.

PRG → User Interface Settings → Brightness, Contrast

Screen Idle Behavior—Users can define an inactivity time period that will be considered screen idle and then set screen idle behavior. Optional behaviors include reducing brightness to a user settable idle level, returning to the last viewed measurement screen or to a specific measurement parameter, and/or logging out if password protection is used.

PRG → User Interface Settings → Inactivity Timeout (sets timeout time)

PRG → User Interface Settings → Timeout Behavior (sets behavior options at timeout)

PRG → User Interface Settings → Idle Brightness (sets idle brightness level, if used as a behavior)

PRG → User Interface Settings → Default Measure Param (sets the monitoring parameter the screen will return to on idle, if used as a behavior)

C445UM Security

Users can set different levels of password protection using the User Interface (PRG → Security). Password protection only locks out changes to device settings. All monitoring and diagnostics are still available. There are three types of password protection:

Local PW—Sets a password that only applies to the user interface.

Admin PW—Sets a password that applies to making changes from any source.

USB PW—Sets a password that only applies to making changes over the USB port.

Out-of-box, there is no password protection. When a password is already set, navigating to these menu items will first prompt the user to *LOGIN*. Once logged in with the correct password, the user has the option to disable password protection, change the password, or simply log out.

C445UM Services

The last menu in the PRG section is the Services Menu. From here, users can perform the following actions:

Test Trip—Sends a Test Trip, causing the control output to open.

Re-Pair Modules—Re-pairs devices after removing or replacing a module in the system after it has already been powered.

Factory Reset—Reboots and resets all values to factory default. This will erase any configuration settings and clear any passwords.

Soft Reset—Sends a reboot command for the entire system.

Proof Test—Executes a Test Trip and forces a Watchdog reset. This function is useful for maintenance purposes to confirm that the contactor opens on a trip and that the internal Watchdog is functioning.

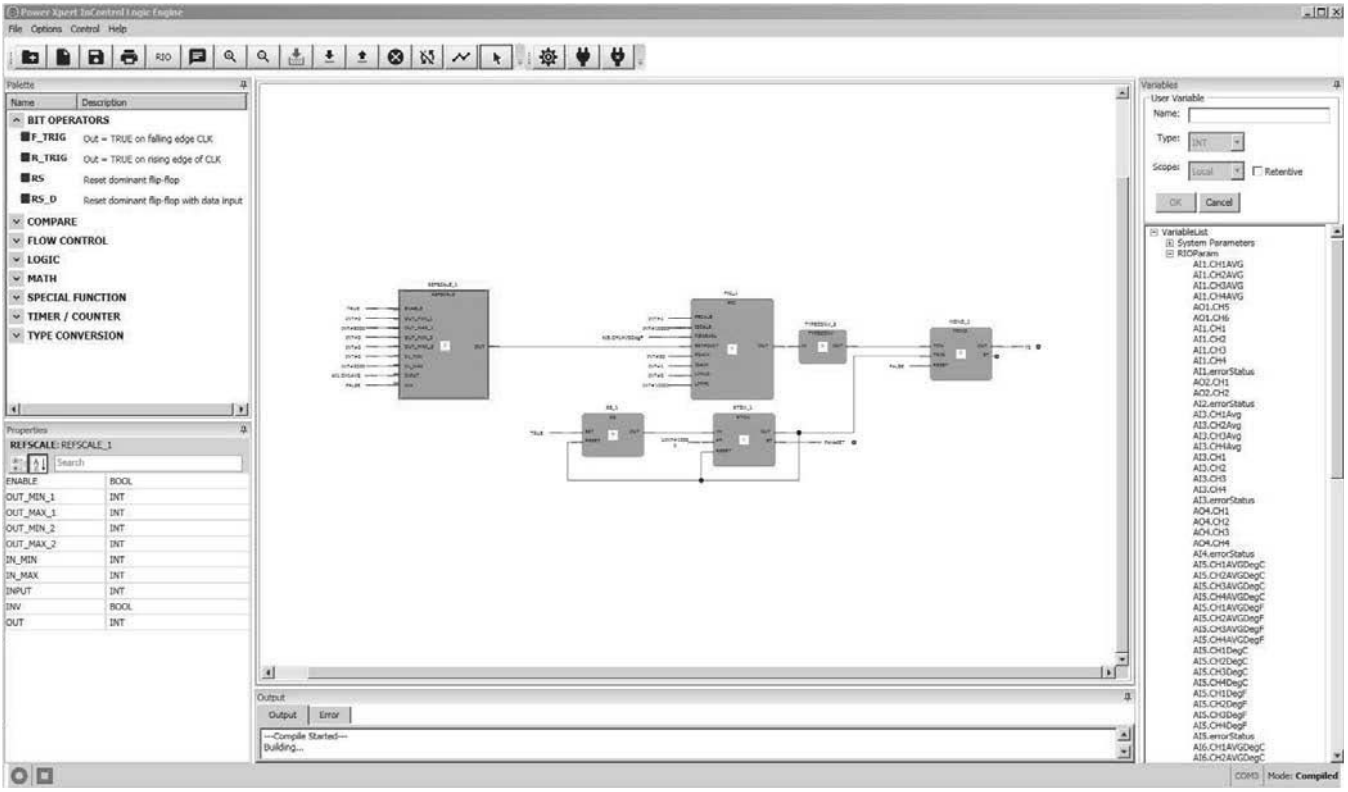
Chapter 9—C445 Logic Engine and Expansion I/O

Power Xpert *in*Control Logic Engine

The Logic Engine in the C445 Motor Management Relay has many applications. From monitoring temperature sensors attached to the windings of a motor to using it for distributed control and even eliminating a central controller. The C445 logic engine uses Function Block programming with an extensive, powerful instruction set and wide ranging data types. It can access the local I/O on the Base Control module, the expansion I/O as well as C445 system parameters allowing monitoring and control of the overload relay.

Power Xpert Logic Programming and I/O Configuration Tool

The software tool is used to create custom logic programs that reside in the C-445 MMR. The tool is also used to configure expansion I/O that is controlled from the logic engine over an RS-485 communication link. Users can create custom programs by selecting function blocks, creating variables, referencing remote I/O data items, setting properties, and accessing C-445 system variables from the logic editing screen. It is also possible to monitor live program execution in debug mode.

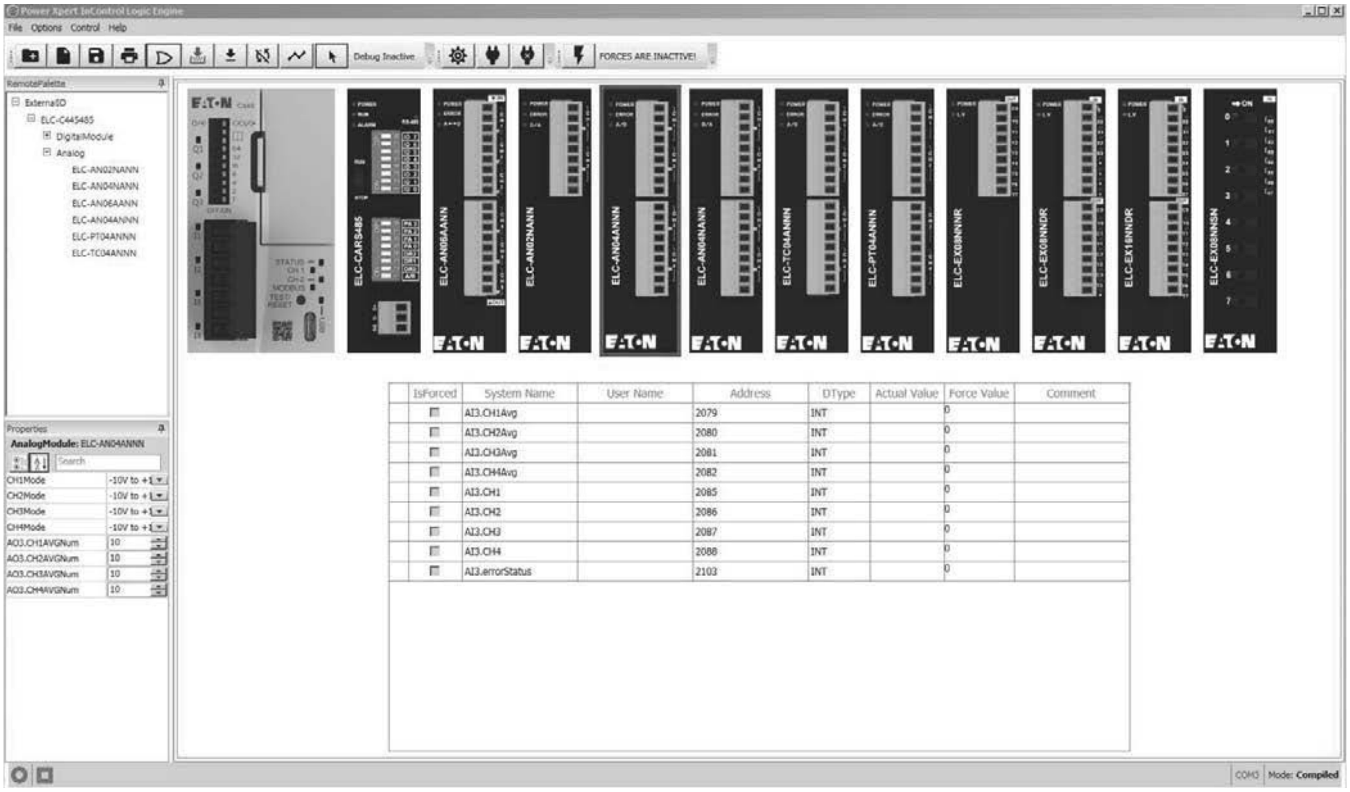


Name	Description
F_TRIG	Out = TRUE on falling edge CLK
R_TRIG	Out = TRUE on rising edge of CLK
RS	Reset dominant flip-flop
RS_D	Reset dominant flip-flop with data input

ENABLE	BOOL
OUT_MIN_1	INT
OUT_MAX_1	INT
OUT_MIN_2	INT
OUT_MAX_2	INT
IN_MIN	INT
IN_MAX	INT
INPUT	INT
INV	BOOL
OUT	INT

```
---Compile Started---
Building...
```

The tool is also used to select I/O expansion modules, assign names to remote I/O points (tags), force I/O, and set module properties using the remote I/O (RIO) configuration screen:



Properties

AnalogModule: ELC-AN04ANNN

CH1Mode	-10V to +1
CH2Mode	-10V to +1
CH3Mode	-10V to +1
CH4Mode	-10V to +1
AO3.CH1AVGNum	10
AO3.CH2AVGNum	10
AO3.CH3AVGNum	10
AO3.CH4AVGNum	10

	IsForced	System Name	User Name	Address	DType	Actual Value	Force Value	Comment
	☐	AI3.CH1Avg		2079	INT		0	
	☐	AI3.CH2Avg		2080	INT		0	
	☐	AI3.CH3Avg		2081	INT		0	
	☐	AI3.CH4Avg		2082	INT		0	
	☐	AI3.CH1		2085	INT		0	
	☐	AI3.CH2		2086	INT		0	
	☐	AI3.CH3		2087	INT		0	
	☐	AI3.CH4		2088	INT		0	
	☐	AI3.errorStatus		2103	INT		0	

Expansion I/O

The expansion I/O consists of digital input and output modules, analog input and output modules as well as thermocouple and RTD temperature input modules. The digital I/O modules include 24 Vdc I/O modules, a 120 Vac input module and relay output modules that support 120 Vac/ 240 Vac and 24 Vdc. There are also combination analog and digital I/O modules consisting of both inputs and outputs.

The analog I/O modules support both –10 Vdc to 10 Vdc and –20 ma to 20 ma. There are analog input and output modules and a combination analog module with 4 inputs and 2 outputs.

The temperature input modules consist of a thermocouple input module and an RTD input module. The Thermocouple module supports 4 Type J, K, R, S and T thermocouple inputs. The RTD module allows for the connection of 4 platinum temperature sensors (PT 100, 3-wire, 100-ohm).

Data Types

Supported data types: BOOL, INT, DINT, UINT and REAL.

Variables and constants used with any function block must be the same data type. There are data type conversion function blocks to allow for converting any variable or constant to another data type. For example, an ADD function block cannot add a DINT and a UINT. One of the variables must be converted. In this case, the UINT could be converted to a DINT and added to the other DINT. The result must be a data type DINT variable.

Note: Variables may be assigned to be retentive. Retentive variables retain their value through a power cycle. All other variable data is reset to 0 following a power cycle. To make a variable retentive, simply check the retentive box when creating the variable.

Constant Values

Enter constants to a user program by entering the following for the various supported data types into the Name field in User Variables. Select a position on the program screen by placing a "donut" before selecting OK. This will place the constant value in a specific position. Simply click on the program palette to add the "donut" where the constant is to be placed. Once placed, the constant can be moved. Below are examples of the syntax required for constant values for each data type supported.

BOOL#1

INT#-123

UINT#123

DINT#100000

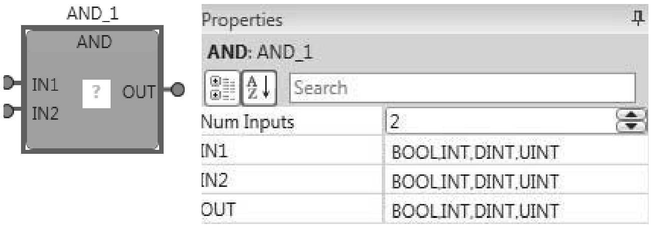
REAL#123.45

The Function Blocks

The Function Blocks execute from left to right, top to bottom. To alleviate any questions as to the execution order, following a program compile, a number appears inside of each Function Block indicating the order in which they will execute.

The data types for each Function Block must be the same, except where otherwise specified. When mixed values are needed, there is a conversion function block (TypeConvert) to convert each constant or variable to the same data type before using it in a specific Function Block operation.

The supported data types for each function block will be displayed in the Properties window. To view this for any FB, simply select the FB. Example below.



AND: AND_1

Num Inputs	2
IN1	BOOL,INT,DINT,UINT
IN2	BOOL,INT,DINT,UINT
OUT	BOOL,INT,DINT,UINT

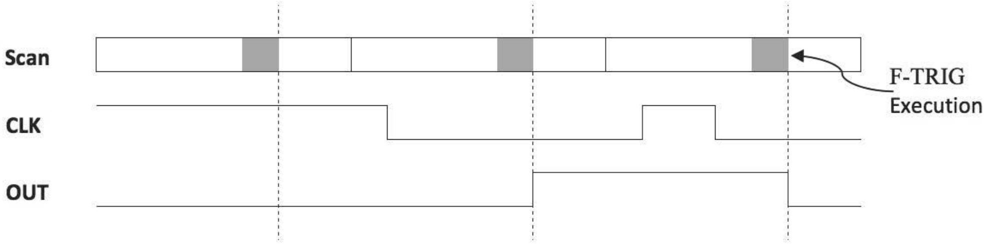
This section will provide a description and an example for each Function Block supported by the C445 Logic Engine. The function blocks are in groups to make them easier to locate.

Bit Operators

F-TRIG—Falling Edge Trigger

The F-TRIG detects a TRUE to FALSE transition of the CLK. The OUT is set to TRUE when the transition is detected and it remains true until the instruction runs in the next scan where it is cleared.

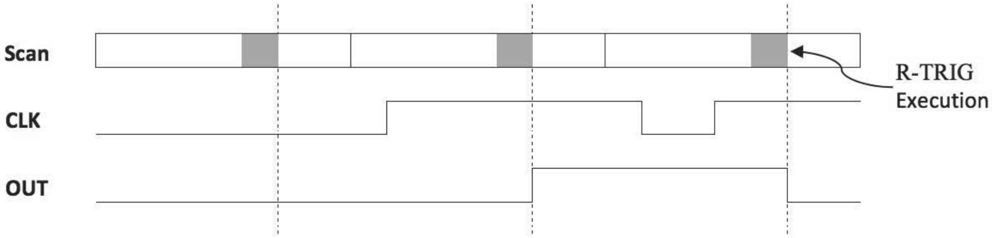
Parameter	Data type	Description
CLK	BOOL	Clock input
OUT	BOOL	Edge detection output



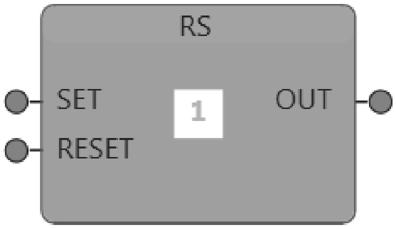
R-TRIG—Rising Edge Trigger

The R-TRIG detects a FALSE to TRUE transition of the CLK. The OUT is set to TRUE when the transition is detected and it remains true until the instruction runs in the next scan where it is cleared.

Parameter	Data type	Description
CLK	BOOL	Clock input
OUT	BOOL	Edge detection output



RS—Reset Dominant Bi-Stable

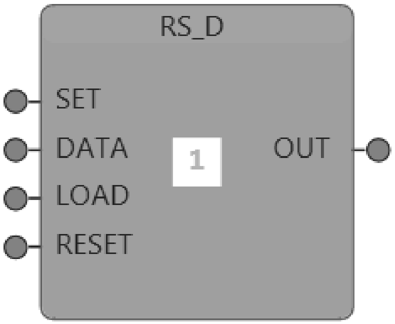


The RS is a reset dominant RS Flip Flop. If RESET is TRUE, OUT is set to FALSE regardless of the state of SET. If RESET is FALSE and SET is TRUE, OUT will be set to TRUE. If SET and RESET are FALSE, OUT will remain in its last state.

SET	RESET	OUT (Last)	OUT
0	0	0	0
0	0	1	1
1	0	0	1
1	0	1	1
x	1	x	0

Parameter	Data type	Description
SET	BOOL	Set input
RESET	BOOL	Reset input
OUT	BOOL	Output

RS_D—Reset Dominant Bi-Stable with Data Input



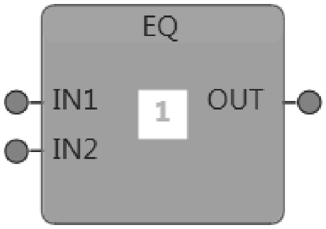
The RS_D function block performs as an RS function block with SET and RESET when LOAD is FALSE. But, when LOAD is set to TRUE, DATA is copied to the output.

SET	**RESET**	**DATA**	**LOAD**	**OUT (Previous)**	**OUT**
0	0	x	0	0	0
0	0	x	0	1	1
1	0	x	0	0	1
1	0	x	0	1	1
x	0	1	1	x	1
x	0	0	1	x	0
x	1	x	x	x	0

Parameter	**Data type**	**Description**
SET	BOOL	Set input
DATA	BOOL	Data input, will be copied to OUT when LOAD = TRUE
LOAD	BOOL	Load input for DATA
RESET	BOOL	Reset input
OUT	BOOL	Output

Compare Group

EQ—Equal To

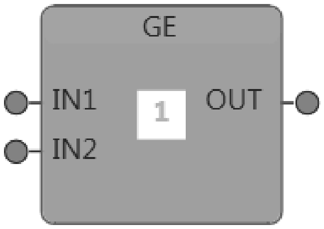


The EQ function block sets OUT to TRUE if all of its inputs are equal, else OUT is SET to FALSE. Up to 5 inputs IN1 – IN5 are supported.

OUT = TRUE IF IN1 = IN2 = … INx

Parameter	Data type	Description
IN1 … IN5	BOOL, INT, DINT, UINT, REAL	Inputs to be compared
OUT	BOOL	Output

GE—Greater Than or Equal To

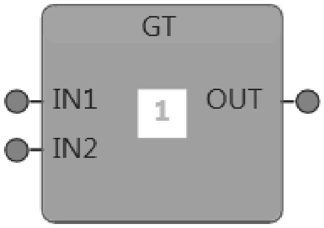


The GE function block sets OUT to TRUE if IN1 is greater than or equal to IN2.

OUT = TRUE IF IN1 ≥ IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Inputs to be compared
OUT	BOOL	Output

GT—Greater Than

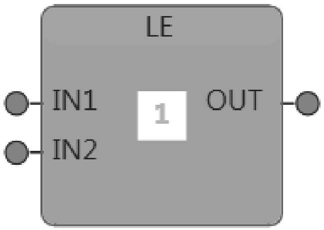


The GE function block sets OUT to TRUE if IN1 is greater than IN2.

OUT = TRUE IF IN1 > IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Inputs to be compared
OUT	BOOL	Output

LE—Less Than or Equal To

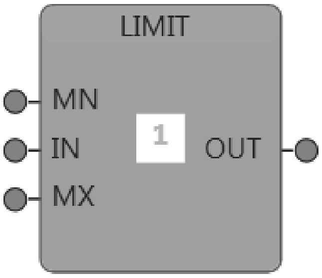


The LE function block sets OUT to TRUE if IN1 is lesser than or equal to IN2.

OUT = TRUE IF IN1 ≤ IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Inputs to be compared
OUT	BOOL	Output

LIMIT—Limit Function



The LIMIT function block will limit IN within the data range specified by the minimum limit, MN and the maximum limit MX. The range limited input is written to OUT. OUT will only be updated if MX ≥ MN.

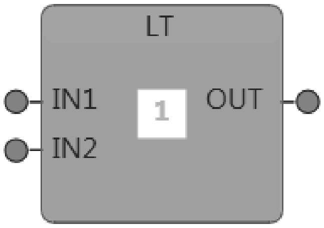
OUT = IN IF MN ≤ IN ≤ MX

OUT = MN IF IN < MN

OUT = MX IF IN > MX

Parameter	Data type	Description
MN	INT, DINT, UINT, REAL	Minimum limit of the input range
IN	INT, DINT, UINT, REAL	Input value
MX	INT, DINT, UINT, REAL	Maximum limit of the input range
OUT	INT, DINT, UINT, REAL	Range limited input value

LT—Less Than

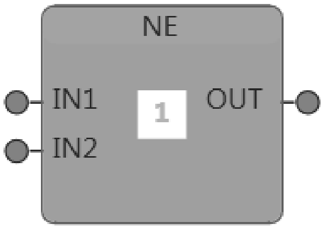


The LT function block sets OUT to TRUE if IN1 is lesser than IN2.

OUT = TRUE IF IN1 < IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Inputs to be compared
OUT	BOOL	Output

NE—Not Equal To



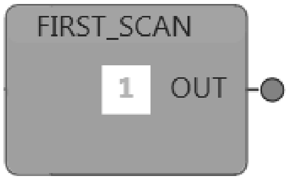
The LT function block sets OUT to TRUE if IN1 is not equal to IN2.

OUT = TRUE IF IN1 ≠ IN2

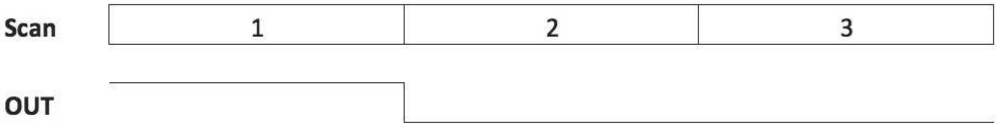
Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Inputs to be compared
OUT	BOOL	Output

Flow Control Group

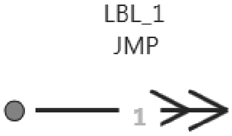
First Scan



The First Scan function block serves as a flag to indicate the first scan of the logic program. OUT is set to TRUE and remains true until the first scan of the program completes execution. This occurs when the logic program is started or restarted by enabling the logic run control or downloading a program or by power cycling the system that already has a loaded logic program. The first scan can be used as a flag for example, to initialize any variables once before executing the main program. This is often used in conjunction with the JMP function block. See the Flow Control example below.



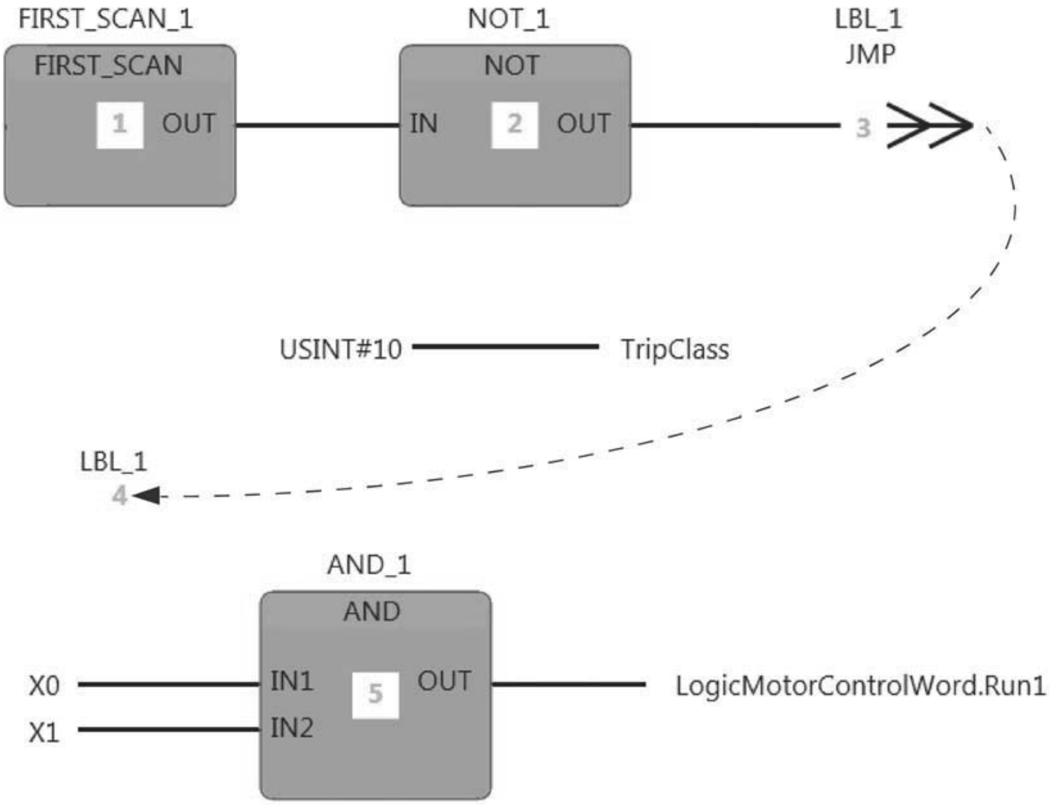
JMP and LBL



The JMP transfers the execution flow of the program to its paired label—LBL when the input condition of the JMP is TRUE. To Add a JMP LBL pair, add the JMP function block to the canvas and then click anywhere in the canvas to add the paired LBL. A JMP and an LBL are paired by using same names for the JMP and the LBL. In the example shown above, LBL_1 is the pairing name for the JMP and the LBL.

Parameter	Data type	Description
JMP Condition	BOOL	When TRUE, JMP is executed.

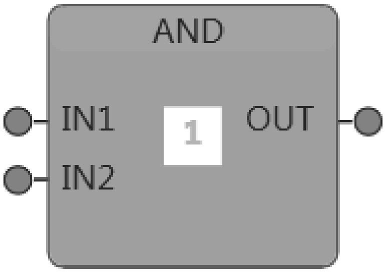
Flow Control Example



In this example, the TripClass System parameter is set to 10 during the first scan of the program before allowing external digital inputs X0 and X1 to start the motor. The JMP will always jump to LBL_1, skipping the segment of the program that sets the trip class except during the first scan when its input condition will be FALSE.

Logic Group

AND—Bitwise AND

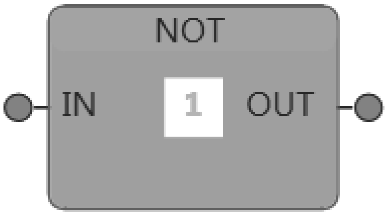


The AND function block performs a bitwise AND operation on all the inputs. Up to 5 inputs IN1 – IN5 are supported.

OUT = IN1 AND IN2 AND …. IN5

Parameter	Data type	Description
IN1 … IN5	BOOL, INT, DINT, UINT	Input operands
OUT	BOOL, INT, DINT, UINT	Result

NOT—Bitwise NOT

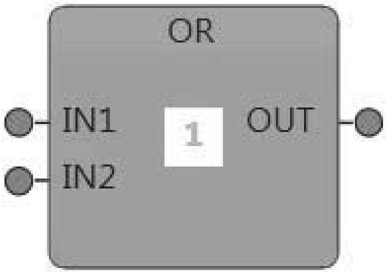


The NOT function block performs a bitwise NOT operation on input.

OUT = !IN

Parameter	Data type	Description
IN	BOOL, INT, DINT, UINT	Input operand
OUT	BOOL, INT, DINT, UINT	Result

OR—Bitwise OR

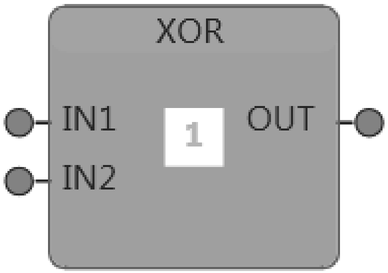


The OR function block performs a bitwise OR operation on all the inputs. Up to 5 inputs IN1 – IN5 are supported.

OUT = IN1 OR IN2 OR …. IN5

Parameter	Data type	Description
IN1 … IN5	BOOL, INT, DINT, UINT	Input operands
OUT	BOOL, INT, DINT, UINT	Result

XOR—Bitwise XOR



The XOR function block performs a bitwise exclusive OR operation on all the inputs. Up to 5 inputs IN1 – IN5 are supported.

OUT = IN1 XOR IN2 XOR …. IN5

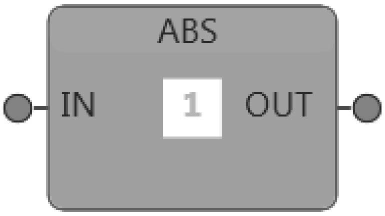
Parameter	Data type	Description
IN1 … IN5	BOOL, INT, DINT, UINT	Input operands
OUT	BOOL, INT, DINT, UINT	Result

Examples with UINT inputs

Function	IN1	IN2	OUT
AND	0x1234	0x4567	0x0024
NOT	0x1234		0xEDCB
OR	0x1234	0x4567	0x5777
XOR	0x1234	0x4567	0x5753

Math Group

ABS—Absolute Value

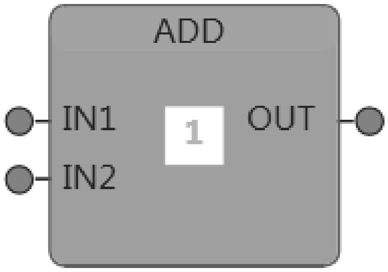


The ABS function block converts the input to the non-negative equivalent (absolute) value.

OUT = |IN|

Parameter	Data type	Description
IN	INT, DINT, UINT, REAL	Input operand
OUT	INT, DINT, UINT, REAL	Result

ADD—Addition

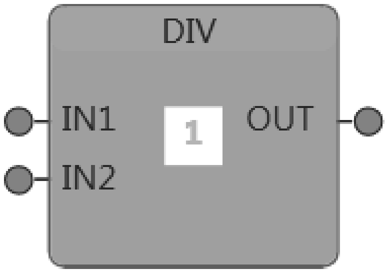


The ADD function block performs an addition of its inputs IN1 and IN2.

OUT = IN1 + IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Input operands
OUT	INT, DINT, UINT, REAL	Result

DIV—Divide



The DIV function block performs a divide operation on the inputs with IN1 as the dividend and IN2 as the divisor and determines the quotient of the operation.

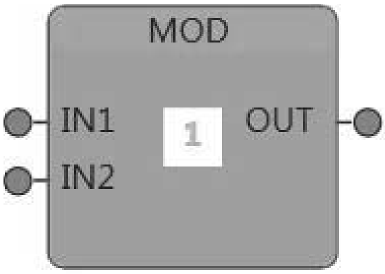
If IN2 is zero during the divide operation, the output will be set to 0 and a divide by zero fault or warning will be generated.

OUT = IN1/IN2 IF IN2 ≠ 0

OUT = 0 IF IN2 = 0

Parameter	Data type	Description
IN1	INT, DINT, UINT, REAL	Dividend
IN2	INT, DINT, UINT, REAL	Divisor
OUT	INT, DINT, UINT, REAL	Quotient

MOD—Modulo



The MOD function block performs a divide operation on the inputs with IN1 as the dividend and IN2 as the divisor and determines the remainder of the operation.

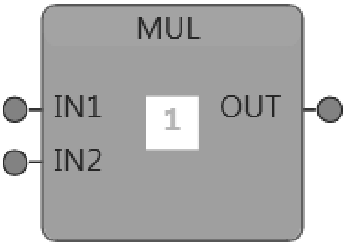
If IN2 is zero during the divide operation, then the output will be set to 0 and a divide by zero fault or warning will be generated.

OUT = IN1 modulo IN2 = IN1 – (IN1/IN2)*IN2 IF IN2 ≠ 0

OUT = 0 IF IN2 = 0

Parameter	Data type	Description
IN1	INT, DINT, UINT, REAL	Dividend
IN2	INT, DINT, UINT, REAL	Divisor
OUT	INT, DINT, UINT, REAL	Remainder

MUL—Multiply

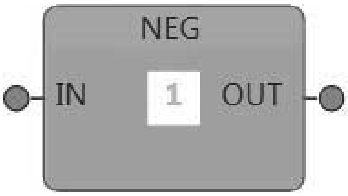


The MUL function block performs a multiply operation on the inputs IN1 and IN2.

OUT = IN1*IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Input operands
OUT	INT, DINT, UINT, REAL	Result

NEG—Negate

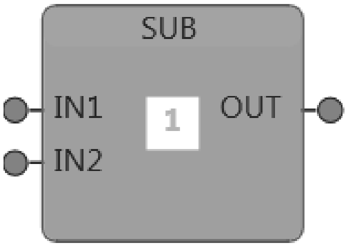


The NEG function block performs a negate operation on the input. In other words, multiplies the input by –1.

OUT = IN *(–1)

Parameter	Data type	Description
IN	INT, DINT, UINT, REAL	Input operand
OUT	INT, DINT, UINT, REAL	Result

SUB—Subtract



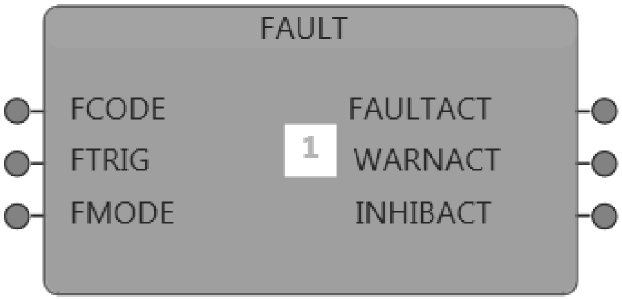
The SUB function block subtracts IN2 from IN1.

OUT = IN1–IN2

Parameter	Data type	Description
IN1, IN2	INT, DINT, UINT, REAL	Input operands
OUT	INT, DINT, UINT, REAL	Result

Special Function Group

FAULT—User-Defined Fault Instruction



The FAULT function block can be used to generate up to 50 user-defined events—faults, warnings and inhibits. An event can be generated by providing an event code to the FCODE, specifying the type of event using the FMODE and triggering the event using the FTRIG.

The function block indicates an active event by setting FAULTACT, WARNACT or INHIBACT to TRUE.

Event Types

Fault—This is a latched event, meaning the event remains true even after FTRIG transitions to FALSE. The latched fault can be cleared using one of the standard C445 fault reset methods provided that FTRIG is FALSE when the fault reset is issued. A fault will stop a running motor.

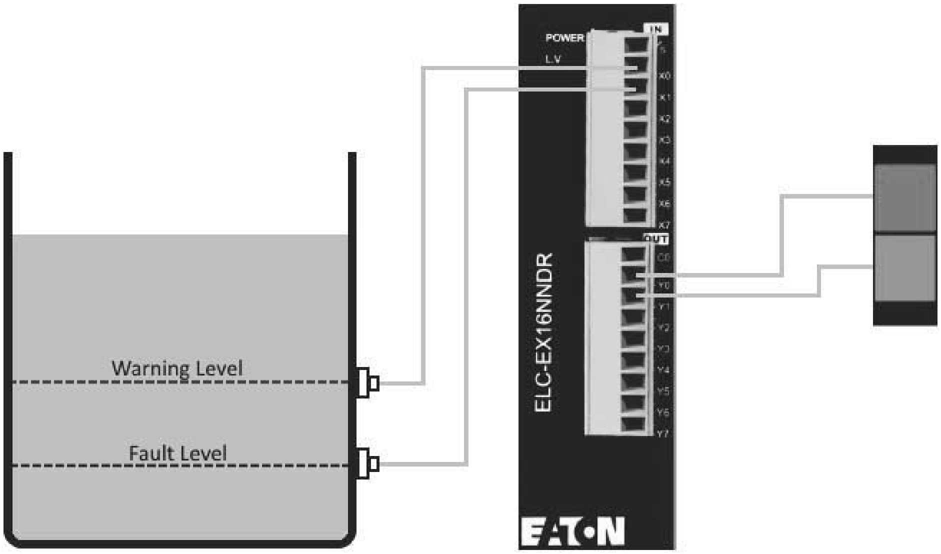
Warning—This is a non-latched event, meaning the event will clear when FTRIG transitions to FALSE. A warning will not stop a running motor.

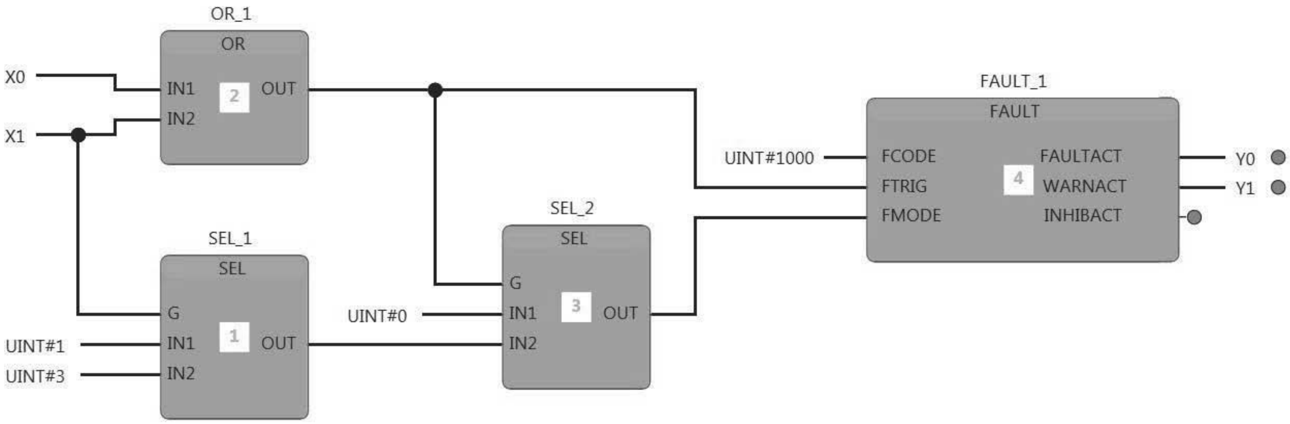
Inhibit—This is a non-latched event, meaning the event will clear when FTRIG transitions to FALSE. An inhibit will stop a running motor.

Parameter	Data type	Description
FCODE	UINT	Event Code Range: 1000–1049 Note: Same code cannot be used with multiple FAULT blocks.
FTRIG	BOOL	Level sensitive trigger
FMODE	UINT	Event Mode 0 = Off 1 = Warning 2 = Inhibit 3 = Fault
FAULTACT	BOOL	TRUE when fault event is active
WARNACT	BOOL	TRUE when warning event is active
INHIBACT	BOOL	TRUE when inhibit event is active

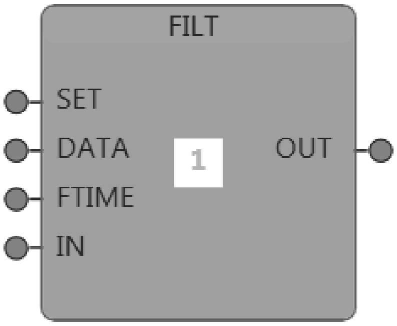
Example

In the following example, the fluid level in a tank is monitored by the program using level switches connected to the inputs of ELC-EX16NNDR module. The FAULT function block is used to generate a warning when the fluid level falls below the warning level and a fault when the fluid level falls below the fault level. A stack light is turned on when either of the events occur.





FILT—Single-Pole Low Pass Filter



The FILT function block is a single-pole low pass filter that filters the input signal. The time constant is defined by FTIME.

The filter is implemented per the equation below.

$$OUT_n = OUT_{(n-1)} + (IN - OUT_n) \times \left(\frac{Program\ Scan\ Time(ms)}{FTIME}\right)$$

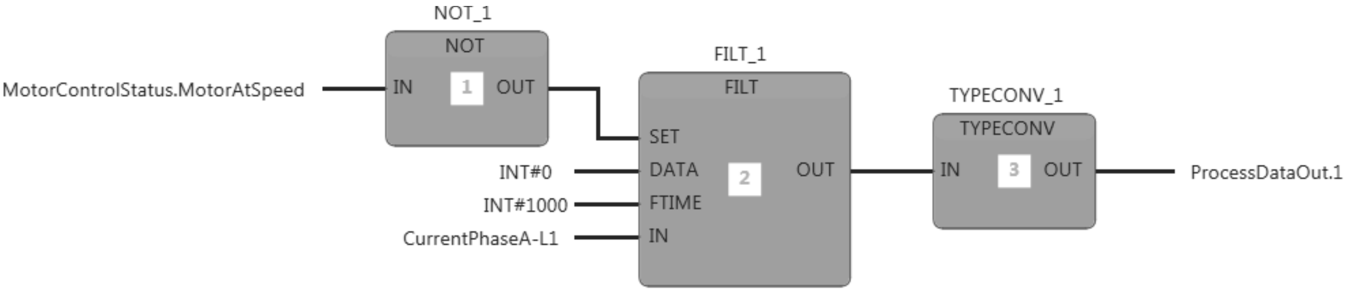
For the proper operation of the filter, FTIME has to be greater than or equal to the program scan time.

The filter can be pre-initialized using the SET and DATA inputs. When SET is true, the output of the filter is pre-initialized with the value specified by the DATA input.

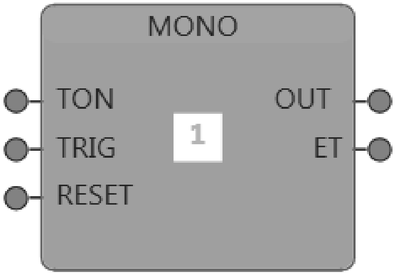
Parameter	Data type	Description
SET	BOOL	Pre-initialize filter command
DATA	INT	Pre-initialize filter data
FTIME	INT	Filter time constant in milliseconds
IN	INT	Signal to be filtered
OUT	INT	Filtered output

Example

In the following example, the FILT block is used to filter the Phase A current with the time constant at 1 second and the program scan time set at 10 ms. The filtered current is made available through a process data out. The filter is cleared when the motor is stopped.

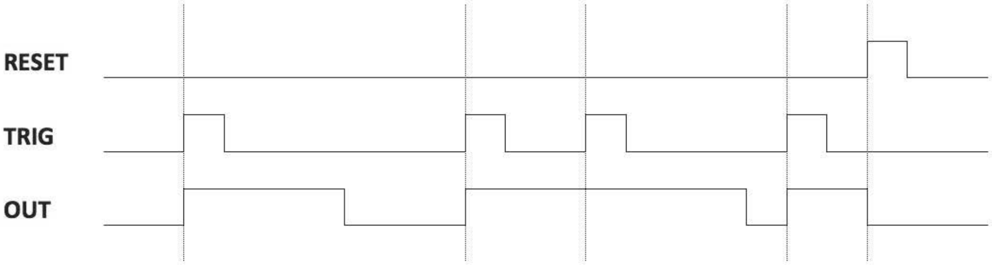


MONO—Monostable Multivibrator

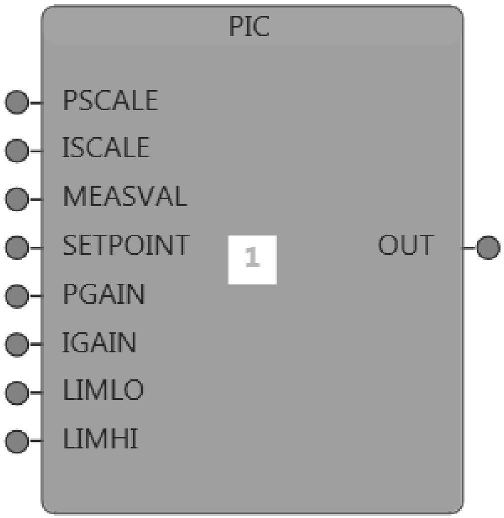


The MONO function block is a monostable multivibrator that generates an output pulse of duration defined by TON when a rising edge trigger is detected in the TRIG input. If a new trigger is detected before the output pulse has completed, the pulse is stretched out by another full pulse duration. The reset clears the OUT irrespective of the state of TON and TRIG.

Parameter	Data type	Description
TON	UINT	Pulse duration (x1ms, x10ms, 100ms, x1s)
TRIG	BOOL	Input trigger
RESET	BOOL	Reset
OUT	BOOL	Generated pulse
ET	UINT	Elapsed time since pulse start



PIC—Proportional Integral Controller



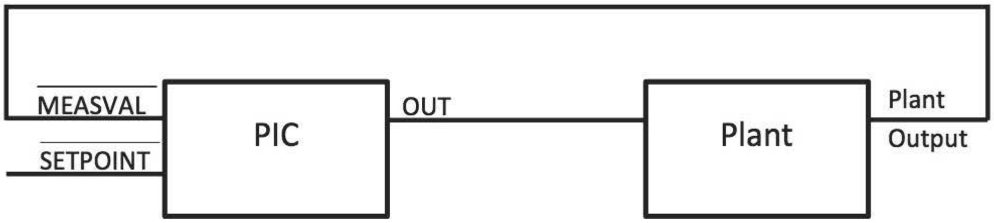
The PI function block is a proportional- and integral-based closed loop controller that tries to bring the error between the set-point command value and the measured feedback value from the plant using the provided gains.

This can be used to control parameters of a plant. Some examples would be temperature, pressure, flow, etc.

A typical use of the block would be to have:

1. A user-defined set-point that can be provided through any source such as an analog input or a process data in.
2. The output of the PIC connected to the plant, usually some driver.
3. The output of the plant fed back to the PI block through any analog source.

When the block starts executing, the PIC function block will try to reduce the error between the MEASVAL and the SETPOINT by altering the OUT.



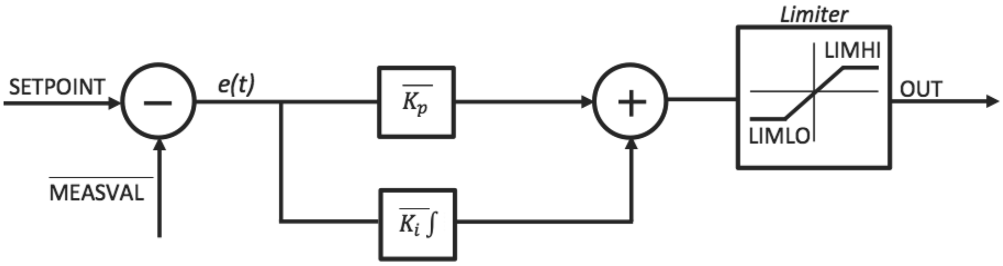
The internal implementation of the PI function block.

$$K_i = \frac{IGAIN}{ISCALE}$$

$$K_p = \frac{PGAIN}{PSCALE}$$

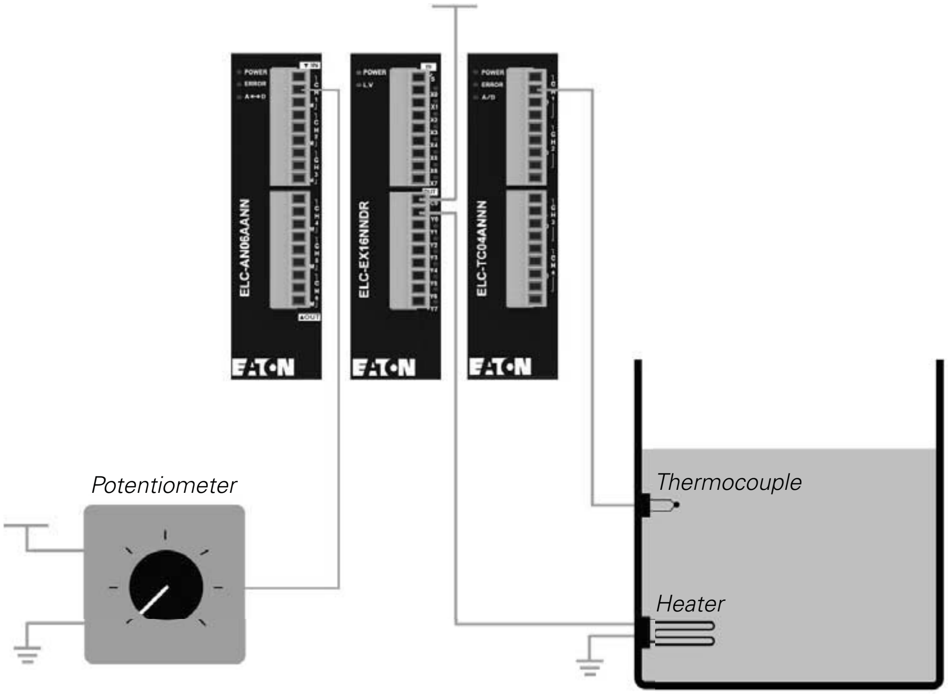
$$e(t) = MEASVAL - SETPOINT$$

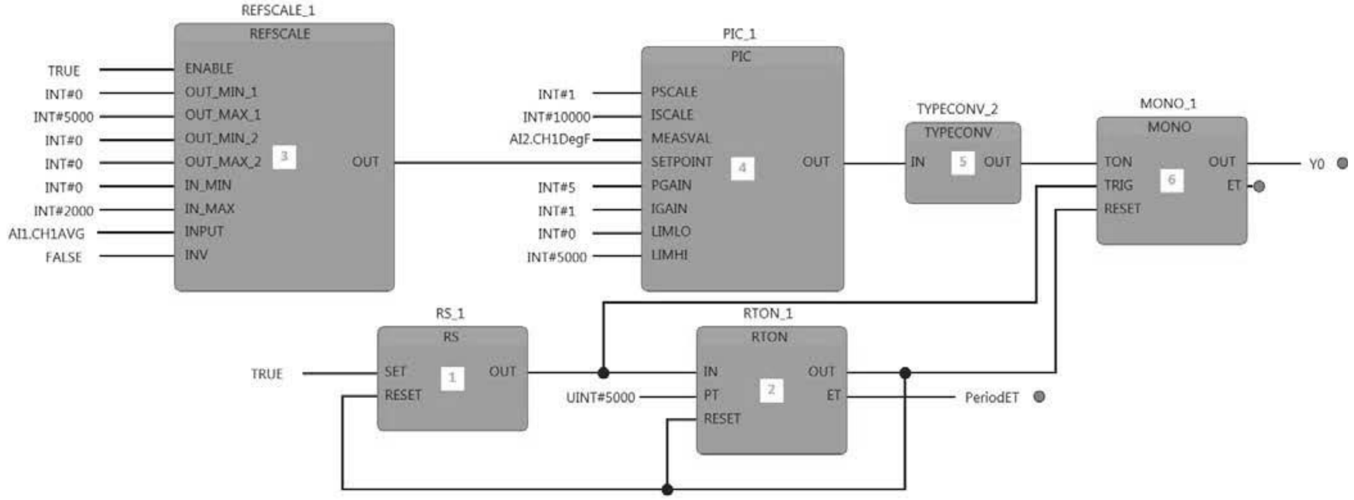
$$OUT(t) = \begin{cases} K_p e(t) + K_i \int_0^t e(t)dt\,, \; if \; LIMLO \leq OUT(t) \leq LIMHI \\ LIMLO, \; if \; OUT(t) < LIMLO \\ LIMHI, \; if \; OUT(t) \; > LIMLO \end{cases}$$



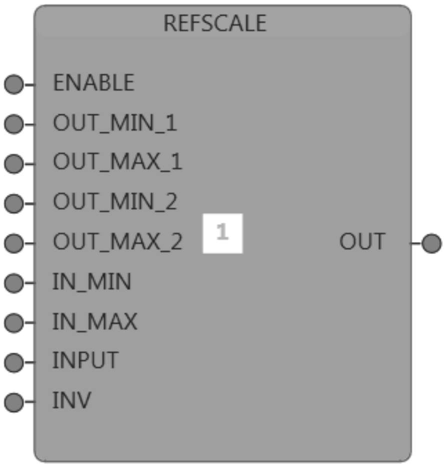
Parameter	Data type	Description
PSCALE	INT	Divider for K_p
ISCALE	INT	Divider for K_i
MEASVAL	INT	Feedback from the plant
SETPOINT	INT	Set-point command
PGAIN	INT	Multiplier for K_p
IGAIN	INT	Multiplier for K_i
LIMLO	INT	Output limiter lower bound
LIMHI	INT	Output limiter upper bound

In the following example, a proportional integral controller (PIC) is used to regulate the temperature of a liquid. The temperature is measured using an ELC-TC04ANN thermocouple module connected to the MEASVAL of the PIC controller acting as the feedback. The heater is turned ON/OFF using the Y0 relay output of ELC-EX16NNDR. The reference temperature is input from a potentiometer. The REFSCALE function converts the 0 to 2000 count analog input range of the analog input to engineering units of 0 to 500 degrees in 0.1 degree increments. The REFSCALE output is connected to the SETPOINT of the PIC controller. The PIC function block in the program compares the reference temperature to that of the thermocouple input. The error is applied to the PIC equation, and the output of the PIC is used as the ON time of a MONOSTABLE timer. The MONOSTABLE is retriggered by a retentive timer that is triggered at a fixed rate, which is used as the period for the MONOSTABLE. This results in efficient PWM control of the heater temperature. In a real-world application, an ELC module with a transistor output module could be used to control a solid-state relay (SSR). Substitution of a transistor output module and SSR for the relay module will result in greater reliability and longer life.





REFSCALE—Range Scaler



The REFSCALE function block scales INPUT within the input range specified by IN_MIN and IN_MAX to one of the output ranges specified by OUT_MIN_1 and OUT_MAX_1 or OUT_MIN_2 and OUT_MAX_2.

When OUT_MIN_2 and OUT_MAX_2 are both set to zero, OUT_MIN_1 and OUT_MAX_1 is considered as the active output range. If either OUT_MIN_2 or OUT_MAX_2 has a non-zero value, then OUT_MIN_2 and OUT_MAX_2 will be considered as the active output range.

The output range can be flipped over the horizontal axis using by setting INV to TRUE.

Internal implementation of the REFSCALE block,

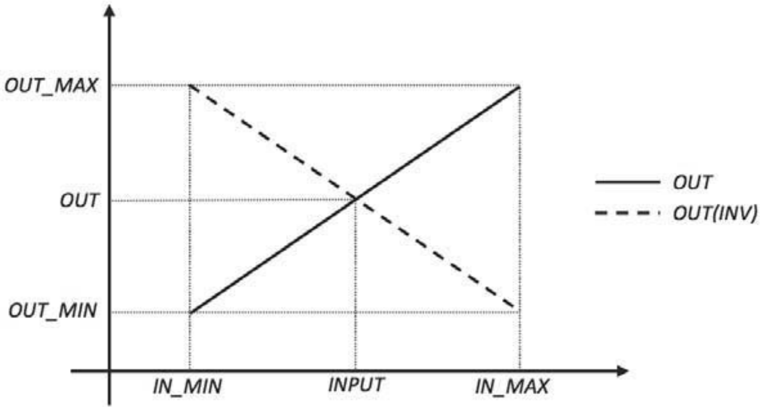
$$OUT\_MIN = \begin{cases} OUT\_MIN\_1, & if\ OUT\_MIN\_2 = 0 \text{ AND } OUT\_MAX\_2 = 0 \\ OUT\_MIN\_2, & if\ OUT\_MIN\_2 \neq 0 \text{ OR } OUT\_MAX\_2 \neq 0 \end{cases}$$

$$OUT\_MAX = \begin{cases} OUT\_MAX\_1, & if\ OUT\_MIN\_2 = 0 \text{ AND } OUT\_MAX\_2 = 0 \\ OUT\_MAX\_2, & if\ OUT\_MIN\_2 \neq 0 \text{ OR } OUT\_MAX\_2 \neq 0 \end{cases}$$

$$m = \frac{OUT\_MAX - OUT\_MIN}{IN\_MAX - IN\_MIN}$$

$$\bar{m} = \frac{OUT\_MIN - OUT\_MAX}{IN\_MAX - IN\_MIN}$$

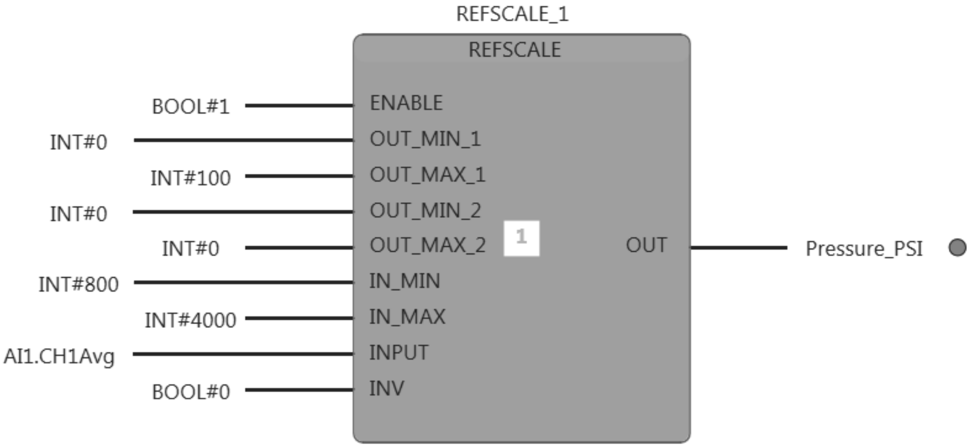
$$OUT = \begin{cases} m \times (INPUT - IN\_MIN) + OUT\_MIN, & if\ INV = FALSE\ AND\ ENABLE = TRUE \\ \bar{m} \times (INPUT - IN\_MIN) + OUT\_MAX, & if\ INV = TRUE\ AND\ ENABLE = TRUE \\ \qquad 0, \quad if\ ENABLE = FALSE \end{cases}$$

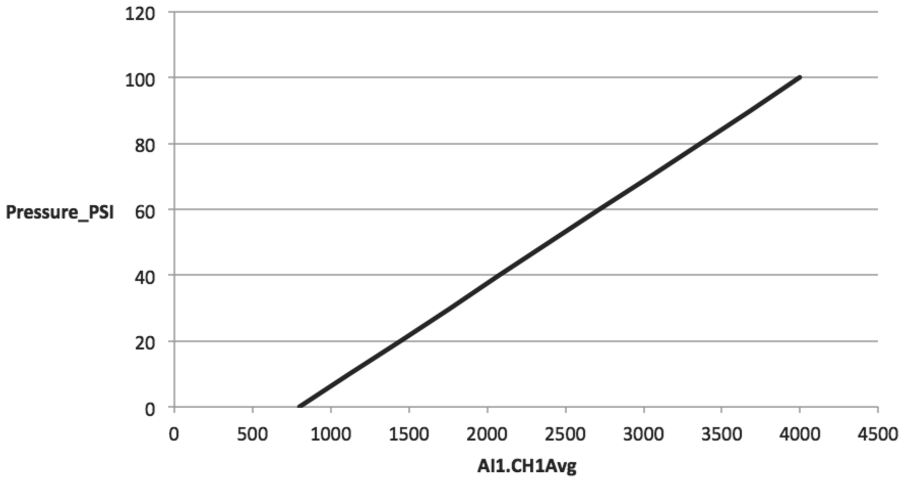


Parameter	Data type	Description
ENABLE	BOOL	Enable scaling
OUT_MIN_1	INT	Output range 1 – lower limit
OUT_MAX_1	INT	Output range 1 – upper limit
OUT_MIN_2	INT	Output range 2 – lower limit
OUT_MAX_2	INT	Output range 2 – upper limit
IN_MIN	INT	Input range lower limit
IN_MAX	INT	Input range upper limit
INV	INT	Invert output

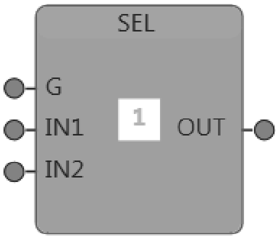
Example

In this example, a pressure sensor is connected to the CH1 input of an ELC-AN04ANNN module in 4–20 mA, which when read, produces a decimal value of 800–4000. This decimal value can be scaled to a PSI value ranging from 0 to 100.





SEL—Select



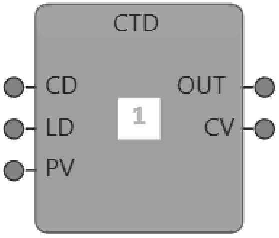
The SEL function block is a selector switch that can switch between two input sources based on the selector input G.

G	OUT
0	IN1
1	IN2

Parameter	Data type	Description
G	BOOL	Selector
IN1	BOOL, INT, DINT, UINT, REAL	Input 1
IN2	BOOL, INT, DINT, UINT, REAL	Input 2
OUT	BOOL, INT, DINT, UINT, REAL	Output

Timers and Counters Group

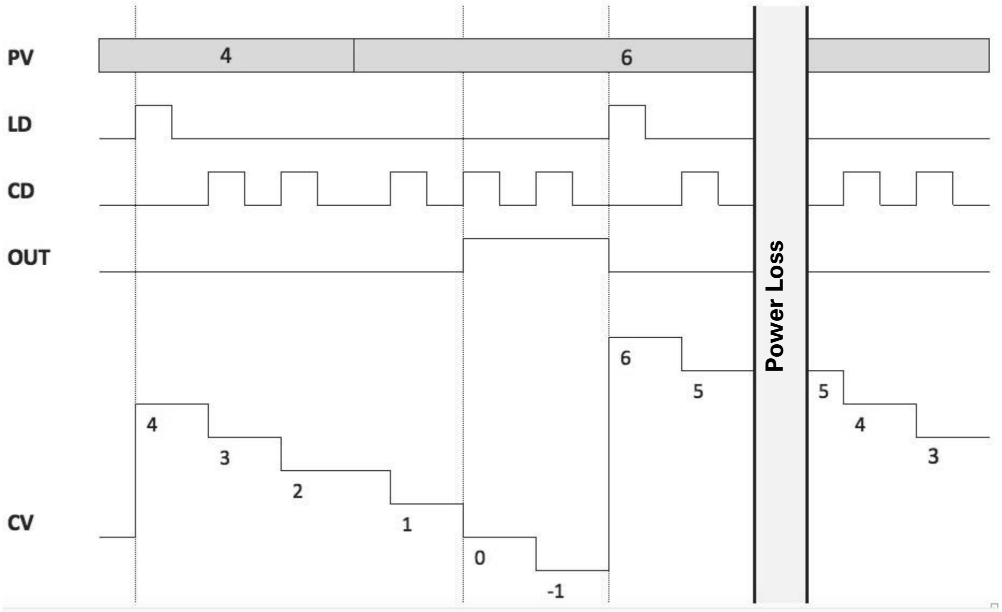
CTD—Down Counter



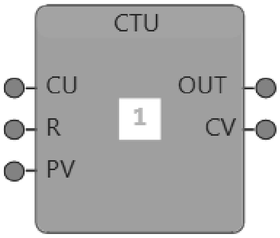
The CTD function block is a down counter that decrements the counter value (CV) by one at the rising edge of the count down (CD) trigger. The counter value is preloaded with the preset value (PV) at the rising edge of load preset (LD) trigger. The counter value is persistent through power cycle of the device.

$$OUT = \begin{cases} FALSE, & if CV > 0 \\ TRUE, & if\ CV \leq 0 \end{cases}$$

Parameter	Data type	Description
CD	BOOL	Count down trigger – rising edge
LD	BOOL	Trigger to preload counter with PV
PV	INT	Preset value
OUT	BOOL	Countdown complete flag
CV	INT	Counter value



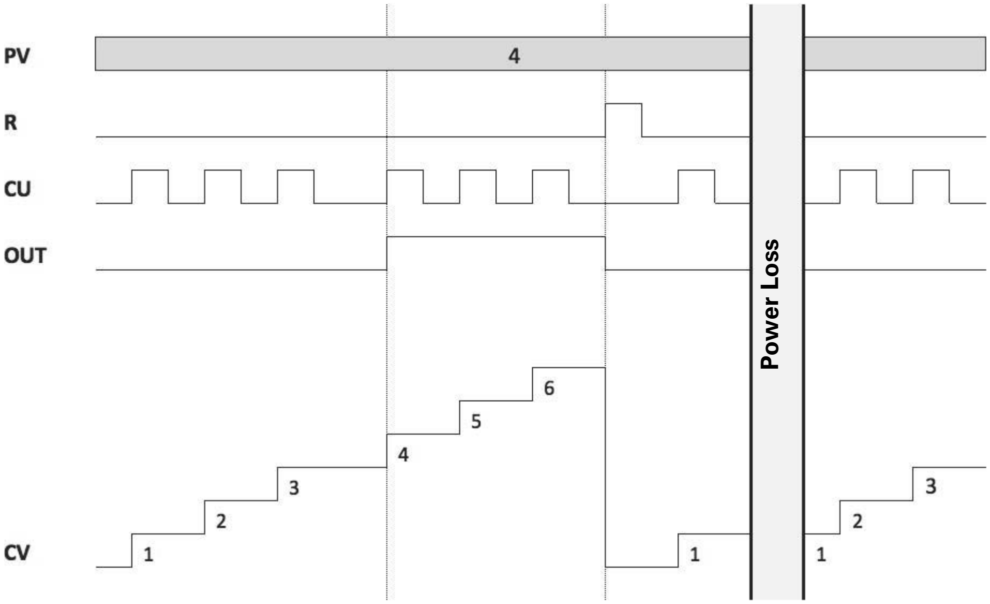
CTU—Up Counter



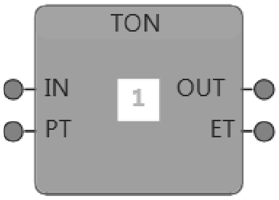
The CTU function block is an up counter that increments the counter value (CV) by one at the rising edge of the count up (CU) trigger. A rising edge reset (R) trigger will clear the counter value irrespective of the state of other inputs. The counter value is persistent through power cycle of the device.

$$OUT = \begin{cases} FALSE, & if CV < PV \\ TRUE, & if\ CV \geq PV \end{cases}$$

Parameter	Data type	Description
CU	BOOL	Count up trigger—rising edge
R	BOOL	Reset counter value
PV	INT	Preset value
OUT	BOOL	Count-up complete flag
CV	INT	Counter value

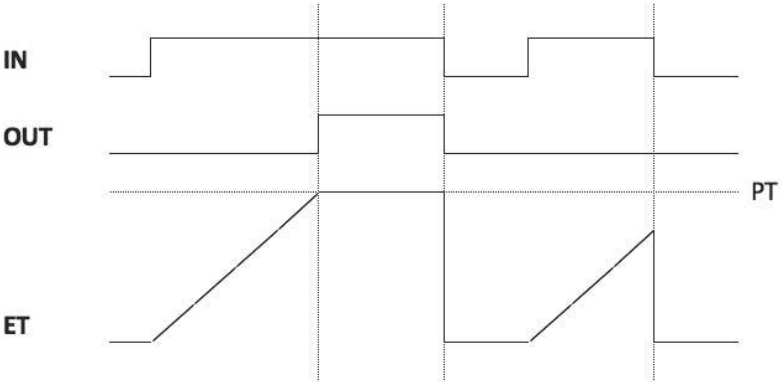


TON—On-Delay Timer

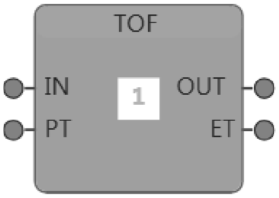


The TON function block is an on-delay timer that delays a FALSE to TRUE transition of IN to OUT by a time defined by PT. When IN is FALSE, OUT will be set to FALSE and the elapsed time (ET) will be set to zero. When IN transitions to TRUE, the timer starts running and updates the ET live. Once the timer reaches the PT, the timer stops running and sets the OUT to TRUE. If the IN transitions to FALSE before the ET could reach PT, the timer is stopped and ET is set to 0.

Parameter	Data type	Description
IN	BOOL	Input trigger to start timer—rising edge
PT	UINT	Preset time (x1ms, x10ms, 100ms, x1s)
OUT	BOOL	Timer expired flag—active high
ET	UINT	Elapsed time (x1ms, x10ms, 100ms, x1s)

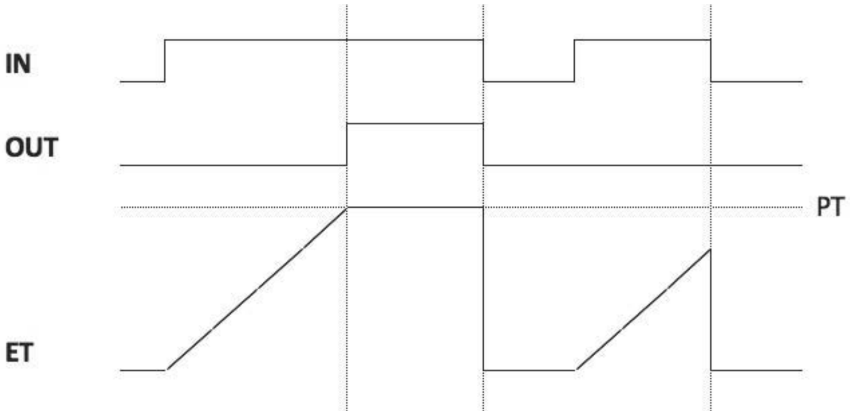


TOF—Off-Delay Timer

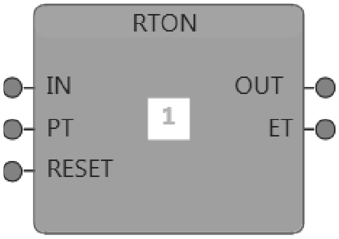


The TOF function block is an off-delay timer that delays a TRUE to FALSE transition of IN to OUT by a time defined by PT. When IN is TRUE, OUT will be set to TRUE and the elapsed time (ET) will be set to zero. When IN transitions to FALSE, the timer starts running and updates the ET live. Once the timer reaches the PT, the timer stops running and sets the OUT to FALSE. If the IN transitions to TRUE before the ET could reach PT, the timer is stopped and ET is set to 0.

Parameter	Data type	Description
IN	BOOL	Input trigger to start timer—falling edge
PT	UINT	Preset time (x1ms, x10ms, 100ms, x1s)
OUT	BOOL	Timer expired flag—active low
ET	UINT	Elapsed time (x1ms, x10ms, 100ms, x1s)

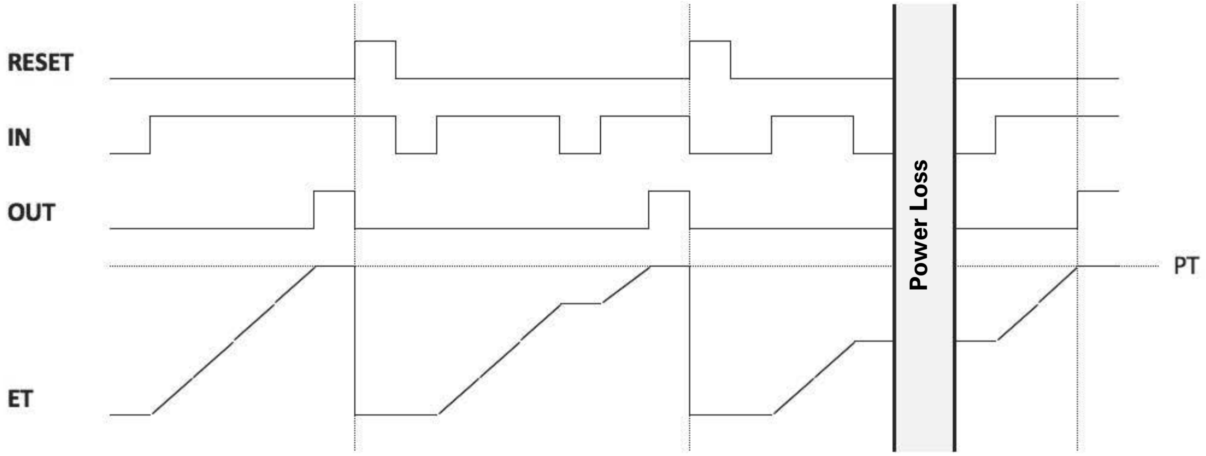


RTON—Retentive On-Delay Timer

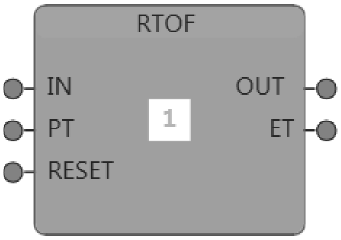


The RTON function block is a retentive on-delay timer that delays a FALSE to TRUE transition of IN to OUT by a time defined by PT. Once the timer reaches the PT, the timer stops running and sets the OUT to TRUE. This behavior is the same as that of the TON function block, but compared to TON, the RTON function block can retain the state of the timer when IN transitions from TRUE to FLASE before the timer could complete (ET = PT), essentially "pausing" the timer. When the IN transitions back to TRUE while the timer is in the paused state, the timer resumes from its retained state instead of starting from zero. The timer can be reset by providing a rising edge trigger to the RESET input. In addition to being retentive, the timer is also persistent through power cycle, meaning that the timer will retain its state in the event of a power loss to the device.

Parameter	Data type	Description
IN	BOOL	Input trigger to start timer—rising edge
PT	UINT	Preset time (x1ms, x10ms, 100ms, x1s)
RESET	BOOL	Reset timer—rising edge
OUT	BOOL	Timer expired flag—active high
ET	UINT	Elapsed time (x1ms, x10ms, 100ms, x1s)

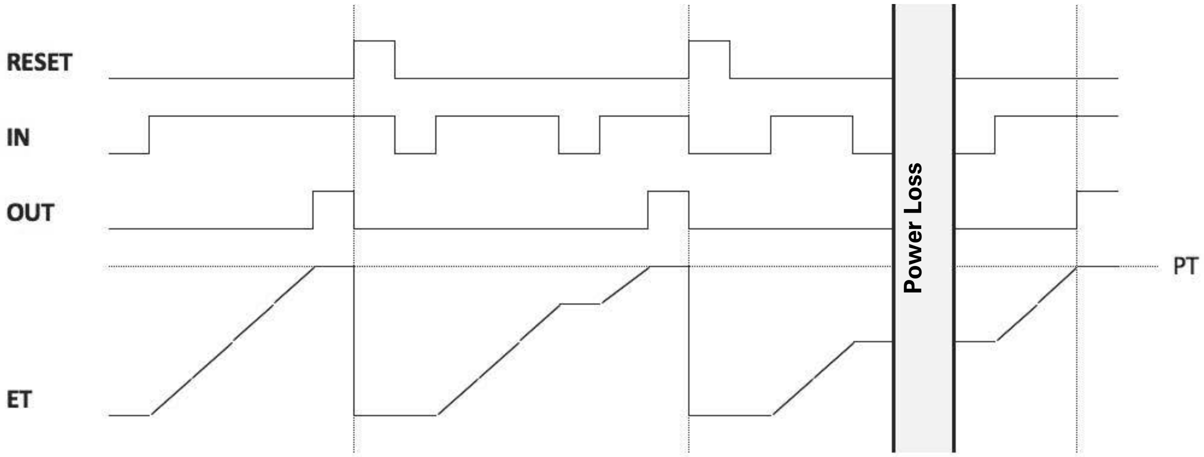


RTOF—Retentive Off-Delay Timer



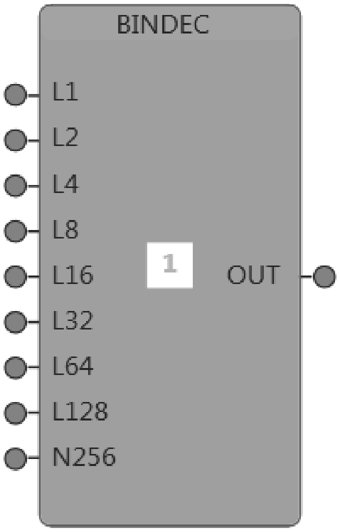
The RTOF function block is a retentive off-delay timer that delays a TRUE to FALSE transition of IN to OUT by a time defined by PT. Once the timer reaches the PT, the timer stops running and sets the OUT to FALSE. This behavior is the same as that of the TOF function block, but compared to TOF, the RTOF function block can retain the state of the timer when IN transitions from FALSE to TRUE before the timer could complete (ET = PT), essentially "pausing" the timer. When the IN transitions back to FALSE while the timer is in the paused state, the timer resumes from its retained state instead of starting from zero. The timer can be reset by providing a rising edge trigger to the RESET input. In addition to being retentive, the timer is also persistent through power cycle, meaning that the timer will retain its state in the event of a power loss to the device.

Parameter	Data type	Description
IN	BOOL	Input trigger to start timer—falling edge
PT	UINT	Preset time (x1ms, x10ms, 100ms, x1s)
RESET	BOOL	Reset timer—rising edge
OUT	BOOL	Timer expired flag—active low
ET	UINT	Elapsed time (x1ms, x10ms, 100ms, x1s)



Type Conversion Group

BINDEC—Binary to Decimal with Offset



The BINDEC function block is an 8-bit binary to decimal converter with an INT offset. Using this block, any number between –32768 and 32767 can be realized. Inputs L1 to L128 are 8-bit inputs and N256 is the INT offset.

The implementation is as shown below.

$$OUT = L1\times1 + L2\times2 + L4\times4 + L8\times8 + L16\times16 + L32\times32 + L64\times64 + L128\times128 + N256$$

Parameter	Data type	Description
L1	BOOL	Binary input bit 0
L2	BOOL	Binary input bit 1
L4	BOOL	Binary input bit 2
L8	BOOL	Binary input bit 3
L16	BOOL	Binary input bit 4
L32	BOOL	Binary input bit 5
L64	BOOL	Binary input bit 6
L128	BOOL	Binary input bit 7
N256	INT	Offset
OUT	INT	Decimal output

Examples

L128…L1	N256	OUT
01000001	500	565
00100000	1000	1032
01111110	1250	1376

BITGET—Extract Bit

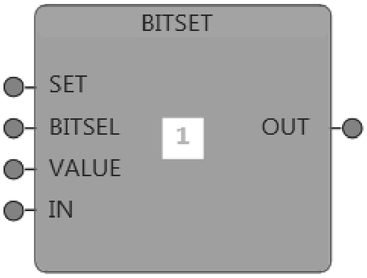
The BITGET function block extracts the bit at the bit position specified by BITSEL from the 16-bit value at IN.

Parameter	Data type	Description
BITSEL	INT	Bit position (0–15) to extract
IN	UINT	16-bit input
OUT	BOOL	Extracted bit

Examples

IN	BITSEL	OUT
65(00000000 0100000**1**)	0	TRUE
32(00000000 00**1**00000)	5	TRUE
12612(001100**0**1 01000100)	9	FALSE

BITSET—Set Bit



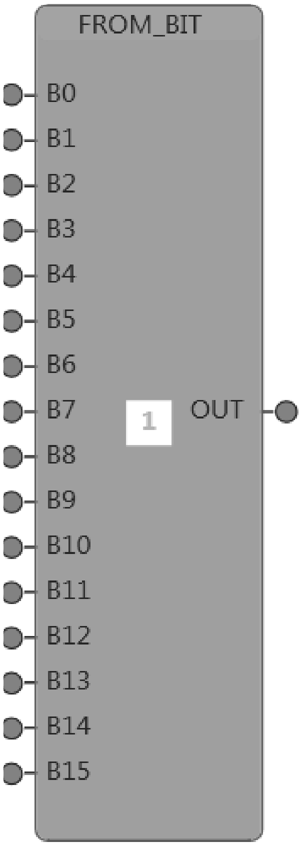
The BITSET function block can set or clear a bit specified by VALUE at the bit position specified by BITSEL of the 16-bit value IN and makes the modified 16-bit value available at the OUT. The bit modification happens only if the SET is set to TRUE else IN is just copied to the OUT.

Parameter	Data type	Description
SET	BOOL	Perform bit setting
BITSEL	INT	Bit position (0–15) to set
VALUE	BOOL	Set/Clear the bit
IN	UINT	16-bit input
OUT	UINT	Bit modified IN

Examples

IN	VALUE	BITSEL	OUT
65(00000000 01000001)	TRUE	2	67(00000000 010000**1**1)
32(00000000 00100000)	TRUE	6	96(00000000 0**1**100000)
12612(00110001 01000100)	FALSE	12	8516(001**0**0001 01000100)

FROM_BIT—Binary to Decimal



The FROM_BIT function block constructs a 16-bit UINT value using 16 individually controllable bits.

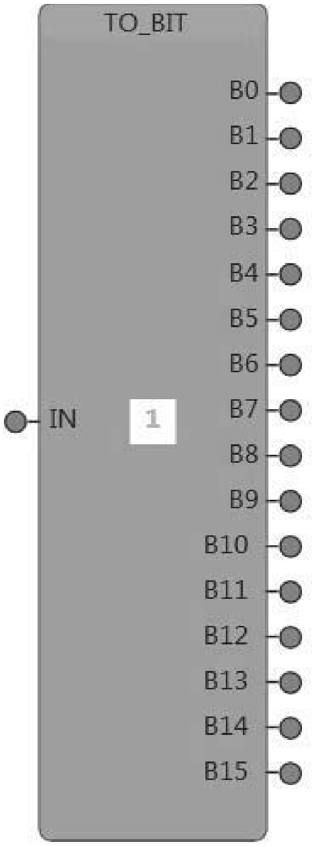
$$OUT = \sum_{n=0\ to\ 15} Bn \times 2^n$$

Parameter	Data type	Description
B0…B15	BOOL	Set/Clear for bits 0 to 15
OUT	UINT	Constructed 16-bit value

Examples

B15…B0	OUT
00000000 01000001	65
00000000 00100000	32
00110001 01000100	12612

TO_BIT—Decimal to Binary



The TO_BIT function block extracts all 16-bits of a 16-bit UINT value.

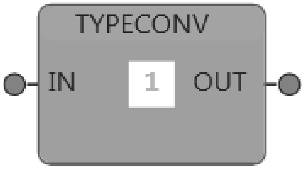
$$Bn_{n=0\ to\ 15} = \left(\frac{IN}{2^n}\right)\%2$$

Parameter	**Data type**	**Description**
IN	UINT	16-bit input
B0…B15	BOOL	Extracted bits of IN

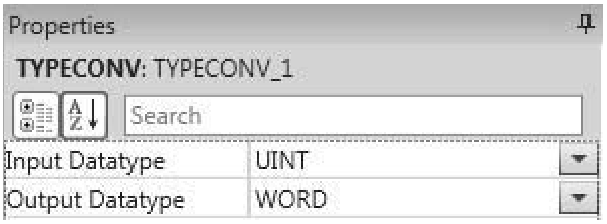
Examples

OUT	**B15…B0**
65	00000000 01000001
32	00000000 00100000
12612	00110001 01000100

TYPECONV—Data type conversion



The TYPECONV function block converts between any of the supported data types—BOOL, SINT, INT, DINT, USINT, UINT, UDINT, REAL, BYTE, WORD, DWORD. The input and output data types can be chosen from the property inspector as shown below.



TYPECONV: TYPECONV_1

Input Datatype UINT

Output Datatype WORD

Parameter	Data type	Description
IN	BOOL, SINT, INT, DINT, USINT, UINT, UDINT, REAL, BYTE, WORD, DWORD	Input to be type converted
OUT	BOOL, SINT, INT, DINT, USINT, UINT, UDINT, REAL, BYTE, WORD, DWORD	Type converted IN

Accessing C445 System Parameters with the Logic Engine

C445 System Parameters are accessible in the Logic Engine in the Variables window. Open the Variables List, then System Parameters.

There are 2 categories under System Parameters.

1. System In
2. System Out

System In parameters are parameters that can be monitored from the C445 Motor Management Relay and the System Out parameters are parameters that can be used to control the C445. There are multiple categories under both the System In and System Out categories, to make finding specific parameters easier.

For example, to monitor the running status of the motor being controlled by the C445, the "MotorControlStatus.Running1" bit can be found under the System In / Control Monitor Control Source Status / Motor Control Status category. If the Logic Engine is the Remote Control source and the active control source for the C445 is the Remote control source, the Logic Engine can access the "LogicMotorControlWord.Run1" bit under the System Out / Logic Motor Control category and use it to run the motor.

For additional information concerning the system parameters, refer to the Modbus Register map in **Appendix D**.

C445 Expansion Inputs and Outputs

Connecting and Configuring Expansion I/O for the C445

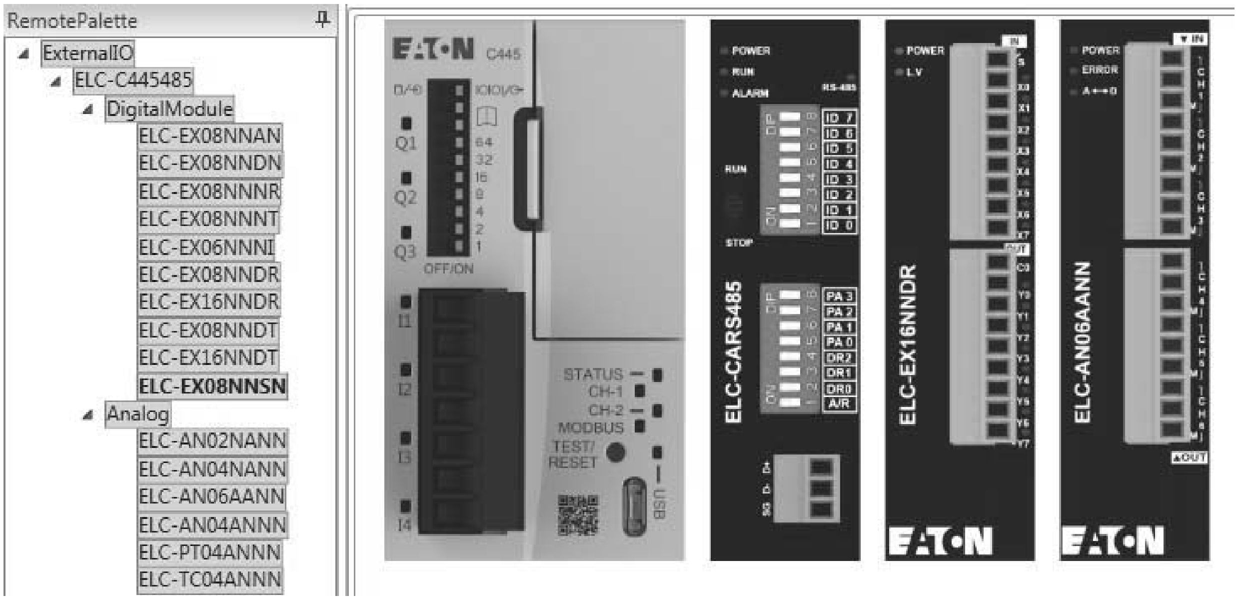
When expansion I/O modules are added to a C445 using the Logic and Expansion I/O software tool, these I/O variables, both digital and analog become accessible in the Logic Engine. Toggle between the Logic Engine and the expansion I/O configuration with the icons shown below.

Access the Logic

RIO Access the Expansion I/O Configurator

Note that the I/O can be used without the Logic Engine. Configure the I/O in the Expansion I/O Configurator page and leave the Logic Engine canvas empty. Then, download the I/O configuration to the C445 with no program. Conversely, the Logic Engine can be used without expansion I/O. Write a logic program compile it and download it to the C445, without adding any I/O modules using the Expansion I/O Configurator page.

Below is a C445 with a digital and an analog expansion I/O module. Simply double click an I/O module on the left to add it to the expansion I/O on the right. The first I/O module added to the C445 also adds the ELC-CARS485 adapter.



Connecting the ELC-CARS485 module to the C445

The default interface parameters for the RS-485 port on the C445 that the ELC-CARS485 module connects to are as follows:

Baud Rate: 115.2K

Parity: Even

Bits/byte: 8

Stop Bits: 1

Mode: RTU

For these default interface parameters, the DIP switches on the ELC-CARS485 module must be set as follows:

PA3—OFF
PA2—ON
PA1—OFF
PA0—ON
DR2—ON
DR1—ON
DR0—ON
A/R—OFF

To change these default interface parameters on the C445, use either the C445UM User Interface or the Power Xpert *in*Control software. The DIP switch settings for the various interface parameter options for the ELC-CARS485 module can be found in publication MN05002003E.

Note: Parity None is not supported.

The second set of DIP switches on the ELC-CARS485 module are for its node address. The address set on these DIP switches for this module must match the address configured for it in the C445 using the user interface or the *in*Control software. This parameter can be found in either tool under the Expansion IO category.

DIP switches labeled ID0 through ID7 are for the node ID. Weighted binary is used where the least significant DIP switch is ID0. For example, if ID2 and ID0 are ON and all the others are OFF, the unit, following a power cycle will be node ID 5.

Connect the ELC-CARS485 module to the RS-485 port on the bottom of the C445 Base Control Module as follows:

C445/BCM		ELC-CARS485
D0	--------------------------	D–
D1	--------------------------	D+
C	--------------------------	SG

To configure the C445 RS-485 port to communicate with the Expansion I/O, use one of the two methods.

1. C445UM User Interface.

   Configure the following parameters with the User Interface:

   1.9. Communications / 1. Modbus / 1. Base Control Module 485 port mode / ELC IO

   2.15. Expansion IO / 2. Expansion IO Comm Config / 1. ELC IO Modbus Address / Make it the same address set on the ELC-CARS485 Adapter DIP switches ID0-ID7.

   3.15. Expansion IO / 3. ELC IO Setup Config / Enter the number of digital inputs, the number of digital outputs and any analog or temperature cards by part number in the order they appear to the right of the ELC-CARS485 adapter. The analog and temperature modules are listed and just need to be selected from a list.

2. The Power Xpert *in*Control software tool. This tool can be found at the following website as a free download: www.eaton.com/c445.

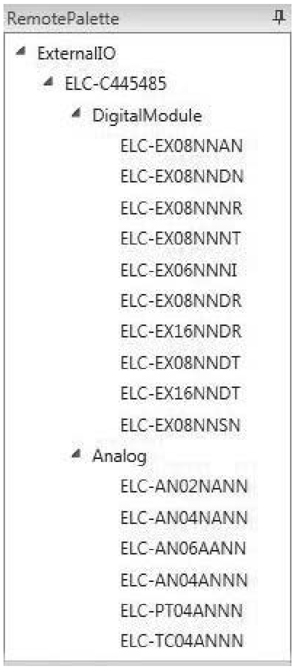
   1. Under the Communications / Modbus category, then Advanced Settings, change the BCM 485 port mode to ELC IO.
   2. Expansion IO
   3. To configure the digital and analog IO modules, use the Logic Engine programming tool and configure the Expansion IO per the instructions below.

Adding Input and Output Modules with the Expansion IO Configurator

After starting the Logic Engine programming tool, the Logic Engine window will be displayed. From the toolbar, select the following icon to access the Expansion I/O Configurator:

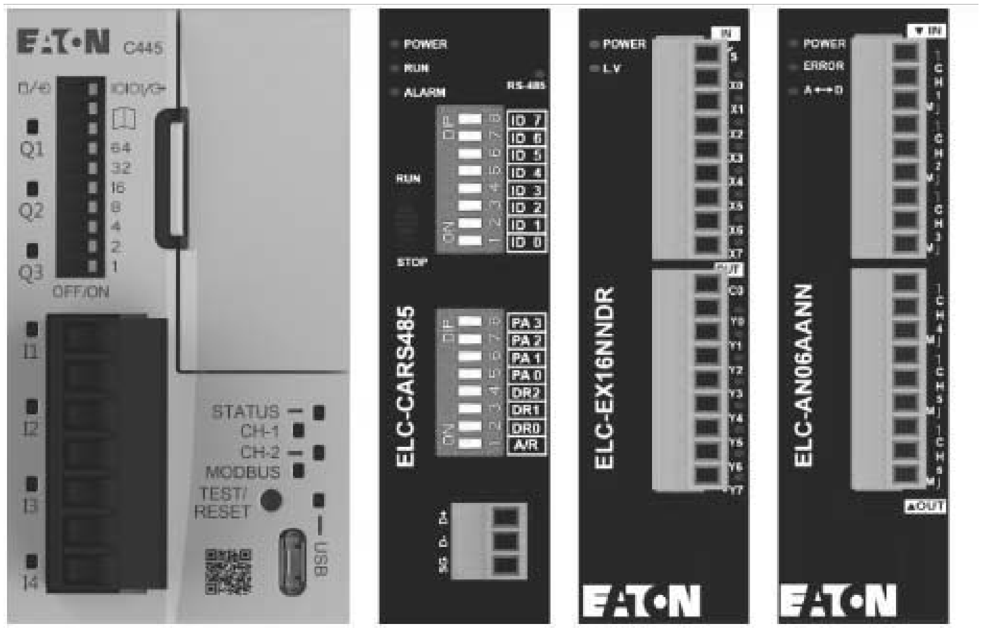
RIO Access the Expansion I/O Configurator

In the Remote Palette on the left, open the Expansion I/O to reveal all available I/O modules as shown below.

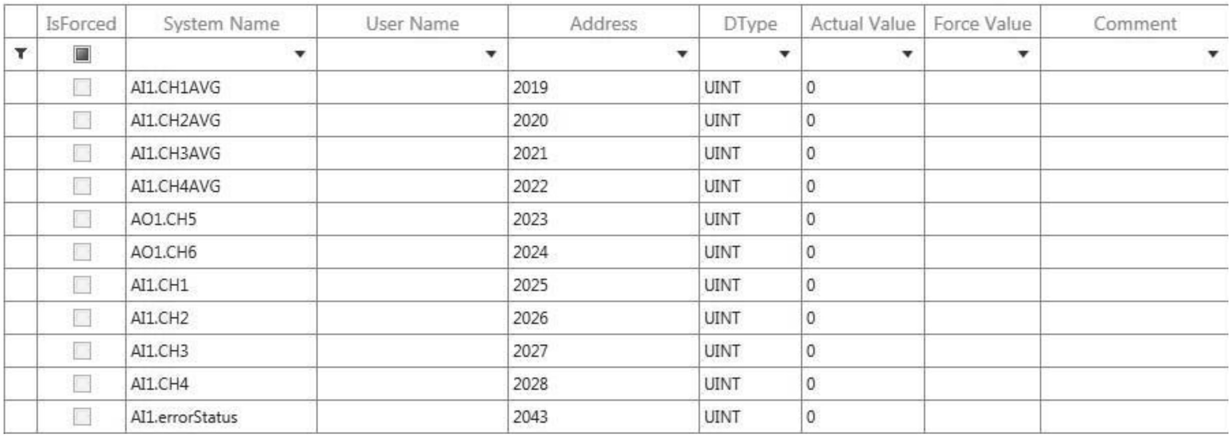


RemotePalette
- ExternalIO
  - ELC-C445485
    - DigitalModule
      - ELC-EX08NNAN
      - ELC-EX08NNDN
      - ELC-EX08NNNR
      - ELC-EX08NNNT
      - ELC-EX06NNNI
      - ELC-EX08NNDR
      - ELC-EX16NNDR
      - ELC-EX08NNDT
      - ELC-EX16NNDT
      - ELC-EX08NNSN
    - Analog
      - ELC-AN02NANN
      - ELC-AN04NANN
      - ELC-AN06AANN
      - ELC-AN04ANNN
      - ELC-PT04ANNN
      - ELC-TC04ANNN

To add an I/O module to the C445 on the right, double click the I/O modules in the order they are to appear. The first I/O module selected will also add the necessary ELC-CARS485 communication adapter. After double clicking the ELC-EX16NNDR followed by the ELC-AN06AANN module, the C445 screen should look like the following.

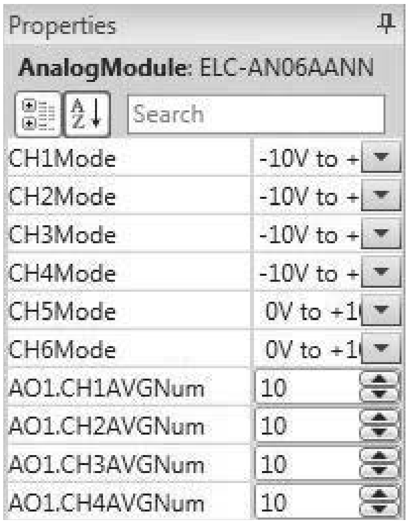


There is nothing to configure for the digital modules, but the analog module channels need to be configured for the analog type. Select the analog module and below it will be displayed the variables available for it in the Logic Engine. The Average values are the analog input signals averaged over a default of 10 samples. The other values for the analog inputs are instantaneous values. The status for the module is also provided.



	IsForced	System Name	User Name	Address	DType	Actual Value	Force Value	Comment
	☐	AI1.CH1AVG		2019	UINT	0		
	☐	AI1.CH2AVG		2020	UINT	0		
	☐	AI1.CH3AVG		2021	UINT	0		
	☐	AI1.CH4AVG		2022	UINT	0		
	☐	AO1.CH5		2023	UINT	0		
	☐	AO1.CH6		2024	UINT	0		
	☐	AI1.CH1		2025	UINT	0		
	☐	AI1.CH2		2026	UINT	0		
	☐	AI1.CH3		2027	UINT	0		
	☐	AI1.CH4		2028	UINT	0		
	☐	AI1.errorStatus		2043	UINT	0		

Also, in the Properties window for this analog module are the selections for the analog type for each I/O channel as well as optional sample counts for average input values. There is a scale function block (REFSCALE) in the Logic Engine for scaling analog values. The “AVGNum“ or average number values are the number of samples used for the average analog input values to smooth out the signals. The default is 10 and if used, nothing needs to be entered for these parameters.



Properties

AnalogModule: ELC-AN06AANN

CH1Mode	-10V to +
CH2Mode	-10V to +
CH3Mode	-10V to +
CH4Mode	-10V to +
CH5Mode	0V to +1
CH6Mode	0V to +1
AO1.CH1AVGNum	10
AO1.CH2AVGNum	10
AO1.CH3AVGNum	10
AO1.CH4AVGNum	10

Selecting the down arrows to the right of CH1Mode through CH6Mode allows the selection for the analog type for each analog input and output. For this analog combination input and output module, CH1 through CH4 are the inputs and CH5 and CH6 are the analog outputs.

Analog input mode selections:

–10 Vdc to +10 Vdc

–6 Vdc to +10 Vdc

–12 mA to +20 mA

–20 mA to +20 mA

Analog output mode selections:

0 Vdc to +10 Vdc

+2 Vdc to +10 Vdc

+4 mA to +20 mA

0 mA to +20 mA

Refer to the Instruction Leaflet for each analog module, thermocouple module and RTD module for the decimal range for each input or output type and specifications and wiring.

ELC-AN04ANNN: IL05003002E
ELC-AN04NANN: IL05003014E
ELC-AN02NANN: IL05003001E
ELC-AN06AANN: IL05003003E
ELC-TC04ANNN: IL05003009E
ELC-PT04ANNN: IL05003008E

The Instruction Leaflet for the Digital I/O modules is shown below:

ELC Digital I/O Cards: IL05003004E
ELC-EX08NNSN: IL05003017E
ELC-CARS485 User Manual: MN05002003E

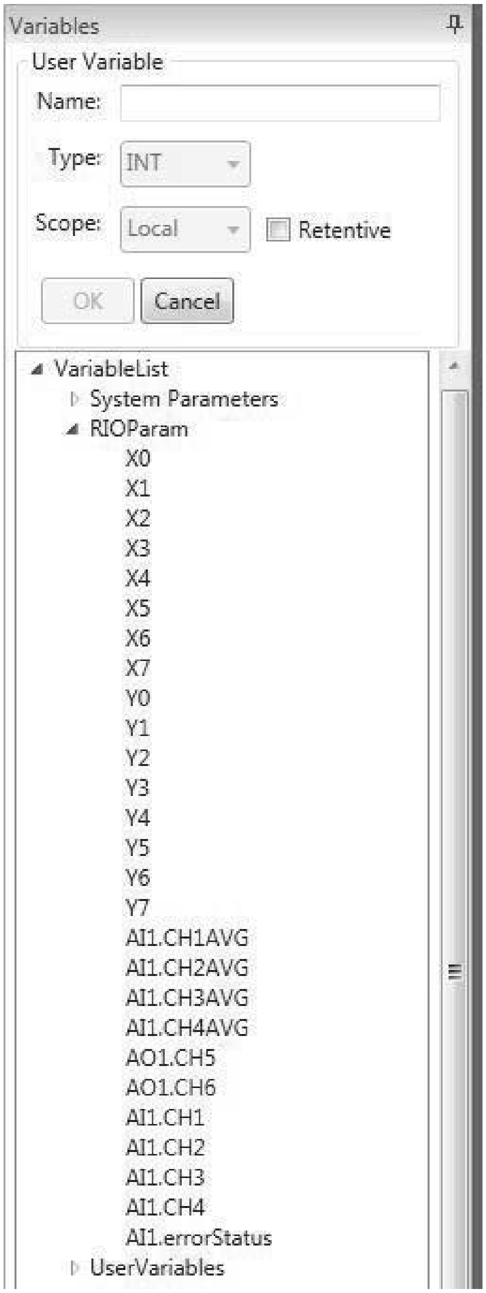
These documents can be found at: www.eaton.com/c445

Accessing Expansion I/O with the Logic Engine

Once the I/O modules are added and the analog modules configured, switch to the Logic Engine by selecting the following icon on the toolbar.

Access the Logic

On the Variables window on the right, open the Variable List, then the RIOParam list as follows.



Name:

Type: INT

Scope: Local ☐ Retentive

- VariableList
  - System Parameters
  - RIOParam
    - X0
    - X1
    - X2
    - X3
    - X4
    - X5
    - X6
    - X7
    - Y0
    - Y1
    - Y2
    - Y3
    - Y4
    - Y5
    - Y6
    - Y7
    - AI1.CH1AVG
    - AI1.CH2AVG
    - AI1.CH3AVG
    - AI1.CH4AVG
    - AO1.CH5
    - AO1.CH6
    - AI1.CH1
    - AI1.CH2
    - AI1.CH3
    - AI1.CH4
    - AI1.errorStatus
  - UserVariables

These variables are for the combo 8 input (X0-X7) / 8 output (Y0-Y7) digital I/O card added earlier and for the 4 input / 2 output combo analog module added earlier. These variables are available to the Logic Engine. Refer to the Logic Engine Function Blocks described earlier in this chapter.

Addressing Digital Inputs

The digital input modules are addressed based on their position to the right of the communication adapter. The inputs for the first digital input module to the right of the adapter will always be X0–X7. If it is a module with 4 inputs the inputs will be addressed X0–X3. X4–X7 will simply be unused (this applies to all subsequent input modules as well). The next digital input module will be addressed as X10–X17, then X20–X27 through X70–X77 for the eighth digital input module. Note that the addresses are using the octal number system. Even if there are digital output and/or analog I/O cards between the first digital input card and the adapter, the input addresses for the digital input cards will be the same.

Addressing Digital Outputs

The digital output modules are addressed based on their position to the right of the communication adapter just as the digital inputs. The outputs for the first digital output module to the right of the adapter will always be Y0–Y7. If it is a module with 4 outputs the outputs will be addressed Y0-Y3. Y4–Y7 will simply be unused (this applies to all subsequent output modules as well). The next digital output module will be addressed as Y10-Y17, then Y20-Y27 through Y70-Y77 for the eighth output module. Note that the addresses are using the octal number system. Even if there are digital input and/or analog I/O cards between the first digital output card and the adapter, the output addresses for the digital output cards will be the same.

Addressing Combination Digital I/O cards

Combo digital I/O cards will have either 4 inputs and 4 outputs or 8 inputs and 8 outputs. The same addressing rules apply as described above. The combo cards are treated the same as far as addressing is concerned as if they were separate cards. For example, if an ELC-EX16NNDR 8 input and 8 output digital I/O card is the first digital card to the right of the adapter, the inputs are addressed as X0-X7 and the outputs as Y0-Y7.

A maximum of 16 I/O modules can be added to the ELC-CARS485 adapter. Any combination of 16 digital and analog modules, including thermocouple and RTD input modules can be added and accessed by the Logic Engine with a maximum of 8 analog modules. Below is how the digital I/O is addressed, assuming 16 digital modules are used, with 8 inputs and 8 outputs per module. Octal addressing is used due to the ease of using this number system when each card has 8 inputs and/or 8 outputs. Even for combination digital I/O cards that have 4 inputs and 4 outputs a full byte for the 4 bits of input and output data is allocated. In that case, only the low 4 bits of the input and output data is utilized. X represents inputs and Y outputs.

The addressing for the digital cards, whether separate or combo cards are as follows:

Module 1: X0-X7, Y0-Y7
Module 2: X10-X17, Y10-Y17
Module 3: X20-X27, Y20-Y27
Module 4: X30-X37, Y30-Y37
Module 5: X40-X47, Y40-Y47
Module 6: X50-X57, Y50-Y57
Module 7: X60-X67, Y60-Y67
Module 8: X70-X77, Y70-Y77
Module 9: X100-X107, Y100-Y107
Module 10: X110-X117, Y110-Y117
Module 11: X120-X127, Y120-Y127
Module 12: X130-X137, Y130-Y137
Module 13: X140-X147, Y140-Y147
Module 14: X150-X157, Y150-Y157
Module 15: X160-X167, Y160-Y167
Module 16: X170-X177, Y170-Y177

Addressing Analog I/O

Analog I/O modules will provide I/O addresses based on whether they are analog/temperature input modules, analog output modules or the analog I/O combination module. Again, a maximum of 8 analog modules are allowed.

Note, the Expansion I/O configurator software will display the proper I/O addresses for each module when it is selected. These addresses will then also be populated in the Logic Engine under VariableList/RIOParam.

If, for example, 3 digital modules are used, but an analog module is between the second digital module and the third digital module, the addressing used for the digital I/O on the 3 cards is the same as if the analog module was not present. Analog I/O addresses contain an I for input or a Q for output along with a number associated with its position relative to other analog modules. In other words, the first occurrence of an analog module to the right of the CARS-485 module is 1. If 8 analog modules are used, they will be 1-8. For analog inputs, there are 2 values for each input. One is an average value of 10 samples and the other is an instantaneous value. The average value will be a much smoother value, but the instantaneous value will show a change in the signal faster. The average value of 10 is configurable.

Expansion I/O Pass-through to fieldbus networks

Supported modules

Digital:

ELC-EX08NNDR: 4 24 Vdc inputs and 4 relay outputs

ELC-EX08NNDT: 4 24 Vdc inputs and 4 24 Vdc transistor outputs

ELC-EX16NNDR: 8 24 Vdc inputs and relay outputs

ELC-EX16NNDT: 8 24 Vdc inputs and 8 24 Vdc transistor outputs

ELC-EX08NNDN: 8 24 Vdc inputs

ELC-EX08NNAN: 8 120 Vac inputs

ELC-EX08NNNR: 8 relay outputs

ELC-EX08NNNT: 8 24 Vdc transistor outputs

ELC-EX06NNNI: 6 high current relay outputs (6 amps/point)

ELC-EX08NNSN: 8 toggle switch inputs

Analog:

ELC-AN04ANNN: 4 analog inputs

ELC-AN02NANN: 2 analog outputs

ELC-AN04NANN: 4 analog outputs

ELC-AN06AANN: 4 analog inputs and 2 analog outputs

ELC-TC04ANNN: 4 thermocouple inputs

ELC-PT04ANNN: 4 platinum thermocouple (PT 100-Ohm) inputs

Additional information for the expansion digital and analog I/O modules can also be accessed from the Instruction Leaflet for each module which can be found on the Eaton website: www.eaton.com. The publication number for the documents for each analog module and for the digital I/O are shown below. These documents also include specifications for the I/O for each card.

1. ELC-AN02NANN, 2 output analog card, IL05003001E.
2. ELC-AN04NANN, 4 output analog card, IL05003014E.
3. ELC-AN04ANNN, 4 input analog card, IL05003002E.
4. ELC-AN06AANN, 4 input and 2 output analog card, IL05003003E.
5. ELC-PT04ANNN, 4 RTD input card, IL05003008E.
6. ELC-TC04ANNN, 4 Thermocouple input card, IL05003009E.
7. Digital I/O, IL05003004E.
8. ELC-EX08NNSN, 8 toggle switch input card, IL05003017E.

In order to control expansion outputs from a remote fieldbus source, the Remote Control Source must be fieldbus or Logic Engine. And fieldbus must be the active control source. Inputs and Outputs can always be monitored via fieldbus even when fieldbus is not the active control source or even when it is not even the Remote Control Source.

Any digital or analog I/O addressed in the Logic Engine program, will not be allowed to be controlled via the remote fieldbus source.

Below are the I/O layouts for each expansion analog module on Ethernet/IP and PROFIBUS.

Input:

ELC-AN06AANN

CH1 AVG

CH2 AVG

CH3 AVG

CH4 AVG

Error Status

ELC-AN04ANNN

CH1 AVG

CH2 AVG

CH3 AVG

CH4 AVG

Error Status

ELC-TC04ANNN

CH1 Average degrees C

CH2 Average degrees C

CH3 Average degrees C

CH4 Average degrees C

CH1 Average degrees F

CH2 Average degrees F

CH3 Average degrees F

CH4 Average degrees F

Error Status

- ELC-PT04ANNN
    - CH1 Average degrees C
    - CH2 Average degrees C
    - CH3 Average degrees C
    - CH4 Average degrees C
    - CH1 Average degrees F
    - CH2 Average degrees F
    - CH3 Average degrees F
    - CH4 Average degrees F
    - Error Status
- ELC-AN02NANN
    - Error Status
- ELC-AN04NANN
    - Error Status

Output:

- ELC-AN04AANN
    - CH5
    - CH6
- ELC-AN02NANN
    - CH1
    - CH2

ELC-AN04NANN

- CH1
- CH2
- CH3
- CH4

Note that all available registers are mapped in the Modbus register map for each analog I/O module used. This is not the case for Ethernet/IP and PROFIBUS. In order to keep the amount of data to a minimum for these networks, configuration of each module must be done using the I/O Configurator in the Logic Engine Programming software tool. Only input, output and error status is provided.

EtherNet/IP

The I/O Assemblies that have been added to support expansion I/O are shown below:

The following input assemblies have been added as extensions to the existing Input Assemblies 100, 107, 110 and 116. The Digital Input (DI) data and Analog Input (AI) referenced below is what has been added to the existing input assembly it corresponds to. Input Assemblies 120 and 124 are new assemblies containing only digital and analog input data. The data layout for each Input assembly can be found in the Ethernet/IP section of Appendix C in this manual.

Input

1. Extensions of Input Assembly 100:
    a. 101: 2 bytes DI and 10 bytes AI
    b. 102: 4 bytes DI and 20 bytes AI
    c. 103: 8 bytes DI and 38 bytes AI
2. Extensions of Input Assembly 107:
    a. 108: 4 bytes DI and 20 bytes AI
    b. 109: 8 bytes DI and 80 bytes AI
3. Extensions of Input Assembly 110:
    a. 111: 2 bytes DI and 2 bytes AI
    b. 112: 4 bytes DI and 10 bytes AI
    c. 113: 6 bytes DI and 20 bytes AI
    d. 114: 8 bytes DI and 38 bytes AI
4. Extensions of Input Assembly 116:
    a. 117: 2 bytes DI and 2 bytes AI #
    b. 118: 4 bytes DI and 12 bytes AI #
    c. 119: 8 bytes DI and 20 bytes AI #
5. New Input Assembly, inputs only:
    a. 120: 4 bytes DI and 38 bytes AI
    b. 122: 8 bytes DI and 80 bytes AI

The following output assemblies have been added as extensions to the existing output Assemblies 104, 105 and 106. The Digital Output (DQ) data and Analog Output (AQ) referenced below is what has been added to the existing Output assembly it corresponds to. Output Assemblies 130 and 131 are new assemblies containing only digital and analog output data. The data layout for each output assembly can be found in the Ethernet/IP section of **Appendix C** in this manual.

Output

1. Extensions of Output Assembly 104:
    a. 123: 2 bytes DQ and 4 bytes AQ
    b. 124: 4 bytes DQ and 12 bytes AQ
2. Extensions of Output Assembly 105:
    a. 125: 4 bytes DQ and 8 bytes AQ
    b. 126: 8 bytes DQ and 16 bytes DQ
3. Extension of Output Assembly 106:
    a. 127: 2 bytes DQ and 4 bytes AQ
    b. 128: 4 bytes DQ and 8 bytes AQ
    c. 129: 8 bytes DQ and 16 bytes AQ
4. New Output Assemblies:
    a. 130: 4 bytes DQ and 32 bytes AQ
    b. 131: 8 bytes DQ and 64 bytes AQ

Note that all available registers are mapped in the Modbus register map for each analog I/O module used. This is not the case for Ethernet/IP and PROFIBUS. In order to keep the amount of data to a minimum for these networks, configuration of each module must be done using the Logic Engine Programming software tool. A minimum amount of data is provided for monitoring analog inputs and controlling analog outputs.

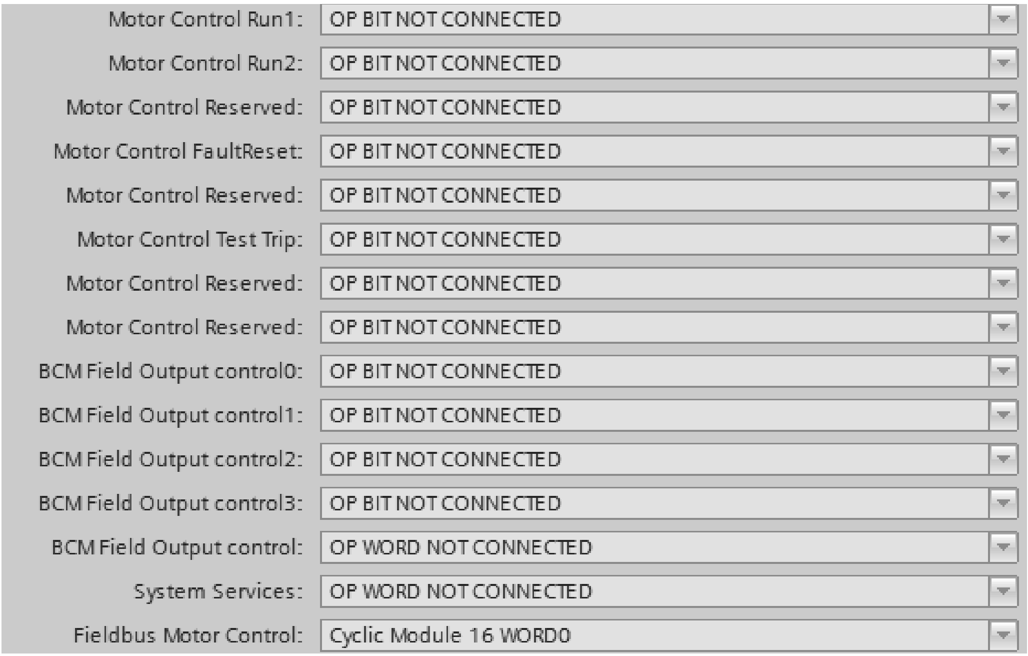
PROFIBUS

For PROFIBUS, additional selections have been added for the expansion I/O so the I/O modules can be monitored and controlled by a PROFIBUS master controller along with C445 motor parameters. Per the following there have also been two additional "Cyclic Modules" added to accommodate the additional I/O data. If Expansion I/O is not used, these larger "Cyclic Modules" shown below can be used to monitor additional motor data as well.

1. Cyclic Module 16: a 32 byte input and 16 byte output module
2. Cyclic Module 17: a 64 byte input and 32 byte output module.

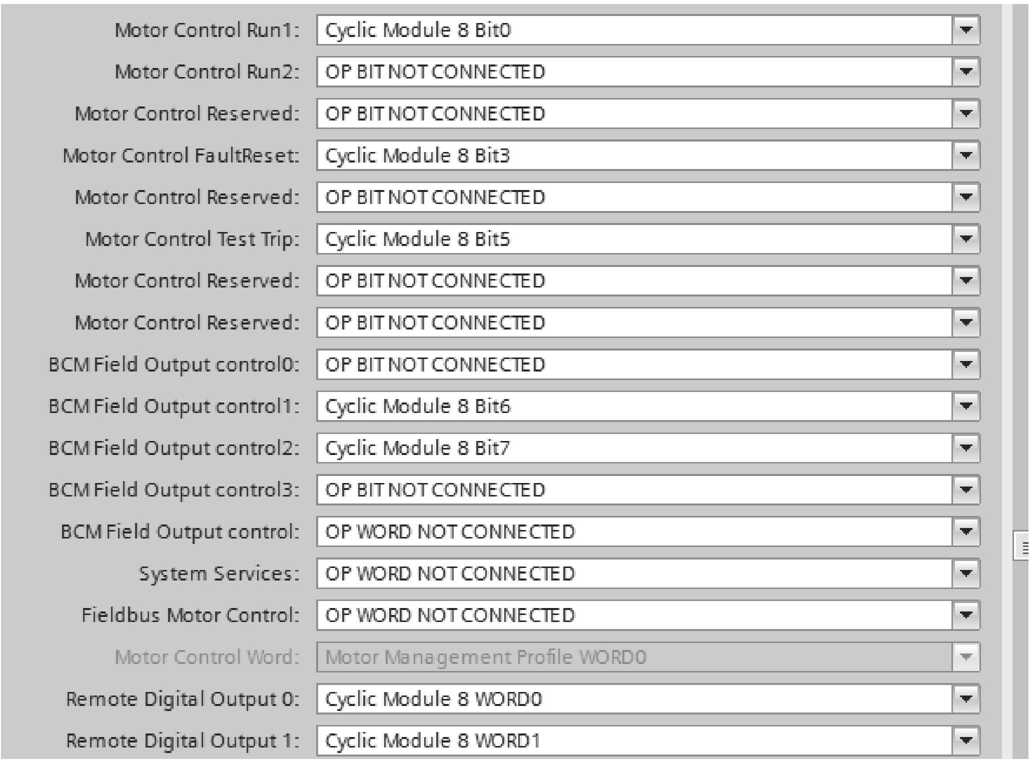
Note: "Cyclic Modules" are what the selectable I/O data blocks in the GSD file are called. Motor and I/O data are mapped to input and/or output addresses assigned to these cyclic modules. Only two cyclic modules can be used per C445 PROFIBUS module with the following restrictions:

1. If 2 Cyclic Modules are assigned, only one may contain output words.
2. The Motor Control bits shown cannot be assigned if the Fieldbus Motor Control word is assigned. Below is an example of the Motor Control bits unassigned and the Fieldbus Motor Control word assigned to Cyclic Module 16, word 0.
3. If the Motor Control bits are assigned, they can only be assigned to Cyclic Modules 4, 5, 6 and 8.
4. If the Motor Control bits are assigned, then the Fieldbus Motor Control word should not be assigned as shown below. The example below is using Cyclic Module 8. In addition, when the Motor Control bits are assigned the first output word to the C445 is a control word based on the bit assignments. Subsequent word assignments such as assigning the System Services or digital or analog output words actually begin with the second output word sent to the C445.



Motor Control Run1: OP BIT NOT CONNECTED
Motor Control Run2: OP BIT NOT CONNECTED
Motor Control Reserved: OP BIT NOT CONNECTED
Motor Control FaultReset: OP BIT NOT CONNECTED
Motor Control Reserved: OP BIT NOT CONNECTED
Motor Control Test Trip: OP BIT NOT CONNECTED
Motor Control Reserved: OP BIT NOT CONNECTED
Motor Control Reserved: OP BIT NOT CONNECTED
BCM Field Output control0: OP BIT NOT CONNECTED
BCM Field Output control1: OP BIT NOT CONNECTED
BCM Field Output control2: OP BIT NOT CONNECTED
BCM Field Output control3: OP BIT NOT CONNECTED
BCM Field Output control: OP WORD NOT CONNECTED
System Services: OP WORD NOT CONNECTED
Fieldbus Motor Control: Cyclic Module 16 WORD0

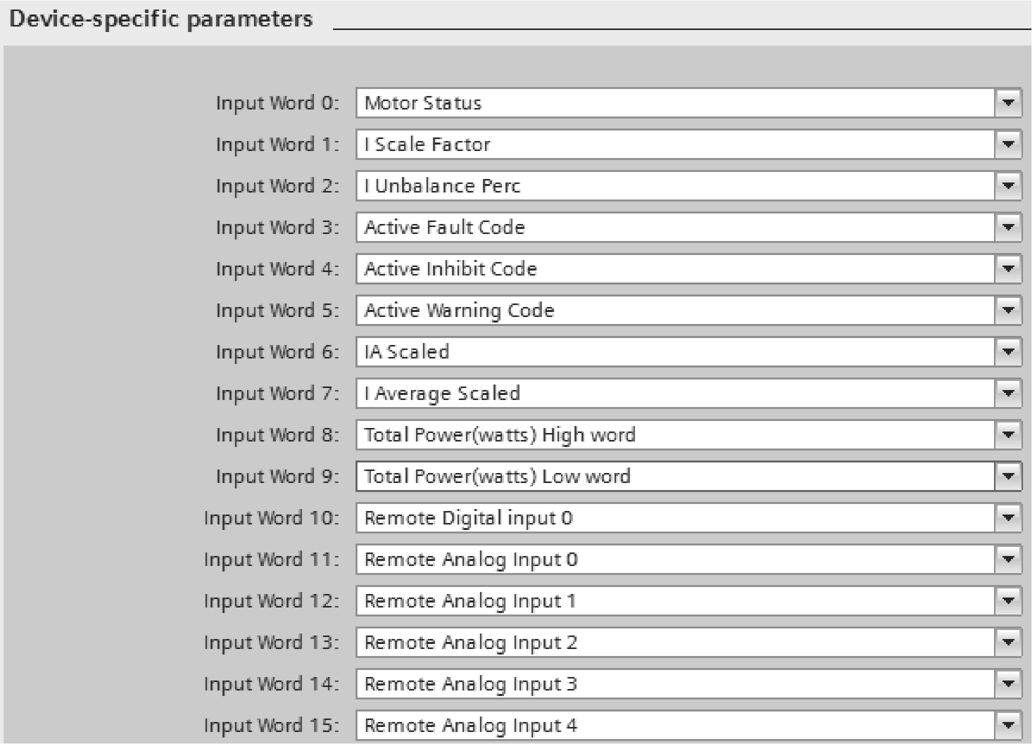
Note that even though Cyclic Module 8 contains 6 output bytes or 3 output words, once Motor Control bits are assigned, only 2 additional words are available to assign to other parameters. As shown below, these final 2 output words are assigned to Remote Digital Output 0 and 1. This means there are four 8 point digital expansion output cards connected to the C445. The Motor Control bits will be the first word sent to the C445, followed by the other 2 assigned words for controlling expansion output modules in this case.



Motor Control Run1: Cyclic Module 8 Bit0
Motor Control Run2: OP BIT NOT CONNECTED
Motor Control Reserved: OP BIT NOT CONNECTED
Motor Control FaultReset: Cyclic Module 8 Bit3
Motor Control Reserved: OP BIT NOT CONNECTED
Motor Control Test Trip: Cyclic Module 8 Bit5
Motor Control Reserved: OP BIT NOT CONNECTED
Motor Control Reserved: OP BIT NOT CONNECTED
BCM Field Output control0: OP BIT NOT CONNECTED
BCM Field Output control1: Cyclic Module 8 Bit6
BCM Field Output control2: Cyclic Module 8 Bit7
BCM Field Output control3: OP BIT NOT CONNECTED
BCM Field Output control: OP WORD NOT CONNECTED
System Services: OP WORD NOT CONNECTED
Fieldbus Motor Control: OP WORD NOT CONNECTED
Motor Control Word: Motor Management Profile WORD0
Remote Digital Output 0: Cyclic Module 8 WORD0
Remote Digital Output 1: Cyclic Module 8 WORD1

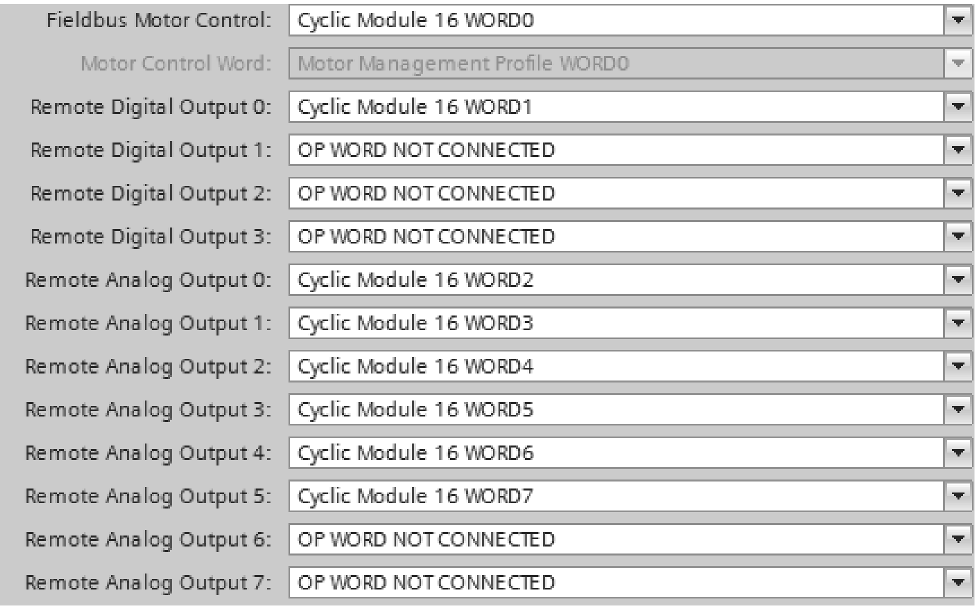
Assigning I/O parameters to Cyclic Modules

To assign Input parameters, select the cyclic module to reveal the input assignments for each word as shown below for Cyclic Module 16 (16 input words). Below is an example. All parameters are available and may be assigned to each input word.



Input Word 0: Motor Status
Input Word 1: I Scale Factor
Input Word 2: I Unbalance Perc
Input Word 3: Active Fault Code
Input Word 4: Active Inhibit Code
Input Word 5: Active Warning Code
Input Word 6: IA Scaled
Input Word 7: I Average Scaled
Input Word 8: Total Power(watts) High word
Input Word 9: Total Power(watts) Low word
Input Word 10: Remote Digital input 0
Input Word 11: Remote Analog Input 0
Input Word 12: Remote Analog Input 1
Input Word 13: Remote Analog Input 2
Input Word 14: Remote Analog Input 3
Input Word 15: Remote Analog Input 4

To assign Output parameters, select the C445 to reveal the output assignments which are at the end of the configuration file parameters as shown below. These are assigned different than the input parameters. For Output assignments, select cyclic module words for each available parameter, including digital and analog output data. Below is an example for the 8 output words for Cyclic Module 16. All parameters are available and may be assigned to each output word for the cyclic modules. Rules concerning the Fieldbus Motor Control word and Motor Control bit assignments is discussed earlier in this section.



Fieldbus Motor Control: Cyclic Module 16 WORD0
Motor Control Word: Motor Management Profile WORD0
Remote Digital Output 0: Cyclic Module 16 WORD1
Remote Digital Output 1: OP WORD NOT CONNECTED
Remote Digital Output 2: OP WORD NOT CONNECTED
Remote Digital Output 3: OP WORD NOT CONNECTED
Remote Analog Output 0: Cyclic Module 16 WORD2
Remote Analog Output 1: Cyclic Module 16 WORD3
Remote Analog Output 2: Cyclic Module 16 WORD4
Remote Analog Output 3: Cyclic Module 16 WORD5
Remote Analog Output 4: Cyclic Module 16 WORD6
Remote Analog Output 5: Cyclic Module 16 WORD7
Remote Analog Output 6: OP WORD NOT CONNECTED
Remote Analog Output 7: OP WORD NOT CONNECTED

Modbus TCP and RS-485 Modbus

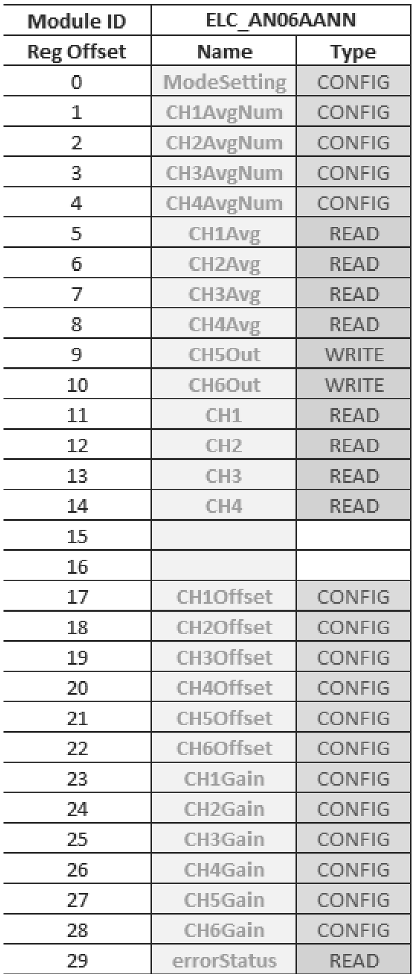
The digital I/O is stored in the following registers and is also mapped based on the position of each digital module to the right of the adapter.

Digital Inputs: registers 2255-2262
Digital Outputs: registers 2263-2270

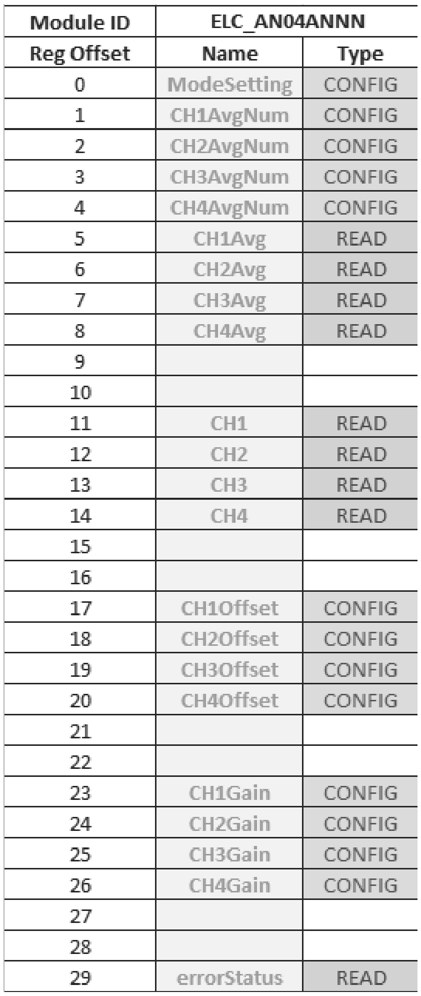
The digital I/O modules are not configurable. The analog I/O modules do need to be configured. In addition, these modules have 30 registers that are mapped to the following registers, based on their position when connected to the ELC-CARS485 adapter module. The first analog module to the right of the adapter is mapped first and so on, with a maximum of 8 analog modules. The Modbus registers that contain the data for the 30 registers for each module are as follows:

Analog module #1: registers 2015-2044
Analog module #2: registers 2045-2074
Analog module #3: registers 2075-2104
Analog module #4: registers 2105-2134
Analog module #5: registers 2135-2164
Analog module #6: registers 2165-2194
Analog module #7: registers 2195-2224
Analog module #8: registers 2225-2254

The data contained in the 30 registers for each type of analog module is shown below. "ModeSetting" is the configuration word for each analog module type and can be configured using the Expansion I/O Configurator page in the Logic Engine programming software. This determines the type of analog I/O for each module (current or voltage) and the type of thermocouple inputs for the thermocouple input module.

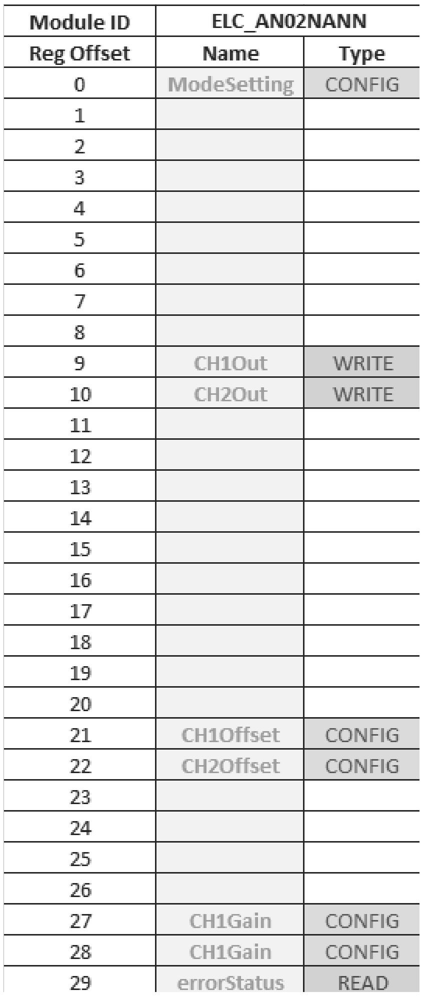


Module ID	ELC_AN06AANN	
Reg Offset	Name	Type
0	ModeSetting	CONFIG
1	CH1AvgNum	CONFIG
2	CH2AvgNum	CONFIG
3	CH3AvgNum	CONFIG
4	CH4AvgNum	CONFIG
5	CH1Avg	READ
6	CH2Avg	READ
7	CH3Avg	READ
8	CH4Avg	READ
9	CH5Out	WRITE
10	CH6Out	WRITE
11	CH1	READ
12	CH2	READ
13	CH3	READ
14	CH4	READ
15		
16		
17	CH1Offset	CONFIG
18	CH2Offset	CONFIG
19	CH3Offset	CONFIG
20	CH4Offset	CONFIG
21	CH5Offset	CONFIG
22	CH6Offset	CONFIG
23	CH1Gain	CONFIG
24	CH2Gain	CONFIG
25	CH3Gain	CONFIG
26	CH4Gain	CONFIG
27	CH5Gain	CONFIG
28	CH6Gain	CONFIG
29	errorStatus	READ

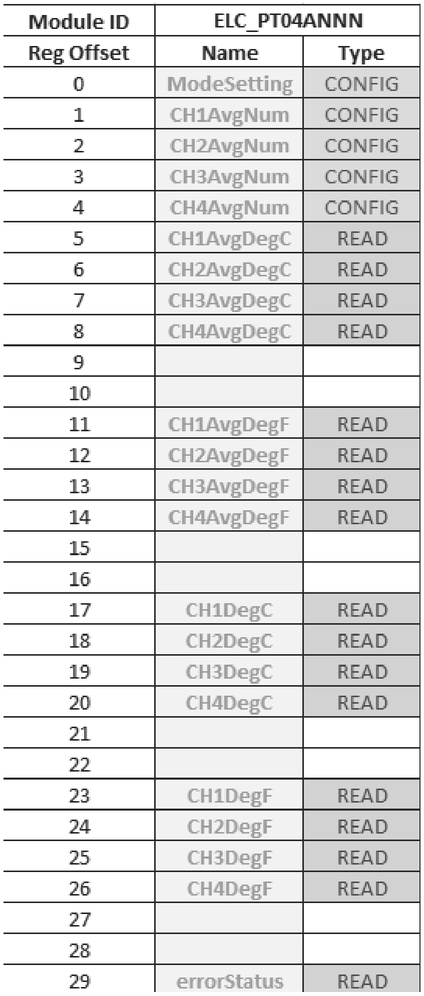


Module ID	ELC_AN04ANNN	
Reg Offset	Name	Type
0	ModeSetting	CONFIG
1	CH1AvgNum	CONFIG
2	CH2AvgNum	CONFIG
3	CH3AvgNum	CONFIG
4	CH4AvgNum	CONFIG
5	CH1Avg	READ
6	CH2Avg	READ
7	CH3Avg	READ
8	CH4Avg	READ
9		
10		
11	CH1	READ
12	CH2	READ
13	CH3	READ
14	CH4	READ
15		
16		
17	CH1Offset	CONFIG
18	CH2Offset	CONFIG
19	CH3Offset	CONFIG
20	CH4Offset	CONFIG
21		
22		
23	CH1Gain	CONFIG
24	CH2Gain	CONFIG
25	CH3Gain	CONFIG
26	CH4Gain	CONFIG
27		
28		
29	errorStatus	READ

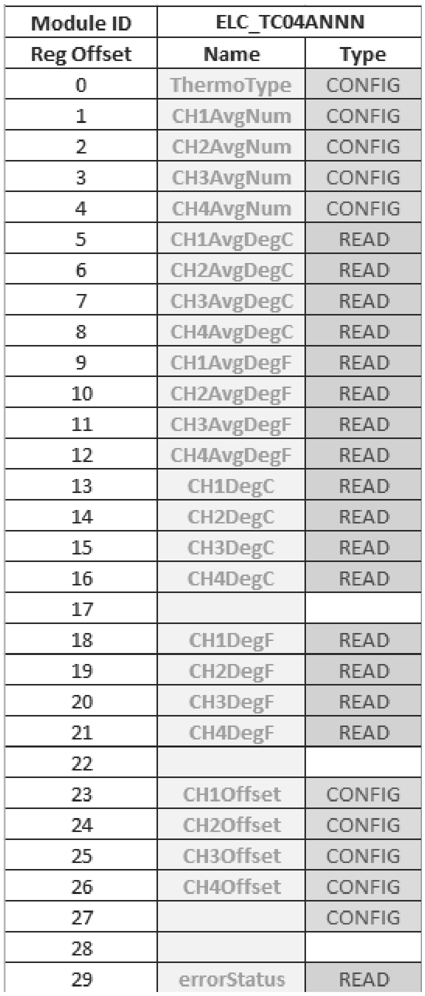
Module ID	ELC_AN04NANN	
Reg Offset	Name	Type
0	ModeSetting	CONFIG
1		
2		
3		
4		
5	CH1Out	WRITE
6	CH2Out	WRITE
7	CH3Out	WRITE
8	CH4Out	WRITE
9		
10		
11		
12		
13		
14		
15		
16		
17	CH1Offset	CONFIG
18	CH2Offset	CONFIG
19	CH3Offset	CONFIG
20	CH4Offset	CONFIG
21		
22		
23	CH1Gain	CONFIG
24	CH2Gain	CONFIG
25	CH3Gain	CONFIG
26	CH4Gain	CONFIG
27		
28		
29	errorStatus	READ



Module ID	ELC_AN02NANN	
Reg Offset	Name	Type
0	ModeSetting	CONFIG
1		
2		
3		
4		
5		
6		
7		
8		
9	CH1Out	WRITE
10	CH2Out	WRITE
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21	CH1Offset	CONFIG
22	CH2Offset	CONFIG
23		
24		
25		
26		
27	CH1Gain	CONFIG
28	CH1Gain	CONFIG
29	errorStatus	READ



Module ID	ELC_PT04ANNN	
Reg Offset	Name	Type
0	ModeSetting	CONFIG
1	CH1AvgNum	CONFIG
2	CH2AvgNum	CONFIG
3	CH3AvgNum	CONFIG
4	CH4AvgNum	CONFIG
5	CH1AvgDegC	READ
6	CH2AvgDegC	READ
7	CH3AvgDegC	READ
8	CH4AvgDegC	READ
9		
10		
11	CH1AvgDegF	READ
12	CH2AvgDegF	READ
13	CH3AvgDegF	READ
14	CH4AvgDegF	READ
15		
16		
17	CH1DegC	READ
18	CH2DegC	READ
19	CH3DegC	READ
20	CH4DegC	READ
21		
22		
23	CH1DegF	READ
24	CH2DegF	READ
25	CH3DegF	READ
26	CH4DegF	READ
27		
28		
29	errorStatus	READ



Module ID	ELC_TC04ANNN	
Reg Offset	Name	Type
0	ThermoType	CONFIG
1	CH1AvgNum	CONFIG
2	CH2AvgNum	CONFIG
3	CH3AvgNum	CONFIG
4	CH4AvgNum	CONFIG
5	CH1AvgDegC	READ
6	CH2AvgDegC	READ
7	CH3AvgDegC	READ
8	CH4AvgDegC	READ
9	CH1AvgDegF	READ
10	CH2AvgDegF	READ
11	CH3AvgDegF	READ
12	CH4AvgDegF	READ
13	CH1DegC	READ
14	CH2DegC	READ
15	CH3DegC	READ
16	CH4DegC	READ
17		
18	CH1DegF	READ
19	CH2DegF	READ
20	CH3DegF	READ
21	CH4DegF	READ
22		
23	CH1Offset	CONFIG
24	CH2Offset	CONFIG
25	CH3Offset	CONFIG
26	CH4Offset	CONFIG
27		CONFIG
28		
29	errorStatus	READ

The data for each I/O module is mapped in the order the modules are positioned. For example, the first physical module with digital outputs will have the data mapped to the first available Digital Output register, 2263. An 8-output or a 4-output card will be mapped to the low byte of register 2263. The next output card will have its data mapped to the high byte of register 2263 and so on. The first physical module with digital inputs will have the data mapped to the first available Digital Input register, 2255. An 8-input or a 4-input card will be mapped to the low byte of register 2255. The next input card will have its data mapped to the high byte of register 2255 and so on. The data for input and output cards with 4 points will be mapped to the 4 low bits in the byte they're mapped to, leaving the high 4 bits unused.

Chapter 10—C445 Ground Fault Monitoring and Protection

Ground Fault Monitoring Methods

- Residual Ground Fault Protection
- Zero-sequence (Core Balance) Fault Protection with Ground Fault Module
- Pulse Detection Protection – Low Voltage High Resistance Ground Fault Pulsing Systems (LVHRGPS)

The C445 Motor Management Relay provides three (3) ground fault monitoring and protection methods for use in industrial applications. These applications may encompass solid ground, low resistance ground, high resistance ground, or high resistance ground systems pulsed ground detection.

Only one (1) protection configuration (Residual or Zero-sequence) can be active in a system. The C445 can monitor and respond to an application that has been configured with a pulsing system. The C445 does not generate the pulse waveforms required for such systems.

All methods may incorporate Fault Trip, Fault trip Indication Only, and Fault Warning responses to events that trigger the C445 protection protocols. Additionally, delay times may be set for selected parameters to optimize system performance.

Residual Ground Fault Monitoring and Protection

Residual Ground Fault protection monitors the ground current of the motor and will react with a Fault action if the ground current exceeds the set threshold. The Ground Fault protection is always active. Ground Fault protection may be set to Fault Trip, Fault Warning, of Fault Trip Indication Only status.

The vector sum of the 3-phase currents is calculated from each phase current transformer (CT) in the C445M… Measurement Module and is transmitted to the C445B… Base Module for signal processing. At such time the signal exceeds a user settable threshold, the C445 will react with a Fault action in accordance with programmed parameters. At such time the signal returns to the allowable operating range programmed into the C445, the Fault action will extinguish. Fault reset requirements such as Manual Reset or Auto-Reset will occur in accordance with programmed parameters.

Table 66. Residual Ground Fault Parameterization

					Parameter Value			Debounce (Milliseconds)			
Fault Code	**Action**	**Modbus**	**Units**	**Frame**	**Min.**	**Max.**	**Default**	**Min.**	**Max.**	**Default**	**Modbus**
4	Fault Trip	1060	Amps	C445MA2P4…	0.12	2.4	1	0	60,000	1,000	1063
				C445MA005…	0.25	5	3	0	60,000	1,000	1063
				C445MA032…	1	9.6	3	0	60,000	1,000	1063
				C445MA045	1	13.5	3	0	60,000	1,000	1063
				C445MB072…	3	21.6	3	0	60,000	1,000	1063
				C445MC090	3	27.0	3	0	60,000	1,000	1063
				C445MC136…	34	40.8	34	0	60,000	1,000	1063
				C445M…EXT	30% of CT Primary	50% of CT Primary	50% of CT Primary	0	60,000	1,000	1063
	Fault Trip Indication Only	1087						0	60,000	1,000	1063
	Shunt trip	1089						0	60,000	1,000	1063
	Fault Warning	1061						200	5,000	2,000	1079
	Fault Trip Delay	—			At Powerup			0s	5s	0s	1062
	Fault Trip Inhibit	1064			Disable	Enable	Disable				
	Fault Trip Inhibit - Run	1065	%		25	100	50				

Zero-sequence Ground Fault Monitoring and Protection

The zero sequence sense current transformer (also called core balance current transformer, window current transformer, or toroidal current transformer) is the basis for sensitive ground fault protection of motors.

When Ground Fault Module (GFM) is recognized, the C445 system no longer uses current information from the C445M… measurement module for ground fault current calculations. The measurement module is still used for current, voltage, and power information including overload protection that is provided to the C445B… base module.

Table 67. Zero-sequence Ground Fault Parameterization

					Parameter Value			Debounce (Milliseconds)			
Fault Code	**Action**	**Modbus**	**Units**	**Frame**	**Min.**	**Max.**	**Default**	**Min.**	**Max.**	**Default**	**Modbus**
4	Fault Trip	1060	Amps	C445XG-CT…	0.03	10.0	4	0	60,000	1,000	1063
	Fault Trip Indication Only	1087	Amps	C445XG-CT…	0.03	10.0	4	0	60,000	1,000	1063
	Shunt trip	1089	Amps	C445XG-CT…	0.03	10.0	4	0	60,000	1,000	1063
	Fault Warning	1061	Amps	C445XG-CT…	0.03	10.0	3.4	200	5,000	2,000	1079
	Fault Trip Delay					At Powerup		0s	5s	0s	1062
	Fault Trip Inhibit	1064			Disable	Enable	Disable				

Zero-sequence Ground Fault monitoring requires the use of an external zero-sequence CT that is connected to a C445XG-MOD adapter module (GFM) coupled to a zero-sequence CT. Current sense range for the Ground Fault Module (GFM) is 0.03 – 10.0 Amps which encompasses all four (4) C445XG-CT… current transformers.

Table 68. C445 Zero-sequence Current Transformers

Catalog Number	Current (A)	Aperture
C445XG-CT2	45	28mm round
C445XG-CT3	90	52mm round
C445XG-CT4	135	63mm round
C445XG-CT7	800	175mm(w) x 80mm (h)

The C445XG-MOD GFM may be either DIN rail mounted or directly mounted with screws by utilizing the optional mounting tabs. The GFM has two (2) RJ12 terminals to enable easy connection to the C445 system with D77E-QPIP… cabling used on the base and measurement modules. Connection to the CT is made via a screw terminal connector on the GFM and screw terminals on the CT.

Note: If the C445 has been powered up and configured prior to connecting the GFM and/or the D77E-QPIP… cables have been moved to different RJ12 terminals, a *Repair* action may be necessary to reconfigure the C445 system.

The first time a GFM module is connected into a C445 system;

- The C445 system will automatically configure the ground current protection for *Fault Indication Only* and configure output relay Q3 for "*Ground Current Fault*".
- The C445B… base module will auto-detect when a GFM module is present in a C445 system and enable the zero-sequence CT over the residual ground fault method (default). The residual ground fault method cannot be selected if the C445 system has recognized the GFM.
- The auto configuration will occur only when the GFM is connected into the C445 system for the very first time.
- The auto configuration will not reoccur when a GFM has already been detected, but a new or different GFM is installed into the C445 system.
- The auto configuration of output relay Q3 will only occur if the current setting is the default.

The C445 system with a GFM installed will fault trip within 50ms + debounce setting value in the event that the CT is exposed to a current in excess of 2X GFM range maximum value.

The C445 system may be configured as a standalone system whereas only ground fault monitoring and indication is enabled. In such a configuration, a C445B… base module is coupled to a GFM connected to the appropriate sized CT to transmit monitoring information via a network. A C445M… measurement module and/or a C445UM user interface module may be added to provide local indication, control, and protection.

The GFM also monitors the health of the CT and provides CT status information to the C445B… base module. Status information includes;

- CT ok
- CT secondary open
- CT secondary shorted
- CT calibration missing

The CT status information can be configured for No Action, Fault Trip, or Fault Warning actions to the C445 System.

Note: Output Q3 on the Base Control Module will automatically be set to "21 Trip Reason - Ground Current Fault" when a Ground Fault Module is connected. This is the default. This can be changed using the *in*Control software, the User Interface, or the Web Pages. This parameter can be found under the Operation Mode category, Advanced Settings.

Pulse Detection Protection

A pulse detection algorithm in the C445 works in conjunction with Low Voltage High Resistance Ground Fault Pulsing Systems. The pulse detection feature monitors the calculated residual ground current and signals when a pulse train is detected in the reading.

The C445B…base module monitors the residual ground current reading and will signal a pulse is active when it detects 4 similar pulses at least 80% of the programmed pulse amplitude.

The C445 will respond to pulse rates between 3 to 100 pulses per minute.

The pulse detection feature may be configured to produce a Fault trip, Fault No Trip, or Warning (default) reaction to a detected pulse waveform.

Pulse Detection amplitude is user settable between 0.03A – 10.00A.

The C445 Pulse Detection feature aids in troubleshooting the system by providing additional pulse information in addition to upstream pulse detection equipment. If pulse detection equipment upstream indicates that a pulse signal is present, but the S445 system does not, then the ground fault lies between the C445 measurement module and the upstream equipment. If both the upstream equipment and the S445 System indicates a pulse signal is detected, then the ground fault lies between the C445M… measurement module and the load (motor).

Table 69. Pulse Detection Protection Parameterization

Fault Code	Action	Modbus	Units	Frame	Parameter Value		
					Minimum	Maximum	Default
44	Fault Trip	1094	Amps	**C445XG-CT2**	0.03	10.0	4
				C445XG-CT3	0.03	10.0	4
				C445XG-CT4	0.03	10.0	4
				C445XG-CT7	0.03	10.0	4
	Fault Trip Indication Only	1088					
	Fault Warning	1003	Amps	**C445XG-CT2**	0.03	10.0	4
				C445XG-CT3	0.03	10.0	4
				C445XG-CT4	0.03	10.0	4
				C445XG-CT7	0.03	10.0	4

C445XG-MOD

C445XG-CT2

C445XG-CT3

C445XG-CT4

C445XG-CT7

Appendix A—Technical Data and Specifications

Communications Isolation Notes

The isolation between the Modbus Port and BCM electronics is functional isolation only. All connections to the Modbus terminal shall meet PELV requirements.

The isolation between the PROFIBUS Port and BCM electronics is functional isolation only. All connections to the PROFIBUS Port terminal shall meet PELV requirements.

The isolation between the Ethernet Port and BCM electronics is functional isolation only. All connections to the Ethernet Port terminal shall meet SELV/PELV requirements.

Table 70. Environmental Specifications

Description	Specification
Temperature	–40 °C to 85 °C (–40 °F to 185 °F), non-operating –40 °C to 60 °C (–40 °F to 140 °F), operating Note: C445UM Monitoring User Interface LCD may not operate below –20 °C but buttons will operate across the operating temperature range.
Operating Humidity	5–95% non-condensing
Altitude NEMA ICS1	2000 meters (6600 feet)
Shock IEC 60068-2-27	15 g any direction for 11 milliseconds, non-operating
Vibration IEC 60068-2-6	5 g non-operating and 3 g operating in any direction
Pollution Degree	3
Protection Degree	Internal Components: IP20 User Interface: IP54 & UL Type12
Cooling	Convection (natural)

Table 71. Power Supply Specifications Summary

Description	Specification
AC Control Power ①	Rated supply voltage (operating range): 110–120 Vac/60 Hz, (94–132 Vac) 220–240 Vac/50 Hz, (187–264 Vac) Requirement of an external control power transformer when the product is used above 150 Vac (220–240 Vac)
DC Control Power ②	Rated supply voltage (operating range): 24 Vdc Nominal (18–30 Vdc) The common terminal of the 24 V power supply shall be earthed
Max. Power Consumption ③	8 W
AC Control Power Input Impulse Withstand Voltage U_{imp}	See **Table 82**.

Notes

① Fuse information—Recommend 1 A slow blow fuse for AC control power. Interrupting capability should be greater than available branch current.

② UL Listed Isolated Class 2/PELV Power Supply Rated Maximum 24 Vdc. Wiring must meet PELV requirements.

③ Base Control Module + Measurement Module + User Interface + Communication Card.

Table 72. Input/Output Specifications

Description	Specification
Relay Rating	Relay Q1 / Q2 (from A – NO) B300 Pilot Duty, R300 Pilot Duty AC-15: 3 A at 120 Vac, 1.5 A at 240 Vac DC-13: 0.22 at 125 Vdc, 0.1 at 250 Vdc, 2 A at 24 Vdc Relay Q3 (from C – latching) B300 Pilot Duty, R300 Pilot Duty AC-15: 3 A at 120 Vac, 1.5 A at 240 Vac DC-13: 0.22 at 125 Vdc, 0.1 at 250 Vdc, 1.5 A at 24 Vdc Relay Q3 (from C – non-latching) B300 Pilot Duty, R300 Pilot Duty AC-15: 3 A at 120 Vac, 1.5 A at 240 Vac DC-13: 0.22 at 125 Vdc, 0.1 at 250 Vdc, 2 A at 24 Vdc The Q3 normally closed relay contacts should not be used for motor contactor control
AC Field Input ①	IEC 61131-2 Type 1 Digital Input Off State: 0 Vac to 20 Vac On State: 79 Vac to 132 Vac Max. ON current: 15 mA
DC Field Input	IEC 61131-2 Type 1 Digital Input Off State: 0 Vac to 5 Vdc On State: 15 Vdc to 30 Vdc Max. ON current: 15 mA
Mandatory Short Circuit Protection for Auxiliary Contacts (relay outputs)	6 A Class gG fuse (IEC 60947-5-1)
Terminal Block	Wiring capacity: 0.2 mm^2 (24 AWG) to 2.5 mm^2 (12 AWG) Use only UL listed or recognized conductors. Copper wire rated 75C (75°C UC wire) for all field wiring terminals and main overload conductor wiring.

Table 73. PTC Specifications

Description	Specification
Standard	EN 60947-8/A1:2006 “Mark A Control Unit”
Compatible Thermal Detectors	MARK A type (abrupt characteristic change) as described in EN 60947-8/A1:2006 Annex A wired in series
Terminals	Marked T1 & T2. 0.2 mm^2 (24 AWG) to 2.5 mm^2 (12 AWG)
Cold Resistance	<= 1500 ohms
Measuring Voltage T1-T2	<= 2.5 V for resistance <= 1330 ohms <= 7.5 V for resistance <= 4 kohms <= 9.0 V open circuit
Temperature Rise Response	3600 ohms ±10%
Over Temperature Reset	1500 ohms ±10%
Short Circuit Response	Between 10 and 20 ohms
Short Circuit Reset	Between 20 and 40 ohms
Wire Break Response	20 k to 40 kohms
Isolation	See **Table 82**.

Table 74. Measurement Module Specifications

Description	Specification
3 Phase Voltage input U12, U23, U31 RMS	Input ratings: 110–690 Vac (94–759 Vac) Grounded, Floating, and High-Resistance Ground Distribution systems supported. 4160 Vac with PT Ratios between 35:1 and 6:1 Connector: Removable screw terminal U_{imp}: See **Table 82**. Line Frequency: 20~80 Hz
3 Phase Current input I1, I2, I3 RMS	Depending on Measurement Module range Current as % of rated FLA 0~720% max rated FLA

Note: Refer to **Chapter 10** for Ground Fault Module specifications.

Table 75. Measurement Module Frame Breaks

Frame Size	Current Range	Aperture Dia. (mm)	Supported Conductor NA 600 V ①	Supported Conductor EMEA 690 V ①	Frequency Range
45 mm	0.3–2.4 Amp	7.8	6 AWG	16 mm^2	20–80 Hz ②
45 mm	1–5 Amp	7.8	6 AWG	16 mm^2	20–80 Hz ②
45 mm	4–32 Amp	7.8	6 AWG	16 mm^2	20–80 Hz ②
45 mm	6–45 Amp	7.8	6 AWG	16 mm^2	20–80 Hz ②
55 mm	N.A. 9-68 Amp ① IEC 9-72 Amp	10.5	3 AWG	25 mm^2	20–80 Hz ②
90 mm	11–90 Amp	15.8	2/0 AWG	70 mm^2	20–80 Hz ②
90 mm	17–136 Amp	15.8	2/0 AWG	70 mm^2	20–80 Hz ②

Notes

① Use only insulated conductors.Conductor outer diameter vary with insulation type. Refer to aperture diameter for sizing.

② Linear to 1.2 FLA over the range of 20–80 Hz. Linear to 7.2x FLA over 47–63 Hz range.

Table 76. EMC Emissions

Description	Specification
Radiated Emissions	EN 55011 (CISPIR 11) Group 1, Class A, ISM Equipment for Industrial, Scientific, and Medical Equipment. 30 MHz to 1000 Mhz The ferrite bead needs to be applied to meet requirements. Bead should go over L1 and L2 terminals only.
Conducted Emissions	IEN 55011 (CISPIR 11) Group 1, Class A, ISM Equipment for Industrial, Scientific, and Medical Equipment. 0.15 MHz to 30 MHz. The ferrite bead needs to be applied to meet requirements. Bead should go over L1 and L2 terminals only.

Table 77. EMC Immunity

Description	Specification	
Surge	61000-4-5 Criteria B	2 kV Line to Earth 1 kV Line to Line
ESD	61000-4-2 Criteria B	8 kV air discharge 4 kV contact discharge
EFT	61000-4-4 Criteria B	Power Ports: 2 kV, 5 kHz, Direct Method Signal Ports: 1 kV, 5 kHz, Clamp Method
Radiated Immunity	61000-4-3 Criteria A	10 V/m 80–2000 MHz, 80% amplitude modulation at 1 kHz 1 V/m 2000–2700 MHz, 80% amplitude modulation at 1 kHz
Conducted Immunity	61000-4-6 Criteria A	10 V/m, 0.15–80 MHz, 80% amplitude modulation a 1 kHz
Magnetic Field Immunity	61000-4-8 Criteria A	30 A/m, 50/60 Hz
Voltage Dips & Interruptions	61000-4-11 Criteria A	110 Vac 60 Hz, 220 Vac 50 Hz 0% rated voltage during 1/2 cycle 0% rated voltage during 1 cycle 70% rated voltage during 25/30 cycles
Voltage Interruptions	61000-4-11 Criteria A	110 Vac 60 Hz, 220 Vac 50 Hz Interruption (0% rated voltage) during 250/300 cycles
Voltage Interruptions	61000-4-29 Criteria A	24 Vdc Interruption (0% rated voltage) for 10 ms

Table 78. Agency Certifications and Regulatory

Description	Specification
Agency Certifications	UL and CSA UL 60947-4-1 CSA 22.2 #60947-4-1 CSA C22.2 NO. 0-10 Low Voltage directive (2006/95/EC) IEC/EN 60947-4-1 IEC/EN 60947-5-1 EN 60947-8 EN 60079-7 (For increased safety method of protection of Ex e motor), EMC directive (2004/108/EC), Machine Directive (2006/42/EC), IEC/EN 61000-4 level 3, PROFIBUS/ODVA Conformance
Regulatory, self-declarations	Recast RoHS Directive/RoHS II (Restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) Directive 2011/65/EU) WEEE Directive (Waste of Electrical and Electronic Equipment 2002/96/EC) REACH Directive 2006/121/EC (Registration, Evaluation, Authorization, and Restriction of Chemicals 1907/2006, 1. Compliance according with REACH article 67, and 2. The compliance of the duty to inform by the supplier according to REACH article 31 and 33) Life Cycle Assessment (LCA, reference ISO 14025)

Table 79. Physical Size Specifications

Description	Specification
Base Control Module	Estimated size (l x w x h): 82 x 45 x 102 mm Mounting: DIN and screw
Measurement Module	Estimated size (l x w x h): 82 x 45 x 63 mm, 32 A/45 A and below 82 x 56 x 116 mm, 68 A/72 A 82 x 90 x 125 mm, 90 A/136 A Mounting: DIN and screw
Base Control Module and Measurement Module Stack-up	Height = 155 mm, BCM and MM (32 A/45 A and below) 55 mm and 90 mm Measurement Modules will not be stackable
Use Interface	Estimated size (l x w x h): 99 x 52 x 37 Mounting: Panel mounted

Note: Refer to **Chapter 10** for Ground Fault Module specifications.

Table 80. Short Circuit Ratings (North American CSA and UL) ①

		Standard-Fault Short Circuit Data				High-Fault Short Circuit Data					
						Fuses (RK5)			Thermal-Magnetic Circuit Breakers		
Measurement Module Frame	Overload FLA Range	480 V (kA)	600 V (kA)	Max. Fuse Size (A) (RK5)	Max. Breaker Size (A)	480 V (kA)	600 V (kA)	Max. Fuse Size (A) (RK5)	480 V (kA)	600 V (kA)	Max. Breaker Size (A)
45 mm	0.3–2.4 A	5	5	6 A	15 A	100	100	6 A	100	35	15 A
45 mm	1–5 A	5	5	20 A	20 A	100	100	20 A	100	35	20 A
45 mm	4–32 A	5	5	125 A	125 A	100	100	125 A	100	35	125 A
45 mm	6–45 A	5	5	175 A	175 A	100	100	175 A	100	35	175 A
55 mm	9–72 A	10	10	250 A	250 A	100	100	250 A	100	35	250 A
90 mm	11–90 A	10	10	360 A	360 A	100	100	360 A	100	50	360 A
90 mm	17–136 A	10	10	400 A	400 A	100	100	400 A	100	50	400 A

Note

① Short circuit protective device (SCPD) sizing per NEC: Max. = 400% of FLA for devices rated less than or equal to 100 A, 300% of FLA over 100 A.

Table 81. Short Circuit Ratings (IEC)

		Standard-Fault Short Circuit Data					High-Fault Short Circuit Data			Thermal-Magnetic Circuit Breakers			
							Fuses (gG)						
Measurement Module Frame	Overload FLA Range	480 V (kA)	690 V (kA)	Max. Fuse Size (A) (gG)	Max. Breaker Size (A) 480 V	Max. Breaker Size (A) 690 V	480 V (kA)	690 V (kA)	Max. Fuse Size (A) (gG)	480 V (kA)	690 V (kA)	Max. Breaker Size (A) 480 V	Max. Breaker Size (A) 690 V
45 mm	0.3–2.4 A	1	1	16 A	15 A	N/A	100	100	10 A	100	N/A	15 A	N/A
45 mm	1–5 A	1	1	20 A	20 A	20 A	100	100	20 A	100	80	20 A	20 A
45 mm	4–32 A	3	3	125 A	125 A	125 A	100	100	125 A	100	80	125 A	125 A
45 mm	6–45 A	3	3	200 A	175 A	160 A	100	100	125 A	100	80	175 A	160 A
55 mm	9–72 A	5	5	250 A	250 A	250 A	100	100	160 A	100	80	250 A	250 A
90 mm	11–90 A	5	5	360 A	360 A	360 A	100	100	360 A	100	80	360 A	360 A
90 mm	17–136 A	10	10	400 A	400 A	400 A	100	100	400 A	100	80	400 A	400 A

Table 82. Impulse Withstand Ratings

			Standard Ratings			Protective Separation (Annex N) Ratings		
C445 Device	**Base Catalog Number**	**Circuit**	**Overvoltage Category**	**Working Voltage**	**Impulse Withstand Rating**	**Overvoltage Category**	**Working Voltage**	**Impulse Withstand Rating**
Measurement module	C445M	Mains	III	690 V	6 kV	III	690 V	8 kV
		PTC (DC)	—	—	—	—	—	4 kV
AC BCM	C445BA	Power	III	230 V	4 kV	II (with CPT)	230 V	4 kV
		Relays	III	230 V	4 kV	III	230 V	6 kV
		K1 to K2	III	>150 V	4 kV	III	<150 V	4 kV
		Inputs	II	120 V	1.5 kV	II	120 V	2.5 kV
DC BCM	C445BD	Relays	III	230 V	4 kV	III	230 V	6 kV
		K1 to K2	III	>150 V	4 kV	III	<150 V	4 kV
		Inputs	II	120 V	1.5 kV	II	120 V	2.5 kV

Appendix B—Troubleshooting and Diagnostics

Table 83. Motor Protection Fault Definitions

Definition	Source	Result	Power Xpert Protection
Thermal Overload			
Overload is a condition in which current draw to a motor exceeds 115% of the full load amperage rating over a period of time for an inductive motor.	An increase in the load or torque that is being driven by the motor. A low voltage supply to the motor would cause the current to go high to maintain the power needed. A poor power factor would cause above normal current draw.	Increase in current draw. Current leads to heat and insulation breakdown, which can cause system failure. Additionally, an increase in current can increase power consumption and waste valuable energy.	Thermal trip behavior is defined by UL, CSA and IEC standards. Trip class is settable from 5–40 by 1 Provides power factor monitoring and low voltage protection features.
Jam			
Jam is similar to thermal overload in that it is a current draw on the motor above normal operating conditions.	Mechanical stall, interference, jam or seizure of the motor or motor load.	The motor attempts to drive the load, which has more resistive force due to the mechanical interference. In order to drive the load, the motor draws an abnormal amount of current, which can lead to insulation breakdown and system failure.	Provides a configurable Jam setting that is active during "motor run state" to avoid nuisance trips. Trip Threshold 50–400% of FLA. Trip Delay 1–20 seconds.
Ground Fault			
A line to ground fault.	A current leakage path to ground.	An undetected ground fault can burn through multiple insulation windings, ultimately leading to motor failure.	Power Xpert has ground fault protection capability with a sensitivity of 3 A or less up through 90 A applications using the built in three phase CTs and the residual current method. That is, the three-phase current signals should sum to zero unless a Ground Fault (GF) condition is present. In the case of a GF, Power Xpert can alarm, trip the starter, or trip an alternative relay that can be used to shunt trip a breaker or light up a warning light. GF current can also be monitored in real-time through the advanced monitoring capabilities. For applications requiring higher ground fault sensitivity across all FLA ranges, add the C445XG-MOD External Ground Fault Module. Refer to **Chapter 10** for more information. **Note:** GF settable thresholds vary with motor FLA. See **Table 26** Current Based Protections for each minimum level.
Imbalanced Phases (voltage and current)			
Uneven voltage or currents between phases in a three-phase system.	When a three-phase load is powered with a poor quality line, the voltage per phase may be imbalanced.	Imbalanced voltage causes large imbalanced currents and as a result this can lead to motor stator windings being overloaded, causing excessive heating, reduced motor efficiency and reduced insulation life.	Provides two protection settings that address this problem. The user can choose to set current imbalance thresholds or voltage imbalance thresholds, each of which can trip the starter. Additionally, both of these may be monitored through Power Xpert's advanced monitoring capabilities, allowing the customer to notice in real-time when and where a condition is present.
Phase Loss—Current (single-phasing)			
One of the three-phase current is not present.	Multiple causes, loose wire, improper wiring, grounded phase, open fuse, and so on.	Single-phasing can lead to unwanted motor vibrations in addition to the results of imbalanced phases as listed above.	Fixed protective setting that takes the starter offline if a phase drops below 60% of the other two phases.

Table 83. Motor Protection Fault Definitions, continued

Definition	Source	Result	Power Xpert Protection
Phase Rotation (phase-reversal)			
Improper wiring, leading to phases being connected to the motor improperly.	A miswired motor. Inadvertent phase-reversal by the utility.	Phase-reversal can cause unwanted directional rotation of a motor. In the event that the load attached to the motor can only be driven in one direction, the result could be significant mechanical failure and/or injury to an operator.	Configurable phase protection, allowing the user to define the phase sequencing intended for that application. If no phase sequence is required, the user has the ability to disable this feature.
Frequency Variance			
When line frequency is inconsistent.	Malfunctioning alternator speed regulator, or poor line quality caused by an overload of a supply powered by individual sources.	Variations in frequency can cause increases in losses, decreasing the efficiency of the motor. In addition, this can result in interference with synchronous devices.	Advanced monitoring capabilities allow the user to monitor frequency in real time. Users can also optionally set an alarm or trip threshold for frequency variations from 70–110%.

Table 84. Load Protection Fault Definitions

Definition	Source	Result	Power Xpert Protection
Under Current or Low Power			
Average rms current provided to the motor falls below normal operating conditions.	Under current is usually associated with a portion of the user's load disappearing. Examples of this would be a broken belt, a dry-pump (low suction head) or a dead-headed centrifugal pump.	If under current goes undetected, a mechanical failure can and has occurred. In the case of a pump, running a pump dry or running a pump in a dead-headed condition can cause excessive heating, damaging expensive seals and breaking down desired fluid properties.	Power Xpert has two protection settings to detect this: under current and low power. Low power is a more consistent way of ensuring detection as power is linear with motor load, where as current is not. An unloaded motor may draw 50% of its rated current, but the power draw will be less than 10% of rated power due to a low power factor.
High Power			
The motor load is drawing more power than it should at normal operating conditions.	This is typical of batch processing applications where several ingredients flow into a mixer. When a substance's consistency changes and viscosity increases from what is expected, the motor may use more power to blend the mixture. Out-of-tolerance conditions can be detected using the High Power and Low Power settings.	If a high-power fault goes undetected, the result may be a batch of material that does not meet specification.	Monitors the three-phase real power. If the real power value is estimated above the set threshold for the set length of time, a fault is detected and the overload will trip the starter. Additionally, power can be monitored in real-time.

Table 85. Line Protection Fault Definitions

Definition	Source	Result	Power Xpert Protection
Over Voltage			
When the line voltage to the motor exceeds the specified rating.	Poor line quality.	An over voltage condition leads to a lower than rated current draw and a poor power factor. A trip limit of 110% of rated voltage is recommended. Over voltage can also lead to exceeding insulation ratings.	Monitors the maximum rms value of the three-phase voltages. If the rms value rises above the set threshold for the set length of time, a fault is detected and the overload can trip the starter or send and display an alarm of the condition. All line-related faults have an “alarm-no-trip” mode.
Under Voltage			
When the line voltage to the motor is below the specified rating.	Poor line quality.	An under voltage condition leads to excessive current draw. This increases the heating of the motor windings and can shorten insulation life. A trip limit set to 90% of rated voltage is recommended.	Monitors the minimum rms value of the three-phase voltages. If the rms value drops below the set threshold for the set length of time, a fault is detected and the overload can trip the starter or send and display an alarm of the condition. All line-related faults have an “alarm-no-trip” mode.

Appendix C—Optional Communication Cards

Ethernet Card (C445XC-E)

Introduction

The C445 Ethernet option card (C445XC-E) supports both the Modbus TCP and EtherNet/IP protocols. This card contains two Ethernet ports but only one IP address. The ports act as a two-port Ethernet switch, allowing the user to optionally daisy chain modules together in a Ring or Linear network, instead of running each module back to a centralized Ethernet switch in a Star Network. Three supported Ethernet network topologies for the C445XC-E card are shown below.

Figure 128. C445 Ethernet Star Network Connection Example

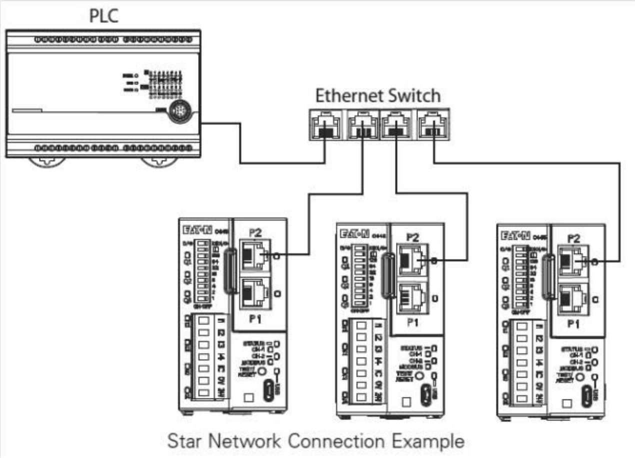


Figure 129. C445 Ethernet Ring Network Connection Example

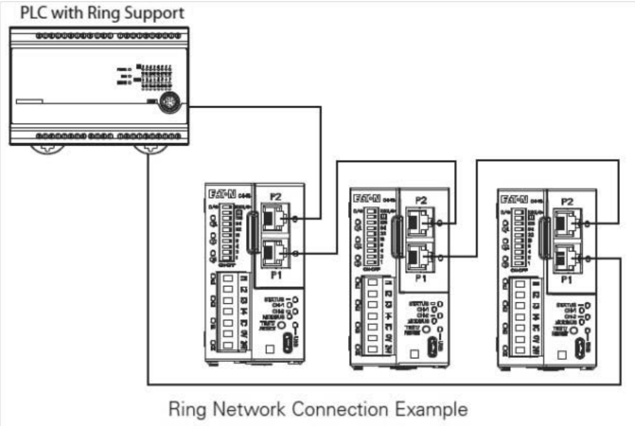
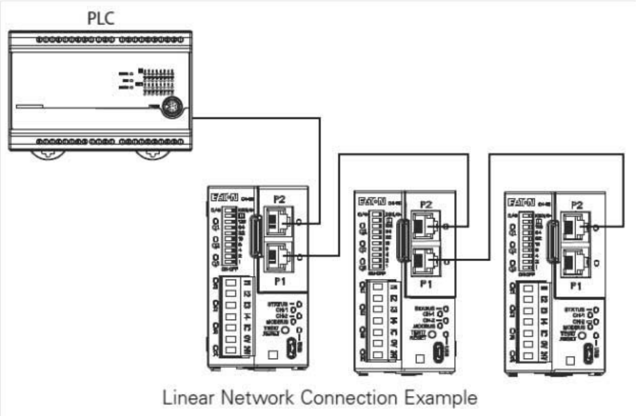


Figure 130. C445 Ethernet Linear Network Connection Example



Installing the Ethernet Communication Card

The Ethernet Communication Card is installed directly into the C445 Base Control Module. To install the card, follow the step by step directions:

1. Remove the blank cover with the unit not powered.
2. Locate the communication card slot
3. Plug the Ethernet communication card into location. Only remove or plug in modules with the unit not powered. Do not hot swap communication modules.

Figure 131. Installing the Ethernet Communication Card

Ethernet Communication Card and DIP Switches

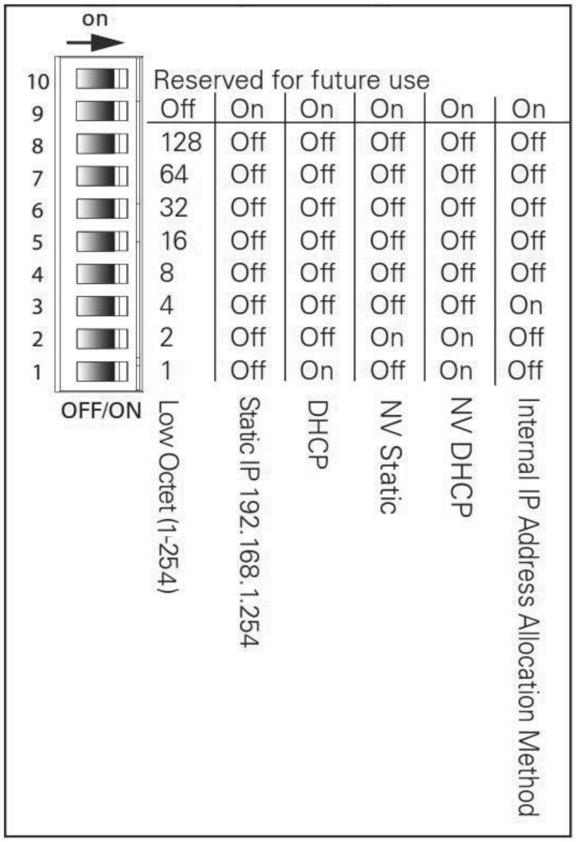
When an optional Ethernet card is connected to a C445, the DIP switches on the Base Control Module are dedicated to determining the IP address of this card per the diagram below.

If the C445 Base Control Module also includes the optional RS-485 Modbus serial port, the node address and the data rate for this port must be configured using the Web Pages or the *in*Control Configuration Software.

DIP Switch settings on the C445 Base Control Module when an Ethernet Card is installed.

DIP Switch 10 is reserved for future use.

Figure 132. Base Control Module DIP Switches with Ethernet Card



	Low Octet (1-254)	Static IP 192.168.1.254	DHCP	NV Static	NV DHCP	Internal IP Address Allocation Method
10	Reserved for future use					
9	Off	On	On	On	On	On
8	128	Off	Off	Off	Off	Off
7	64	Off	Off	Off	Off	Off
6	32	Off	Off	Off	Off	Off
5	16	Off	Off	Off	Off	Off
4	8	Off	Off	Off	Off	Off
3	4	Off	Off	Off	Off	On
2	2	Off	Off	On	On	Off
1	1	Off	On	Off	On	Off

Descriptions

When switch 9 is OFF:

Low Octet: DIP Switch numbers set low octet of static IP address 192.168.1.X where X is 0 – 253

Ethernet Port Setting

The lower 8 switches (1-7) are each given a value based on weighted binary. If the switch second from the top (9) is Off, the 8 lower switches are provided a value from the bottom up as follows: 1, 2, 4, 8, 16, 32, 64, 128. The switches are turned On when they are pushed to the right. Add the value of all switches that are On to determine the overall value. This value represents the low octet of the IP address 192.168.1.x. This is an easy way to configure the Ethernet Card to a known IP address so a computer can be configured to easily and quickly communicate with the C445 via Modbus TCP Ethernet with the *in*Control software tool. Then, using this tool, the C445 Ethernet Card may be configured with any static IP address. Information on how to go online with the C445 using the software tool and Modbus TCP may be found in the *in*Control software user manual. The following procedure indicates a procedure using the software tool to set a static IP address, subnet mask and gateway address for the C445 Ethernet Card.

1. Set DIP Switch 9 to OFF.
2. Set the bottom 2 DIP Switches (1-2) ON and leave the others OFF resulting in a value of 3 and an IP address of 192.168.1.3 assigned to the Ethernet Card.
3. Power cycle the C445 so the new DIP Switch settings will be used.
4. Using the *in*Control software, go online with the C445 via Modbus TCP and the Ethernet Card.
5. Under the Communications/Ethernet categories in the software tool, configure a static IP address, subnet mask and gateway address. These will not take effect until a soft reset is issued to the C445 or until it receives a power cycle.
6. Go offline with the C445 in the software tool.
7. Set the DIP Switches so only the following switches are ON: 2 and 9. The Ethernet Card will now be configured for "NV Static IP Address".
8. Issue a soft reset or power cycle the C445. When it powers up the Ethernet Card will be configured with the static IP address, subnet mask and gateway address it was configured for with the *in*Control software tool.
9. This same process could be accomplished using the USB port or the RS-485 port with the *in*Control software tool.

When switch 9 is ON and other DIP switches are:

0 – Static IP: hardcoded IP address of 192.168.1.254

1 – DHCP: Pulls IP address from DHCP server

2 – NV Static: Full address taken from device Non-Volatile Memory (static)

3 – NV DHCP: Addresses are taken from the DHCP server and assigned to device NV memory. To keep this address as static, power down the device and then change DIP Switch setting to 2 (NV Static) before re-powering the device

4 – Internal IP Address Allocation Method: Device disregards DIP Switch selections and IP configuration is done via *in*Control software by setting parameter "IP ADDRESS ALLOCATION METHOD." The available settings for this parameter are the same as settings 0 through 3 available via DIP Switches. Setting 3 NV DHCP allows devices to get addresses from DHCP and assigns them to NV memory. Next, setting the parameter to 2 in the software before power cycle will allow devices to retain the last active IP addresses as static without having to physically change DIP Switches on each device.

The DIP Switches are used to configure the IP address for the Ethernet port. Even though there are two Ethernet ports on the Ethernet Option card, these ports act as a two port switch and both have the same IP address. This allows multiple C445 Ethernet Cards to be daisy-chained rather than each being connected to the same switch or switches. It also provides for the capability of connecting in a redundant ring topology when connected through switches that support this technology.

LED Status Indicators

The Ethernet Card includes indicators for the module status (MS) and Network Status (NS). The Module Status Indicator states are described in the table below.

Table 86. Module Status Indicator

Indicator State	Summary	Requirement
Steady Off	No power	If no power is supplied to device, the module status indicator shall be steady Off.
Steady Green	Device operational	If the device is operating correctly, the module status indicator shall be steady green
Flashing Green	Standby	If the device has not been configured, the module status indicator shall be flashing green.
Flashing Red	Minor Fault	If the device has detected a recoverable minor fault, the module status indicator shall be flashing red.
Steady Red	Major Fault	If the device has detected a non-recoverable major fault, the module status indicator shall be steady red.

Table 87. Network Status Indicator

Indicator State	Summary	Requirement
Steady Off	Not Powered, No IP Address	The device is powered off, or is powered on but with no IP address configured (Interface Configuration attribute of the TCP/IP Interface Object).
Flashing Green	No Connections	An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out.
Steady Green	Connected	At least one CIP connection (any transport class) is established, and an Exclusive Owner connection has not timed out.
Flashing Red	Connection Time-out	An Exclusive Owner connection for which this device is the target has timed out. The network status indicator shall return to steady green only when all timed out Exclusive Owner connections are re-established.
Steady Red	Duplicate IP	If the device has detected a non-recoverable major fault, the module status indicator shall be steady red.
Flashing Green and Red	Self-test	While the device is performing its power up testing, the module status indicator shall be flashing green and red.

Ethernet LED Indications

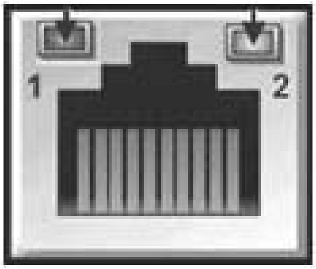


Table 88. Ethernet LED Description

LED	Description
[1] Ethernet Link status	Flashes with Ethernet message activity.
[2] Ethernet Link speed	Displays the link speed: Amber LED on the Ethernet Jack is ON when link speed is 100 mbps Amber LED on the Ethernet Jack is OFF when link speed is 10 mbps

Configuration Using a Web Browser

The Ethernet Card includes an embedded web page that provides the ability to monitor the status and set the configuration of the C445 Motor Management Relay System and the Ethernet Card. The Web Pages have been validated for use with Internet Explorer. To use the web page open your Internet Explorer browser and enter the IP address assigned to the Ethernet Card:

http:// *IP Address*

The web page provides five levels of authorization as shown in the chart below:

Table 89. Five Levels Of Authorization

Level	Default User Name	Default Password	Description
Open	<none>	<none>	Open access, has no password. Allows opening web page to be viewed, but no additional information is available
Read_Only	readonly	readonly	Read_Only access allows parameters to be viewed, but no control or configuration
Control	control	control	Control provides capabilities of Read_Only plus allows motor and discrete outputs to be turned on and off
Config	configuration	configuration	Config provides capabilities of Control plus the ability to set configuration values
Super_User	superuser	superuser	Super_User provides the capabilities of Config plus the ability to change user names and passwords

Note: In addition to the individual levels, **a password exemption** setting is provided. This setting specifies a level that can be accessed without any password protection. **The default value of the password exemption is Super_User**. All capabilities of the web page are accessible without a password prompt until the password exemption is changed to a lower level. User names and passwords are case sensitive, and limited between 6~16 characters. For security reasons, it is recommended that the user change the default passwords and adjust the password exemption level to be lower than Super_User after configuration. It is also recommended that these changes be made within a local subnet.

Refer to **System Configuration and Commissioning** on **Page 45** for a complete description and procedure on how to use the password feature for the Web Pages.

Configuration Using an EDS File

The C445 has an EtherNet/IP EDS file available. It can be imported into any EtherNet/IP configuration tools that support EDS files. This EDS file may be downloaded from the Eaton website.

http://www.eaton.com

Configuring Using the *in*Control Software Tool

There is a Modbus TCP Ethernet DTM/Driver for the *in*Control software tool. This interface may be used to connect to the C445 Motor Management Relay via the C445 Ethernet Card. Refer to the *in*Control software tool user manual for additional information (publication MN040013EN.

EtherNet/IP Protocol

The C445 Ethernet Card can be connected to any EtherNet/IP network. It can be connected both as an Explicit Message server and as an Implicit (I/O) Message target.

The Implicit connections supported include:

- Exclusive Owner
- Listen Only
- Input Only

Table 90. EtherNet/IP Object Model for the C445 Motor Management Relay

No.	Class	Object	No. of Instances	Description
1	0x01 (1)	Identity	1	Provides module identity object.
2	0x02 (2)	Message Router	1	Internal object implemented per ODVA specification
3	0x04 (4)	Assembly Object	I/P:50, 51, 54, 100, 107, 110, 116, 121 O/P:2, 5,104, 105, 106 Dynamic I/P:150	Binds attributes from multiple objects for access with a single Implicit (I/O) connection.
4	0x06 (6)	Connection Manager	1	Internal object supporting connection management. Implemented per ODVA specification
5	0x08 (8)	Discrete Input Point	8	Status information for the discrete Inputs.
6	0x09 (9)	Discrete Output Point	3	Status and control for the discrete Outputs.
7	0x29 (41)	Control Supervisor	1	Motor control functions.
8	0x2C (44)	Overload	1	Motor overload protection.
9	0x88 (136)	System Component Definition	5	Vendor Specific Object.
10	0x93 (147)	Voltage Object	1	Vendor Specific object for monitoring voltage.
11	0x96 (150)	Dynamic Input Assembly Interface	1	An interface to insert the parameter in dynamic assembly instance number 150.
12	0xC7 (199)	Test Only	1	Vendor Specific Object.
13	0x9B (155)	Motor Info	1	Vendor Specific Object.
14	0x9F (159)	Operation Mode	1	Vendor Specific Object.
15	0xA0 (160)	Modbus	1	Vendor Specific Object.
16	0xA1 (161)	Motor Monitoring	1	Vendor Specific Object.
17	0xA2 (162)	Motor Protection	1	Vendor Specific Object.
18	0xA5 (165)	Snap Shot	1	Vendor Specific Object.
19	0xAA (170)	Parameter Access	1	Vendor Specific Object.
20	0xB0 (176)	RTC	1	Vendor Specific Object. Provides access to RTC
21	0xB1 (177)	BCM	1	Vendor Specific Object.
23	0xB3 (179)	Option Card	1	Vendor Specific Object.
24	0xF4 (244)	Port Object	1	The Port Object describes the communication interfaces that are present on the device and visible to CIP.
25	0xF5 (245)	TCP/IP Interface	1	EtherNet/IP Specific object. Information about the TCP/IP Interface. Implemented per ODVA specification
26	0xF6 (246)	Ethernet Link	2	EtherNet/IP Specific object. Ethernet link object for each of the 2 Ethernet ports on the device. Implemented per ODVA specification.

Object Details

Table 91. Identity Object—Class 0x01 (1)

Class Services

ID	Service
0x0E	Get_Attribute_Single
0x01	Get_Attribute_All

Instance Services

ID	Service		
0x01	Get_Attributes_All		
0x05	Reset	Reset	
		Service data: 0	**Soft Reset:** Initializes adapter to the Power-up state.
		Service data: 1	**Factory Reset:** Writes default values to all instance attributes and then saves all non-volatile attributes to NV memory and then performs the equivalent of a Reset (0).
0x0E	Get_Attribute_Single		

Class Attributes

Sr. No.	ID	Access Rule	Data Type	Description	Remarks / Default Values
1	1 (0x1)	Get	UINT	Revision	1
2	2 (0x2)	Get	UINT	Max Instances	1
3	3 (0x3)	Get	UINT	Number of instances	1
4	6 (0x6)	Get	UINT	Maximum ID Class Attribute	7
5	7 (0x7)	Get	UINT	Maximum ID Instance Attribute	7

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	
1	1 (0x1)	Get	UINT	Vendor ID	0x44 (68) (Eaton Vendor ID)
2	2 (0x2)	Get	UINT	Device Type	Motor Starter Profile: 0x16
3	3 (0x3)	Get	UINT	Product Code	0x830A
4	4 (0x4)	Get	STRUCT of:	Revision	
			USINT	Major Revision	1
			USINT	Minor Revision	1
5	5 (0x5)	Get	WORD	Status	Status will be as per CIP Specification.
6	6 (0x6)	Get	UDINT	Serial Number	Unique number will be written during production.
7	7 (0x7)	Get	SHORT_STRING	Product Name	C445 EtherNet Communication Card

Table 92. Message Router Object—Class 0x2 (2)

Class Services

Service code	Service Name
0x0E	Get Attribute Single
0x01	Get Attributes All

Instance Services

Service code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single
0x0A	Multiple Service Packet (optional)

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max. Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.
4	4 (0x4)	Get	STRUCT	Optional Attribute List	List of optional instance attributes utilized in an object class implementation.
5	5 (0x5)	Get	STRUCT	Optional service list	List of optional services utilized in an object class implementation.
6	6 (0x6)	Get	UINT	Maximum ID Number Class Attributes	The attribute ID number of the last class attribute of the class definition implemented in the device.
7	7 (0x7)	Get	UINT	Maximum ID Number Instance Attributes	The attribute ID number of the last instance attribute of the class definition implemented in the device.

Instance Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Nil	Get	STRUCT N.A.	A list of supported objects. No.of supported classes in the class array. List of supported class codes
2	2 (0x2)	Nil	Get	UINT N.A.	Maximum connections supported

Table 93. Assembly Object—Class 0x4 (4)

Class Services

ID	Service
0x0E	Get_Attribute_Single
0x08	Create

Instance Services

ID	Service
0x0E	Get_Attribute_Single
0x10	Set_Attribute_Single
0x18	Get_Member
0x19	Set_Member
0x09	Delete

Class Attributes

Sr. No.	ID	Access Rule	Data Type	Description	Remarks/Default
1	1 (0x1)	Get	UINT	Revision	2
2	2 (0x2)	Get	UINT	Max. Instance	96
3	3 (0x3)	Get	UINT	Number of Instances	09
4	4 (0x4)	Get	Struct of:	Optional Attribute List	
			UINT	Number of Attributes	1
			Array of UINT	Array of Attributes	04 00
5	6 (0x6)	Get	USINT	Maximum ID Class Attribute	07 00
6	7 (0x7)	Get	USINT	Maximum ID Instance Attribute	04 00

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	Remarks/Default
1	3 (0x3)	Get / Set	ARRAY of BYTES	Data	
2	4 (0x4)	Get		Size	

Table 94. C445 Assembly Object Instances

Type	Instance	Description
Output	2 (0x02)	Basic Overload
	3 (0x03)	Basic Motor Starter
	5 (0x05)	Extended Motor Starter
	104 (0x68)	Basic Starter Relay
	105 (0x69)	Basic Output Control
	106 (0x6A)	Extended Motor Starter 2
	123 (0x7B)	Basic Starter Relay with Analog and Digital Outputs
	124 (0x7C)	Basic Starter Relay with Extended Analog and Digital Outputs
	125 (0x7D)	Basic Output Control with Analog and Digital Outputs
	126 (0x7E)	Basic Output Control with Extended Analog and Digital Outputs
	127 (0x7F)	Extended Motor Starter 2 with Basic Analog and Digital Outputs
	128 (0x80)	Extended Motor Starter 2 with Analog and Digital Outputs
	129 (0x81)	Extended Motor Starter 2 with Extended Analog and Digital Outputs
	130 (0x82)	Basic Analog and Digital Outputs
	131 (0x83)	Extended Analog and Digital Outputs

Table 94. C445 Assembly Object Instances, continued

Type	Instance	Description
Input	50 (0x32)	Basic Overload
	51 (0x33)	Extended Overload
	52 (0x34)	Basic Motor Starter
	54 (0x36)	Extended Motor Starter 2
	100 (0x64)	Status Current Monitoring
	101 (0x65)	Status Current Monitoring with Basic Analog and Digital Inputs
	102 (0x66)	Status Current Monitoring with Analog and Digital Inputs
	103 (0x67)	Status Current Monitoring with Extended Analog and Digital Inputs
	107 (0x6B)	Status Current Monitoring
	108 (0x6C)	Extended Overload with Local IO and Expansion Analog and Digital Inputs
	109 (0x6D)	Extended Overload with Local IO and Extended Expansion Analog and Digital Inputs
	110 (0x6E)	Status, Current Voltage, Trip
	111 (0x6F)	Status Current, Voltage, Trip with Basic Analog and Digital Inputs
	112 (0x70)	Status Current, Voltage, Trip with Analog and Digital Inputs
	113 (0x71)	Status Current, Voltage, Trip with Extended Analog and Digital Inputs
	114 (0x72)	Status Current, Voltage, Trip with Extended Analog and Digital Inputs 2
	116 (0x74)	Full Monitoring
	117 (0x75)	Full Monitoring with Basic Analog and Digital Inputs
	118 (0x76)	Full Monitoring with Analog and Digital Inputs
	119 (0x77)	Full Monitoring with Extended Analog and Digital Inputs
	120 (0x78)	Basic Analog and Digital Inputs
	121 (0x79)	Status and Short Measurements
	122 (0x7A)	Extended Analog and Digital Inputs
Input-Dynamic	150 (0x96)	Dynamic input Assembly

Output Instance 2: Basic Overload

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Reserved	Reserved	FaultReset	Reserved	Reserved

Output Instance 3: Basic Motor Starter

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Reserved	Reserved	FaultReset	Reserved	Run1

Output Instance 5: Extended Motor Starter

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Reserved	Reserved	FaultReset	Run2	Run1

Input Instance 50: Basic Overload

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Fault/Trip

Input Instance 51: Extended Overload

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Warning	Fault/trip

Input Instance 52: Basic Motor Starter

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Reserved	Reserved	Running 1	Reserved	Faulted/Tripped

Input Instance 54: Extended Motor Starter 2

Length = 1 Byte

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Cntr Ifrom Net	Ready	Running 2	Running 1	Warning	Faulted/Trip

Input Instance 100 (0x64): Status, Current

Length = 8 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed

Input Instance 100 (0x64): Status, Current, continued

Length = 8 Bytes

Byte Offset	Size (bytes)	Name	Description
2	2	Current I1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current I2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current I3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."

Input Instance 101 (0x65): Status Current Monitoring with Basic Analog and Digital Inputs

Length = 20 bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
10	10	Analog Inputs	5 Input words of data for analog inputs and status word(s)

Input Instance 102 (0x66): Status Current Monitoring with Analog and Digital Inputs

Length = 32 bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
10	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
12	20	Analog Inputs	10 Input words of data for analog inputs and status word(s)

Input Instance 103 (0x67): Status Current Monitoring with Extended Analog and Digital Inputs

Length = 32 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
10	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
12	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
14	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
16	38	Analog Inputs	19 Input words of data for analog inputs and status word(s)

Output Instance 104 (0x68): Basic Starter Relay

Length = 2 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Extended Motor Starter 2	Vendor specific Extended Motor starter Bit 0 = Run1 Bit 1 = Run2 Bit 2 = Reserved Bit 3 = Fault Reset Bit 4 to 15 = Reserved

Output Instance 105 (0x69): Basic Output Control

Length = 2 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Overload w/Relay	Basic Overload with Relays Bit 0 = Output #1 Bit 1 = Output #2 Bit 2 = Output #3 (set) Bit 3 = Fault Reset Bit 4 = Output #3 (reset) Bit 5 = Test Trip Bit 6 to 15 = reserved

Output Instance 106 (0x6A): Extended Motor Control 2

Length = 2 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Control Relay	Basic Control Bits: (Byte1: NETCTRL_CONTROL_WORD) (Byte2: BCM_FIELD_OUTPUTS) Bit 0: Run1 Bit 1: Run2 Bit 2: Switch Control to Remote (see note below) Bit 3: Fault Reset Bit 4: Control from network / Switch to remote Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved Bit 8: Output #1 (Conditional. Depends on profile selected) Bit 9: Output #2 (Conditional. Depends on profile selected) Bit 10: Output #3 (set) (Conditional. Depends on profile selected) Bit 11: Output #3 (reset) (Conditional. Depends on profile selected) Bits 12–15: Reserved

Note: To use Bit 2 in Output Instances 106, 127, 128 and 129 to switch the Active Control source between Local (0) and Remote (1), the “Allow Remote Control Switch” must be Enabled (True). This parameter can be found in the Operation Mode category, under Advanced Parameters.

Output Instance 123 (0x7B): Basic Starter Relay with Analog and Digital Outputs

Length = 8 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Starter with Analog and Digital Outputs	Vendor specific Basic starter Bit 0 = Run1 Bit 1 = Run2 Bit 2 = Reserved Bit 3 = Fault Reset Bits 4 to 15 = Reserved
2	2	Digital Outputs	Bits 0-7 = Outputs for first digital output card Bits 8-15 = Outputs for second digital output card
4	4	Analog Outputs	2 Output words of data for 2 analog outputs

Output Instance Output Instance 124 (0x7C): Basic Starter Relay with Extended Analog and Digital Outputs

Length = 18 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Starter with Analog and Digital Outputs	Vendor specific Basic starter Bit 0 = Run1 Bit 1 = Run2 Bit 2 = Reserved Bit 3 = Fault Reset Bits 4 to 15 = Reserved
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	2	Digital Outputs	Bits 0-7 = Outputs for the third digital output card Bits 8-15 = Outputs for the fourth digital output card
6	12	Analog Outputs	6 Output words of data for 6 analog outputs

Output Instance 125 (0x7D):Basic Output Control with Analog and Digital Outputs

Length = 14 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Output Control With Analog and Digital Outputs	Basic Output Control Bit 0 = Output#1 Bit 1 = Output #2 Bit 2 = Output #3 Bit 3 = Fault Reset Bit 4 = Reserved Bit 5 = Test Trip Bits 6 to 15 = Reserved
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	2	Digital Outputs	Bits 0-7 = Outputs for the third digital output card Bits 8-15 = Outputs for the fourth digital output card
6	8	Analog Outputs	4 Output words of data for 4 analog outputs

Output Instance 126 (0x7E): Basic Output Control with Extended Analog and Digital Outputs

Length = 26 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Output Control With Extended Analog and Digital Outputs	Bit 0 = Output#1 Bit 1 = Output #2 Bit 2 = Output #3 Bit 3 = Fault Reset Bit 4 = Reserved Bit 5 = Test Trip Bits 6 to 15 = Reserved
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	2	Digital Outputs	Bits 0-7 = Outputs for the third digital output card Bits 8-15 = Outputs for the fourth digital output card

Output Instance 126 (0x7E): Basic Output Control with Extended Analog and Digital Outputs, continued

Length = 26 Bytes

Byte Offset	Size (bytes)	Name	Description
6	2	Digital Outputs	Bits 0-7 = Outputs for the fifth digital output card Bits 8-15 = Outputs for the sixth digital output card
8	2	Digital Outputs	Bits 0-7 = Outputs for the seventh digital output card Bits 8-15 = Outputs for the eighth digital output card
10	16	Analog Outputs	8 Output words of data for 8 analog outputs

Output Instance 127 (0x7F): Extended Motor Starter 2 with Basic Analog and Digital Outputs

Length = 8 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Extended Motor Starter 2 with Basic Analog and Digital Outputs	Extended Motor Starter 2 bits (Byte 1: NETCTRL_CONTROL) (Byte 2: BCM_Field_Outputs) Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: Control From Network / Switch to Remote Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved Bit 8: Output#1 (Conditional. Depends on Operation Mode) Bit 9: Output#2 (Conditional. Depends on Operation Mode) Bit 10: Output#3 (Conditional. Depends on Operation Mode) Bits 11-15: Reserved
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	4	Analog Outputs	2 Output words of data for 2 analog outputs

Output Instance 128 (0x80): Extended Motor Starter 2 with Analog and Digital Outputs

Length = 14 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Extended Motor Starter 2 with Analog and Digital Outputs	Extended Motor Starter 2 bits (Byte 1: NETCTRL_CONTROL) (Byte 2: BCM_Field_Outputs) Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: Control From Network / Switch to Remote Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved Bit 8: Output#1 (Conditional. Depends on Operation Mode) Bit 9: Output#2 (Conditional. Depends on Operation Mode) Bit 10: Output#3 (Conditional. Depends on Operation Mode)
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	2	Digital Outputs	Bits 0-7 = Outputs for the third digital output card Bits 8-15 = Outputs for the fourth digital output card
6	8	Analog Outputs	4 Output words of data for 4 analog outputs

Output Instance 129 (0x81): Extended Motor Starter 2 with Extended Analog and Digital Outputs

Length = 26 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Extended Motor Starter 2 with Analog and Digital Outputs	Extended Motor Starter 2 bits (Byte 1: NETCTRL_CONTROL) (Byte 2: BCM_Field_Outputs) Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: Control From Network / Switch to Remote Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved Bit 8: Output#1 (Conditional. Depends on Operation Mode) Bit 9: Output#2 (Conditional. Depends on Operation Mode) Bit 10: Output#3 (Conditional. Depends on Operation Mode) Bits 11-15: Reserved
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	2	Digital Outputs	Bits 0-7 = Outputs for the third digital output card Bits 8-15 = Outputs for the fourth digital output card
6	2	Digital Outputs	Bits 0-7 = Outputs for the fifth digital output card Bits 8-15 = Outputs for the sixth digital output card
8	2	Digital Outputs	Bits 0-7 = Outputs for the seventh digital output card Bits 8-15 = Outputs for the eighth digital output card
10	16	Analog Outputs	8 Output words of data for 8 analog outputs

Output Instance 130 (0x82): Basic Analog and Digital Outputs

Length = 36 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
2	2	Digital Outputs	Bits 0-7 = Outputs for the third digital output card Bits 8-15 = Outputs for the fourth digital output card
4	32	Analog Outputs	16 Output words of data for 16 analog outputs

Output Instance 131 (0x83): Extended Analog and Digital Outputs

Length = 72 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
2	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
4	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
6	2	Digital Outputs	Bits 0-7 = Outputs for the first digital output card Bits 8-15 = Outputs for the second digital output card
8	64	Analog Outputs	32 Output words of data for 32 analog outputs

Input Instance 107 (0x6B): Extended Overload Input w/IO

Length = 2 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Overload w/Relay	Extended overload assembly with IO Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed

Input Instance 108 (0x6C): Extended Overload with Local IO and Expansion Analog and Digital Inputs

Length = 26 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Extended Overload	Extended Overload with Inputs Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
4	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
6	20	Analog Inputs	10 Input words of data for analog inputs and status word(s)

Input Instance 109 (0x6D): Extended Overload with Local IO and Extended Expansion Analog and Digital Inputs

Length = 90 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Extended Overload	Extended Overload with Inputs Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
4	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
6	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card

Input Instance 109 (0x6D): Extended Overload with Local IO and Extended Expansion Analog and Digital Inputs, continued

Length = 90 Bytes

Byte Offset	Size (bytes)	Name	Description
8	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
10	80	Analog Inputs	40 Input words of data for analog inputs and status word(s)

Input Instance 110 (0x6E): Status, Current, Voltage, Trip

Length = 22 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	PACKED_C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current I1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current I2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current I3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."

Input Instance 110 (0x6E): Status, Current, Voltage, Trip, continued

Length = 22 Bytes

Byte Offset	Size (bytes)	Name	Description
8	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - undervoltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
12	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
14	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
16	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
18	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
20	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)

Input Instance 111 (0x6F): Status, Current, Voltage, Trip with Basic Analog and Digital Inputs

Length = 26 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection

Input Instance 111 (0x6F): Status, Current, Voltage, Trip with Basic Analog and Digital Inputs, continued

Length = 26 Bytes

Byte Offset	Size (bytes)	Name	Description
12	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
14	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
16	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
18	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
20	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
22	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
24	2	Analog Inputs	1 Input word of data for an analog output card status

Input Instance 112 (0x70): Status, Current, Voltage, Trip with Analog and Digital Inputs

Length = 36 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."

Input Instance 112 (0x70): Status, Current, Voltage, Trip with Analog and Digital Inputs, continued

Length = 36 Bytes

Byte Offset	Size (bytes)	Name	Description
8	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
12	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
14	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
16	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
18	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
20	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
22	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
24	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card Bits 8-15 = Inputs for the fourth digital input card
26	10	Analog Inputs	5 Input words of data for analog inputs and status word(s)

Input Instance 113 (0x71): Status, Current, Voltage, Trip with Extended Analog and Digital Inputs

Length = 48 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection

Input Instance 113 (0x71): Status, Current, Voltage, Trip with Extended Analog and Digital Inputs, continued

Length = 48 Bytes

Byte Offset	Size (bytes)	Name	Description
12	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
14	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
16	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
18	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
20	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
22	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
24	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card Bits 8-15 = Inputs for the fourth digital input card
26	2	Digital Inputs	Bits 0-7 = Inputs for the fifth digital input card Bits 8-15 = Inputs for the sixth digital input card
28	20	Analog Inputs	10 Input words of data for analog inputs and status word(s)

Input Instance 114 (0x72): Status, Current, Voltage, Trip with Extended Analog and Digital Inputs 2

Length = 68 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."

Input Instance 114 (0x72): Status, Current, Voltage, Trip with Extended Analog and Digital Inputs 2, continued

Length = 68 Bytes

Byte Offset	Size (bytes)	Name	Description
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
12	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
14	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
16	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
18	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
20	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
22	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
24	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card Bits 8-15 = Inputs for the fourth digital input card
26	2	Digital Inputs	Bits 0-7 = Inputs for the fifth digital input card Bits 8-15 = Inputs for the sixth digital input card
28	2	Digital Inputs	Bits 0-7 = Inputs for the seventh digital input card Bits 8-15 = Inputs for the eighth digital input card
30	38	Analog Inputs	19 Input words of data for analog inputs and status word(s)

Input Instance 116 (0x74): Full Monitoring

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	PACKED_C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current I1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current I2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current I3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Field inputs	LOGIC_INPUT_STATE_BITFIELD: Digital Input Status.
10	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
12	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
14	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
16	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
18	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
20	4	Motor Power	POWER_WATTS: Motor Power Watts
24	1	Voltage Unbalance Percentage	LINE_V_UNBALANCE_PERC: Max Deviation from Average Voltage Divided by Average Voltage (%).
25	1	Current Unbalance Percentage	MOTOR_I_UNBALANCE_PERC: Max Deviation from Average Current Divided by Average Current (%)

Input Instance 116 (0x74): Full Monitoring, continued

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
26	2	Apparent Power Factor	POWER_PF_APPARENT: (%) (x0.01)
28	2	Ground Current	MOTOR_GF_I_RES_RMS: Ground Current in Amps x current scale factor
30	2	Line frequency	LINE_FREQ Line Frequency (x0.01Hz)
32	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground fault current 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
36	4	Warning Reason	STATUS_WARNING_BITS Warning/Alarm Indications 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current warning 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current

Input Instance 116 (0x74): Full Monitoring, continued

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
36	4	Warning Reason	STATUS_WARNING_BITS, continued 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
40	1	Thermal Pile Percentage	OVLD_THERMAL_MEM_PERCENT: Thermal Capacity 0% Cold Motor 100% Will Cause an Overload Trip (%)

Input Instance 117 (0x75): Full Monitoring with Basic Analog and Digital Inputs

Length = 46 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Field Inputs	LOGIC_INPUT_STATE_BITFIELD: Digital Input Status.

Input Instance 117 (0x75): Full Monitoring with Basic Analog and Digital Inputs, continued

Length = 46 Bytes

Byte Offset	Size (bytes)	Name	Description
10	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter “I Scale Factor.”
12	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
14	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
16	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
18	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
20	4	Motor Power	POWER_WATTS: Motor Power Watts
24	1	Voltage Unbalance Percentage	LINE_V_UNBALANCE_PERC: Max Deviation from Average Voltage Divided by Average Voltage (%)
25	1	Current Unbalance Percentage	MOTOR_I_UNBALANCE_PERC: Max Deviation from Average Current Divided by Average Current (%)
26	2	Apparent Power Factor	POWER_PF_APPARENT: (%) (x0.01)
28	2	Ground Current	MOTOR_GF_I_RES_RMS: Ground Current in Amps x current scale factor
30	2	Line Frequency	LINE_FREQ Line Frequency (x0.01Hz)
32	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit

Input Instance 117 (0x75): Full Monitoring with Basic Analog and Digital Inputs, continued

Length = 46 Bytes

Byte Offset	Size (bytes)	Name	Description
32	4	Trip Reason	STATUS_TRIPPED_BITS, continued 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
36	4	Warning Reason	STATUS_WARNING_BITS Warning/Alarm Indications 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current warning 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
40	2	Thermal Pile Percentage	OVLD_THERMAL_MEM_PERCENT: Thermal Capacity 0% Cold Motor 100% Will Cause an Overload Trip (%)
42	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
44	2	Analog Inputs	1 Input word of data for an analog output card status

Input Instance 118 (0x76): Full Monitoring with Analog and Digital Inputs

Length = 58 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Field Inputs	LOGIC_INPUT_STATE_BITFIELD: Digital Input Status.
10	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
12	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
14	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
16	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
18	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
20	4	Motor Power	POWER_WATTS: Motor Power Watts
24	1	Voltage Unbalance Percentage	LINE_V_UNBALANCE_PERC: Max Deviation from Average Voltage Divided by Average Voltage (%)
25	1	Current Unbalance Percentage	MOTOR_I_UNBALANCE_PERC: Max Deviation from Average Current Divided by Average Current (%)

Input Instance 118 (0x76): Full Monitoring with Analog and Digital Inputs, continued

Length = 58 Bytes

Byte Offset	Size (bytes)	Name	Description
26	2	Apparent Power Factor	POWER_PF_APPARENT: (%) (x0.01)
28	2	Ground Current	MOTOR_GF_I_RES_RMS: Ground Current in Amps x current scale factor
30	2	Line Frequency	LINE_FREQ Line Frequency (x0.01Hz)
32	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
36	4	Warning Reason	STATUS_WARNING_BITS Warning/Alarm Indications 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current warning 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power

Input Instance 118 (0x76): Full Monitoring with Analog and Digital Inputs, continued

Length = 58 Bytes

Byte Offset	Size (bytes)	Name	Description
36	4	Warning Reason	STATUS_WARNING_BITS, continued 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
40	2	Thermal Pile Percentage	OVLD_THERMAL_MEM_PERCENT: Thermal Capacity 0% Cold Motor 100% Will Cause an Overload Trip (%)
42	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
44	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card Bits 8-15 = Inputs for the fourth digital input card
46	12	Analog Inputs	6 Input words of data for analog inputs and status word(s)

Input Instance 119 (0x77): Full Monitoring with Extended Analog and Digital Inputs

Length = 70 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
2	2	Current L1	MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current L2	MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."

Input Instance 119 (0x77): Full Monitoring with Extended Analog and Digital Inputs, continued

Length = 70 Bytes

Byte Offset	Size (bytes)	Name	Description
6	2	Current L3	MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Field Inputs	LOGIC_INPUT_STATE_BITFIELD: Digital Input Status.
10	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
12	2	Voltage L1-L2	LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
14	2	Voltage L2-L3	LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
16	2	Voltage L3-L1	LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
18	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
20	4	Motor Power	POWER_WATTS: Motor Power Watts
24	1	Voltage Unbalance Percentage	LINE_V_UNBALANCE_PERC: Max Deviation from Average Voltage Divided by Average Voltage (%)
25	1	Current Unbalance Percentage	MOTOR_I_UNBALANCE_PERC: Max Deviation from Average Current Divided by Average Current (%)
26	2	Apparent Power Factor	POWER_PF_APPARENT: (%) (x0.01)
28	2	Ground Current	MOTOR_GF_I_RES_RMS: Ground Current in Amps x current scale factor
30	2	Line Frequency	LINE_FREQ Line Frequency (x0.01Hz)
32	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power

Input Instance 119 (0x77): Full Monitoring with Extended Analog and Digital Inputs, continued

Length = 70 Bytes

Byte Offset	Size (bytes)	Name	Description
32	4	Trip Reason	STATUS_TRIPPED_BITS, continued 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
36	4	Warning Reason	STATUS_WARNING_BITS Warning/Alarm Indications 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current warning 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection
40	2	Thermal Pile Percentage	OVLD_THERMAL_MEM_PERCENT: Thermal Capacity 0% Cold Motor 100% Will Cause an Overload Trip (%)
42	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
44	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card Bits 8-15 = Inputs for the fourth digital input card
46	2	Digital Inputs	Bits 0-7 = Inputs for the fifth digital input card Bits 8-15 = Inputs for the sixth digital input card
48	2	Digital Inputs	Bits 0-7 = Inputs for the seventh digital input card Bits 8-15 = Inputs for the eighth digital input card
50	20	Analog Inputs	10 Input words of data for analog inputs and status word(s)

Input Instance 120 (0x78): Basic Analog and Digital Inputs

Length = 42 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card Bits 8-15 = Inputs for the second digital input card
2	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card Bits 8-15 = Inputs for the fourth digital input card
4	38	Analog Inputs	19 Input words of data for analog inputs and status word(s)

Input Instance 121 (0x79): Status And Short Measurements

Length = 10 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
0	2	Device Status	C445_DEVICE_STATUS: Device Bit Array Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed

Input Instance 121 (0x79): Status And Short Measurements, continued

Length = 10 Bytes

Byte Offset	Size (bytes)	Name	Description
2	2	Current Average	MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter “I Scale Factor.”
4	2	Voltage Average	LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
6	4	Trip Reason	STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - Reserved 0x0000 0008 - ground current fault 0x0000 0010 - current phase loss 0x0000 0020 - current unbalance 0x0000 0040 - instantaneous over current 0x0000 0080 - jam 0x0000 0100 - PF deviation 0x0000 0200 - voltage phase loss 0x0000 0400 - voltage unbalance 0x0000 0800 - freq deviation fast 0x0000 1000 - freq deviation slow 0x0000 2000 - under current 0x0000 4000 - high power 0x0000 8000 - low power 0x0001 0000 - Reserved 0x0002 0000 - exceeds starts limit 0x0004 0000 - overload 0x0008 0000 - stall 0x0010 0000 - phase rotation mismatch 0x0020 0000 - PTC 0x0040 0000 - under voltage restart 0x0080 0000 - peak demand 0x0100 0000 - HRGF pulse detection

Input Instance 122 (0x7A): Extended Analog and Digital Inputs

Length = 42 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Digital Inputs	Bits 0-7 = Inputs for the first digital input card
			Bits 8-15 = Inputs for the second digital input card
2	2	Digital Inputs	Bits 0-7 = Inputs for the third digital input card
			Bits 8-15 = Inputs for the fourth digital input card
4	2	Digital Inputs	Bits 0-7 = Inputs for the fifth digital input card
			Bits 8-15 = Inputs for the sixth digital input card
6	2	Digital Inputs	Bits 0-7 = Inputs for the seventh digital input card
			Bits 8-15 = Inputs for the eighth digital input card
8	80	Analog Inputs	40 Input words of data for analog inputs and status word(s)

Table 95. Connection Manager Object—Class 0x6 (6)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single
0x01	Get Attributes All

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x01	Get Attributes All
0x10	Set Attribute Single
0x02	Set Attributes All
0x4E	Forward Close
0x52	Unconnected Send
0x54	Forward Open
0x5A	Get Connection Owner
0x5B	Large Forward Open

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max. Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.
4	4 (0x4)	Get	STRUCT	Optional Attribute List	List of optional instance attributes utilized in an object class implementation.
5	6 (0x6)	Get	UINT	Maximum ID Number Class Attributes	The attribute ID number of the last class attribute of the class definition implemented in the device.
6	7 (0x7)	Get	UINT	Maximum ID Number Instance Attributes	The attribute ID number of the last instance attribute of the class definition implemented in the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Set	UINT	Open Requests	Number of Forward Open service requests received.
2	2 (0x2)	Set	UINT	Open Format Rejects	Number of Forward Open service requests which were rejected due to bad format.
3	3 (0x3)	Set	UINT	Open Resource Rejects	Number of Forward Open service requests which were rejected due to lack of resources.
4	4 (0x4)	Set	UINT	Open Other Rejects	Number of Forward Open service requests which were rejected for reasons other than bad format or lack of resources.
5	5 (0x5)	Set	UINT	Close Requests	Number of Forward Close service requests received.
6	6 (0x6)	Set	UINT	Close Format Requests	Number of Forward Close service requests which were rejected due to bad format.
7	7 (0x7)	Set	UINT	Close Other Requests	Number of Forward Close service requests which were rejected for reasons other than bad format.
8	8 (0x8)	Set	UINT	Connection Timeouts	Total number of connection timeouts that have occurred in connections controlled by this Connection Manager.

Table 96. Discrete Input Object—Class 0x8 (8)

Class Services

Service code	Service Name
0x0E	Get Attribute Single

Instance Services

Service code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max. Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Instance	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1),	3 (0x3)	Get	BOOL	value	ON/OFF Status of BCM Digital Inputs: 0: OFF, 1: ON Instance 1- BCM Digital i/p-1
2	2 (0x2)	3 (0x3)	Get	BOOL	value	ON/OFF Status of BCM Digital Inputs: 0: OFF, 1: ON Instance 2-BCM Digital i/p-2
3	3 (0x3)	3 (0x3)	Get	BOOL	value	ON/OFF Status of BCM Digital Inputs: 0: OFF, 1: ON Instance 3-Digital i/p-3
4	4 (0x4)	3 (0x3)	Get	BOOL	value	ON/OFF Status of BCM Digital Inputs: 0: OFF, 1: ON Instance 4-BCM Digital i/p-4
9	1 (0x1)	101 (0x65)	Get/Set	UINT	Debounce	BCM Digital i/p-1 debounce time. Applies to both raising & Falling edge. (mSec)
10	2 (0x2)	101 (0x65)	Get/Set	UINT	Debounce	BCM Digital i/p-2 debounce time. Applies to both raising & Falling edge. (mSec)
11	3 (0x3)	101 (0x65)	Get/Set	UINT	Debounce	BCM Digital i/p-3 debounce time. Applies to both raising & Falling edge. (mSec)
12	4 (0x4)	101 (0x65)	Get/Set	UINT	Debounce	BCM Digital i/p-4 debounce time. Applies to both raising & Falling edge. (mSec)

Table 97. Discrete Output Object—Class 0x9 (9)

Class Services

Service code	Service Name
0x0E	Get Attribute Single

Instance Services

Service code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max. Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Instance	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1), 2 (0x2), 3 (0x3), 4 (0x4)	3 (0x3)	Set	BOOL	Logic output state bit field	ON/OFF Status of Digital Outputs. (BCM Field Output control)
2	1 (0x1), 2 (0x2), 3 (0x3)	5 (0x5)	Set	BOOL	Fault Action	Action taken on output’s value in Communication Fault state
3	1 (0x1), 2 (0x2), 3 (0x3)	6 (0x6)	Set	BOOL	Fault Value	User-defined value for use with Fault Action attribute
4	1 (0x1), 2 (0x2), 3 (0x3)	7 (0x7)	Set	BOOL	Idle Action	Action taken on output’s value in Communication Idle state
5	1 (0x1), 2 (0x2), 3 (0x3)	8 (0x8)	Set	BOOL	Idle Value	User-defined value for use with Idle Action attribute

Table 98. Control Supervisor Object—Class 0x29 (41)

Class Services

ID	Service	Requirements
0x0E	Get Attribute Single	

Instance Services

ID	Service	
0x0E	Get_Attribute_Single	
0x10	Set_Attribute_Single	
0x05	Reset Service	Type 0

Class Attributes

Sr. No.	ID	Access Rule	Data Type	Name	Description	Default	Range
1	1 (0x1)	Get	UINT	Revision		1	—
2	2 (0x2)	Get	UINT	Max Instance		1	—
3	3 (0x3)	Get	UINT	Number of Instances		1	—

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description			
1	3 (0x3)	Set	BOOL	Run1	Run/Stop Event Matrix	0	0 – 1
2	4 (0x4)	Set	BOOL	Run2	Run/Stop Event Matrix	0	0 – 1
3	5 (0x5)	Set	BOOL	NetCtrl	Requests Run/Stop control to be local or from network. 0 = Local Control 1 = Network Control Note that the actual status of Run/Stop control is reflected in attribute 15, CtrlFromNet.	0	0 – 1
4	7 (0x7)	Get	BOOL	Running1	1 = (Enabled and Run1) or (Stopping and Running1) or (Fault_Stop and Running1) 0 = Other state	0	0 – 1
5	8 (0x8)	Get	BOOL	Running2	1 = (Enabled and Run1) or (Stopping and Running1) or (Fault_Stop and Running1) 0 = Other state	0	0 – 1
6	9 (0x9)	Get	BOOL	Ready	1 = Ready or Enabled or Stopping 0 = Other state	0	0 – 1
7	11 (0xB)	Get	BOOL	Warning	1 = Warning (not latched) 0 = No Warnings present	0	0-1
8	12 (0xC)	Set	BOOL	FaultRst	0⟶1 = Fault Reset 0 = No action	0	0 – 1
9	13 (0xD)	Get	UINT	Fault Queue-1	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.		
10	15 (0xF)	Get	BOOL	CtrlFromNet	Status of Run/Stop control source. 0=Control is local 1=Control is from network	0	0 – 1
11	17 (0x11)	Set	BOOL	CIP Force Fault (Need Dependent DCID in BCM)	0 ⟶1 = Force		

Table 98. Control Supervisor Object—Class 0x29 (41), continued

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	
12	101 (0x65)	Get/Set	BYTE	Fieldbus Motor Control	Device Bit Array Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: Reserved Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved
13	102 (0x66)	Get/Set	BYTE	Network Control Word with NetCtrl bit	Device Bit Array Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: NetCtrl Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved
14	103 (0x67)	Get/Set	BYTE	FieldBus Input Feedback Register	Bit 0: Network feedback input0 Bit 1: Network feedback input1 Bit 2: Network feedback input2 Bit 3: Network feedback input3 Bit 4: Network feedback input4 Bit 5: Network feedback input5 Bit 6: Network feedback input6 Bit 7: Network feedback input7
15	104 (0x68)	Get	WORD	Packed Device Status	Bit 0: Faulted/Tripped Bit 1: Warning Bit 2: Output #1 Bit 3: Output #2 Bit 4: Input #1 Bit 5: Input #2 Bit 6: Input #3 Bit 7: Input #4 Bit 8: Running1 Bit 9: Running2 Bit 10: Remote or CtrlFromNet Bit 11: Output #3 Bit 12: Reserved Bit 13: Inhibited Bit 14: Ready Bit 15: AtRef or Up-To-Speed
16	105 (0x69)	Get	BYTE	Motor Control Status	Bit 0: Running1 Bit 1: Running2 Bit 2: Remote or CtrlFromNet Bit 3: Faulted/Tripped Bit 4: Warning Bit 5: Inhibited Bit 6: Ready Bit 7: AtRef or Up-To-Speed

Table 98. Control Supervisor Object—Class 0x29 (41), continued

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	
17	106 (0x6A)	Get	Array of 4 Bytes	Tripped Status Bits	Bit 0: Undervoltage Bit 1: Overvoltage Bit 2: Reserved Bit 3: Ground current fault Bit 4: Current phase loss Bit 5: Current unbalance Bit 6: Instantaneous over current Bit 7: Jam Bit 8: PF deviation Bit 9: Voltage phase loss Bit 10: voltage unbalance Bit 11: Freq deviation fast Bit 12: Freq deviation slow Bit 13: Under current Bit 14: High power Bit 15: Low power Bit 16: Reserved Bit 17: Exceeds starts limit Bit 18: Overload Bit 19: Stall Bit 20: Phase rotation mismatch Bit 21: PTC Bit 22: Under voltage restart Bit 23: Peak demand Bit 24: HRGF Pulse Detection
18	107 (0x6B)	Get	Array of 4 Bytes	Warning Status Bits	Bit 0: Undervoltage Bit 1: Overvoltage Bit 2: Reserved Bit 3: Ground current warning Bit 4: Current phase loss Bit 5: Current unbalance Bit 6: Instantaneous over current Bit 7: Jam Bit 8: PF deviation Bit 9: Voltage phase loss Bit 10: Voltage unbalance Bit 11: Freq deviation fast Bit 12: Freq deviation slow Bit 13: Under current Bit 14: High power Bit 15: Low power Bit 16: Reserved Bit 17: Exceeds starts limit Bit 18: Overload Bit 19: Stall Bit 20: Phase rotation mismatch Bit 21: PTC Bit 22: Under voltage restart Bit 23: Peak demand Bit 24: HRGF Pulse Detection

Table 98. Control Supervisor Object—Class 0x29 (41), continued

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	
19	108 (0x6C)	Get	UINT	Active Fault	0: No Faults 1: Undervoltage 2: Overvoltage 3: Reserved 4: Ground current 5: Current phase loss 6: Current unbalance 7: Instantaneous over current 8: Jam 9: PF deviation 10: Voltage phase loss 11: Voltage unbalance 12: Freq deviation fast 13: Freq deviation slow 14: Under current 15: High power 16: Low power 17: Contactor failure 18: Exceeds starts limit 19: Overload 20: Stall 21: Phase rotation 22: PTC - See PTC State for details 23: Under voltage restart 24: Measurement Module fault 25: Communication loss on active fieldbus 26: Measurement Module not available or comm loss with the module 27: User Interface not available or comm loss with the module 28: Test trip device fault 29: Option card not available or comm loss with the module 30: RTC Option board NV memory fail 31: Currently connected User Interface does not match with what was connected before. 32: Currently connected Measurement Module does not match with what was connected before. 33: Currently connected Comm Card does not match with what was connected before 38: Ground Fault Module firmware is incompatible 39: Ground Fault Module communication loss 40: Ground Fault Module mismatch 41: Ground Fault Module CT open 42: Ground Fault Module CT shorted 43: Ground Fault Module CT no cal 44: HRGF Pulse Detect 200–232: Logic engine faults 500: Internal - Communication loss with Power Supply Board 501: Internal - Power Supply Board is not responding to SPI 502: Internal - Checksums in NV Memory (F-RAM) didn't match during read (neither pair) 503: Internal - Checksums in NV Memory (F-RAM) didn't match during write (neither pair) 504: Internal - Expected backup memory RTC module is missing 505: Internal - Expected backup memory RTC module is mismatched with actual 506: Internal - Backup Memory RTC module has NV fault. 507: Internal - Serial flash memory fault in BCM 508: Internal - Mapping Error 511: Internal Ground Fault Module NV memory error 1000–1049: Logic User faults

Table 98. Control Supervisor Object—Class 0x29 (41), continued

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	
20	109 (0x6D)	Get	UINT	Active Warning	0: No warnings 1: Undervoltage 2: Overvoltage 3: Reserved 4: Ground current 5: Current phase loss 6: Current unbalance 7: Instantaneous over current 8: Jam 9: PF deviation 10: Voltage phase loss 11: Voltage unbalance 12: Freq deviation fast 13: Freq deviation slow 14: Under current 15: High power 16: Low power 17: Contactor failure 18: Exceeds starts limit 19: Overload 20: Stall 21: Phase rotation 22: PTC - See PTC State for details 23: Peak demand 24: Measurement Module warning 25: Real time clock default value loaded 26: RTC battery voltage too low 27: Base Control Module high temperature warning 31: Ground Fault Module high ambient temp 41: Ground Fault Module CT open 42: Ground Fault Module CT shorted 43: Ground Fault Module CT no cal 44: HRGF Pulse Detect 220–232: Logic engine warnings 1000–1049: Logic User warnings
21	110 (0x6E)	Get	UINT	Active Inhibit	0: No Inhibits 1: Incorrect Configuration 2: Soft reset required 3: Backspin 4: Undervoltage restart timer active 5: Measurement Module inhibit 6: Under voltage 7: Voltage unbalance 8: Starts per hour limit 9: Over voltage inhibit 10: ELC Hardware mismatch 11: Run Interlock input open 1000–1049: Logic User inhibits

Table 98. Control Supervisor Object—Class 0x29 (41), continued

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description		
22	111 (0x6F)	Get	USINT	Config Inhibit Reason	0: No active inhibits 1: Local and Remote motor control sources both point to Fieldwire 2: Local motor control source is set to User Interface but the User Interface type does not match 3: One or more enabled protection features requires a voltage option card in the Measurement Module 4: One or more enabled protection features requires a PTC (Temperature) option card in the Measurement Module 5: Selected starter profile is incompatible with fieldwire as local control or fieldwire type 6: Cannot choose fieldwire as the feedback source when the fieldwire is used as a local / remote source with the selected starter 7: UI Custom Overlay - Multiple buttons assigned to same function 8: UI Custom Overlay - Multiple functions assigned to the same button LED 9: UI Custom Overlay - Multiple functions assigned to the same status LED 10: Selected starter profile is incompatible with the connected UI 11: The General Purpose I/O operational mode does not use fieldwire as a control source 12: Q3 configured for latching relay and shunt trip output	
23	112 (0x70)	Get/Set	USINT	Motor Control Communication Loss Behavior	0: Stop on comloss event - no fault 1: Ignore comloss and keep present state 2: Send RUN1 command on comloss event 3: Send RUN2 command on comloss event 4: Stop C445 controller and issue comloss fault	4
24	113 (0x71)	Get/Set	USINT	Motor Control Network Idle Behavior	0: Stop on idle event 1: Ignore idle and keep present state 2: Send RUN1 command on idle event 3: Send RUN2 command on idle event	0
25	114 (0x72)	Get/Set	USINT	System Services	0: No Active Service 1: Clear fault queue 2: Clear trip snapshot 3: Test trip 4: Re-pair external modules 5: Factory reset 6: Soft reset 7: Reset Fault 8: Proof Test	
26	115 (0x73)	Get	USINT	Proof Test Status	0: Proof Test was never run after a power cycle 1: Proof Test currently running 2: Proof Test passed 3: Proof Test failed	0
27	116 (0x74)	Get	UINT	Base Control Module Fault Queue - 1	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.	
28	117 (0x75)	Get	UINT	Base Control Module Fault Queue - 2	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.	
29	118 (0x76)	Get	UINT	Base Control Module Fault Queue – 3	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.	

Table 98. Control Supervisor Object—Class 0x29 (41), continued

Instance Attributes

Sr. No.	ID	Access Rule	Data Type	Description	
30	119 (0x77)	Get	UINT	Base Control Module Fault Queue - 4	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.
31	120 (0x78)	Get	UINT	Base Control Module Fault Queue - 5	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.
32	121 (0x79)	Get	UINT	Base Control Module Fault Queue - 6	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.
33	122 (0x7A)	Get	UINT	Base Control Module Fault Queue - 7	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.
34	123 (0x7B)	Get	UINT	Base Control Module Fault Queue - 8	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.
35	124 (0x7C)	Get	UINT	Base Control Module Fault Queue - 9	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.
36	125 (0x7D)	Get	UINT	Base Control Module Fault Queue - 10	A list of faults based on most recent. Duplicates are not allowed. They are sorted by event with the newest at the top of the queue.

Table 99. Overload Object—Class 0x2C (44)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1	Get	UINT	Revision	Revision of this object
2	2	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	4 (0x4)	Get/Set	USINT	Motor Overload Trip Class	Overload trip class
2	5 (0x5)	Get	UINT	Motor Current Average - Scaled	Scaled motor current average
3	6 (0x6)	Get	USINT	Motor I Unbalance Percent	Motor current unbalance percent
4	7 (0x7)	Get	USINT	Thermal memory Percent	Thermal memory
5	8 (0x8)	Get	UINT	Motor Current Phase A - Scaled	Scaled phase A motor current
6	9 (0x9)	Get	UINT	Motor Current Phase B - Scaled	Scaled phase B motor current
7	10 (0xA)	Get	UINT	Motor Current Phase C - Scaled	Scaled phase C motor current
8	11 (0xB)	Get	UINT	Ground Current - RMS	Motor ground fault current RMS

Table 99. Overload Object—Class 0x2C (44), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
9	101 (0x65)	Get	UINT	Motor Overload Trip FLA	Motor Overload Trip FLA
10	102 (0x66)	Get/Set	UINT	Motor Overload Trip FLA Motor1	Motor Overload Trip FLA Motor1
11	103 (0x67)	Get/Set	UINT	Motor Overload Trip FLA Motor2	Motor Overload Trip FLA Motor2
12	104 (0x68)	Get	UINT	Motor Current Scale Factor	Motor Current Scale Factor
13	105 (0x69)	Get	UINT	Motor Current Average Percent FLA	Motor Current Average Percent FLA
14	106 (0x6A)	Get	USINT	Thermal capacity level remaining	Thermal capacity level remaining
15	107 (0x6B)	Get	UINT	Time for overload to reach reset threshold	Time for overload to reach reset threshold
16	108 (0x6C)	Get	UINT	Time to Trip (overload)	Time to Trip (overload)
17	109 (0x6D)	Get/Set	USINT	Motor Overload Alarm Threshold	Motor Overload Alarm Threshold
18	110 (0x6E)	Get/Set	USINT	Thermal overload reset threshold. Level where reset is possible.	Thermal overload reset threshold. Level where reset is possible.
19	111 (0x6F)	Get/Set	UINT	CT Ratio Active - Primary	CT Ratio Active - Primary
20	112 (0x70)	Get/Set	UINT	CT Ratio Active - Secondary	CT Ratio Active - Secondary
21	113 (0x71)	Get	REAL	Motor Current Average - Float	Motor Current Average - Float
22	114 (0x72)	Get	REAL	Motor Current Phase A - Float	Motor Current Phase A - Float
23	115 (0x73)	Get/	REAL	Motor Current Phase B - Float	Motor Current Phase B - Float
24	116 (0x74)	Get	REAL	Motor Current Phase C - Float	Motor Current Phase C - Float
25	117 (0x75)	Get	UINT	Measurement Module FLA - Min	Measurement Module FLA - Min
26	118 (0x76)	Get	UINT	Measurement Module FLA - Max	Measurement Module FLA - Max

Table 100. System Component Definition Object—Class 0x88 (136)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1	Get	UINT	Revision	Revision of this object
2	2	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Instance	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x01)	1 (0x1)	Get	UINT	BCM hardware rev	BCM Product hardware revision numerical
2	1 (0x01)	2 (0x2)	Get	UINT	BCM firmware rev	BCM Firmware revision numerical
3	1 (0x01)	3 (0x3)	Get	UDINT	BCM product Serial No.	BCM Device Product Serial Number
4	1 (0x01)	4 (0x4)	Get	UINT	BCM Product code	BCM Product code.
5	1 (0x01)	5 (0x5)	Get	UINT	BCM Product Sub code	BCM Product Subcode.

Table 100. System Component Definition Object—Class 0x88 (136), continued

Instance Attributes

Sr. No.	Instance	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
6	2 (0x02)	1 (0x1)	Get	UINT	Power Board hardware rev	Power Board Product hardware revision numerical
7	2 (0x02)	2 (0x2)	Get	UINT	Power Board firmware rev	Power Board Firmware revision numerical
8	2 (0x02)	3 (0x3)	Get	UDINT	Power Board product Serial No.	Power Board Device Product Serial Number
9	3 (0x03)	1 (0x1)	Get	UINT	MM hardware rev	MM Product hardware revision numerical
10	3 (0x03)	2 (0x2)	Get	UINT	MM firmware rev	MM Firmware revision numerical
11	3 (0x03)	3 (0x3)	Get	UDINT	MM product Serial No.	MM Device Product Serial Number
12	3 (0x03)	4 (0x4)	Get	UINT	MM Product code	MM Product code.
13	3 (0x03)	5 (0x5)	Get	UINT	MM Product Sub code	MM Product Subcode.
14	4 (0x04)	1 (0x1)	Get	UINT	OPTION CARD hardware rev	OPTION CARD Product hardware revision numerical
15	4 (0x04)	2 (0x2)	Get	Array of 2 UINT	OPTION CARD firmware rev	OPTION CARD Firmware revision numerical
16	4 (0x04)	3 (0x3)	Get	UDINT	OPTION CARD product Serial No.	OPTION CARD Device Product Serial Number
17	4 (0x04)	4 (0x4)	Get	UINT	OPTION CARD Product code	OPTION CARD Product code.
18	4 (0x04)	5 (0x5)	Get	UINT	OPTION CARD Product Sub code	OPTION CARD Product Subcode.
19	5 (0x05)	2 (0x2)	Get	Array of 2 UINT	UI firmware rev	UI Firmware revision numerical
20	5 (0x05)	3 (0x3)	Get	UDINT	UI product Serial No.	UI Device Product Serial Number
21	5 (0x05)	4 (0x4)	Get	UINT	UI Product code	UI Product code.
22	5 (0x05)	5 (0x5)	Get	UINT	UI Product Sub code	UI Product Subcode.

Table 101. Voltage Object—Class 0x93 (147)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	0x1	Get	UINT	Revision	Revision of this object
2	0x2	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	0x3	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get	UINT	Line Voltage LL Phases AB	Supply Line-to-Line Voltage AB
2	2 (0x2)	Get	UINT	Line Voltage LL Phases BC	Supply Line-to-Line Voltage BC
3	3 (0x3)	Get	UINT	Line Voltage LL Phases CA	Supply Line-to-Line Voltage CA
4	4 (0x4)	Get	UIN T	Line Voltage LL Average	Supply Line-to-Line Voltage Average
5	5 (0x5)	Get	USINT	Line V Unbalance Percent	Supply Voltage Unbalance percentage

Table 101. Voltage Object—Class 0x93 (147), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
6	6 (0x6)	Get	USINT	Line Voltage Phase Order	Supply frequency in centi-Hz
7	7 (0x7)	Get/Set	UINT	PT Ratio (only available with external PT) - Primary	PT Ratio (only available with external PT) - Primary
8	8 (0x8)	Get	UINT	Line Frequency - Scaled	Line Frequency - Scaled
9	9 (0x9)	Get/Set	UINT	PT Ratio (only available with external PT) - Secondary	PT Ratio (only available with external PT) - Secondary
10	10 (0xA)	Get	UINT	Measurement Module Voltage Scale Factor	Measurement Module Voltage Scale Factor
11	11 (0xB)	Get/Set	USINT	Protection UnderVoltage Trip Level	Protection UnderVoltage Trip Level
12	12 (0xC)	Get/Set	UINT	Protection UnderVoltage Trip Debounce	Protection UnderVoltage Trip Debounce
13	13 (0xD)	Get/Set	USINT	Protection UnderVoltage Alarm Level	Protection UnderVoltage Alarm Level
14	14 (0xE)	Get/Set	UINT	Protection UnderVoltage Start Delay	Protection UnderVoltage Start Delay
15	15 (0xF)	Get/Set	UINT	Protection OverVoltage Trip Level	Protection OverVoltage Trip Level
16	16 (0x10)	Get/Set	UINT	Protection OverVoltage Trip Debounce	Protection OverVoltage Trip Debounce
17	17 (0x11)	Get/Set	UINT	Protection OverVoltage Alarm Level	Protection OverVoltage Alarm Level
18	18 (0x12)	Get/Set	USINT	Protection V Unbalance Trip Percent Level	Protection V Unbalance Trip Percent Level
19	19 (0x13)	Get/Set	UINT	Protection V Unbalance Trip Debounce Time	Protection V Unbalance Trip Debounce Time
20	20 (0x14)	Get/Set	USINT	Protection V Unbalance Alarm Percent Level	Protection V Unbalance Alarm Percent Level
21	21 (0x15)	Get	USINT	V Phase Loss Trip Level in percent	V Phase Loss Trip Level in percent
22	22 (0x16)	Get	UINT	V Phase Loss Debounce	V Phase Loss Debounce
23	23 (0x17)	Get/Set	BOOL	Protection start inhibit enable	Protection start inhibit enable
24	24 (0x18)	Get/Set	USINT	Undervoltage start inhibit threshold	Undervoltage start inhibit threshold
25	25 (0x19)	Get/Set	USINT	Voltage Imbalance start inhibit threshold	Voltage Imbalance start inhibit threshold
26	26 (0x1A)	Get/Set	USINT	Over Voltage start inhibit threshold	Over Voltage start inhibit threshold
27	27 (0x1B)	Get/Set	USINT	Protection Under Voltage Restart Fault Level (Percent)	Protection Under Voltage Restart Fault Level (Percent)
28	28 (0x1C)	Get/Set	USINT	Protection Under Voltage Restart Restoration Level (Percent)	Protection Under Voltage Restart Restoration Level (Percent)
29	29 (0x1D)	Get/Set	UINT	Undervoltage restart max time for immediate restart	Undervoltage restart max time for immediate restart
30	30 (0x1E)	Get/Set	UDINT	Undervoltage restart delay short	Undervoltage restart delay short
31	31 (0x1F)	Get/Set	UDINT	Undervoltage restart max time for delayed restart short	Undervoltage restart max time for delayed restart short
32	32 (0x20)	Get/Set	UINT	Undervoltage restart delay long	Undervoltage restart delay long
33	33 (0x21)	Get/Set	UINT	Undervoltage restart max time for delayed restart long	Undervoltage restart max time for delayed restart long

Table 102. Dynamic input Assembly Interface Object—Class 0x96 (150)

Class Services

Service code	Service Name
0x0E	Get Attribute Single

Instance Services

Service code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	0x1	Get	UINT	Revision	Revision of this object
2	0x2	Get	UINT	Max. Instance	Maximum instance number of an object currently created in this class level of the device.
3	0x3	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description	Default
1	1 (0x1)	Get/Set	UINT	Dynamic Assembly Interface-Index-1	An interface to insert the parameter in dynamic assembly instance number 150, Index-1.	1
2	2 (0x2)	Get/Set	UINT	Dynamic Assembly Interface-Index-2	An interface to insert the parameter in dynamic assembly instance number 150, Index-2.	18
3	3 (0x3)	Get/Set	UINT	Dynamic Assembly Interface-Index-3	An interface to insert the parameter in dynamic assembly instance number 150, Index-3.	2
4	4 (0x4)	Get/Set	UINT	Dynamic Assembly Interface-Index-4	An interface to insert the parameter in dynamic assembly instance number 150, Index-4.	3
5	5 (0x5)	Get/Set	USINT	Dynamic Assembly Interface-Index-5	An interface to insert the parameter in dynamic assembly instance number 150, Index-5.	4
6	6 (0x6)	Get/Set	UINT	Dynamic Assembly Interface-Index-6	An interface to insert the parameter in dynamic assembly instance number 150, Index-6.	6
7	7 (0x7)	Get/Set	USINT	Dynamic Assembly Interface-Index-7	An interface to insert the parameter in dynamic assembly instance number 150, Index-7.	7
8	8 (0x8)	Get/Set	USINT	Dynamic Assembly Interface-Index-8	An interface to insert the parameter in dynamic assembly instance number 150, Index-8.	8

C445 supports following parameters as a member of dynamic input assembly instance.

Table 103. Dynamic Input Assembly Instance Parameters

Value	Parameter Name	Description
0	Assembly Terminator	D_IN_ASM_TERMINATOR
1	Packed Device status (See Control Supervisor Object)	C445_DEVICE_STATUS
2	Motor Current Phase A - Scaled	MOTOR_I_A_SCALED
3	Motor Current Phase B - Scaled	MOTOR_I_B_SCALED
4	Motor Current Phase C - Scaled	MOTOR_I_C_SCALED
5	Motor Current Average - Scaled	MOTOR_I_AVE_SCALED
6	Line Voltage LL Phases AB	LINE_V_LL_AB_RMS
7	Line Voltage LL Phases BC	LINE_V_LL_BC_RMS
8	Line Voltage LL Phases CA	LINE_V_LL_CA_RMS
9	Line Voltage LL Average	LINE_V_LL_AVE_RMS
10	Total Watts for all three phases	POWER_WATTS
11	Line V Unbalance Percent	LINE_V_UNBALANCE_PERC
12	Motor Current Average Percent FLA	MOTOR_I_AVE_PERCENT_FLA
13	Apparent Power Factor	POWER_PF_APPARENT
14	GF High Resistance - RMS	MOTOR_GF_I_HR_RMS
15	Line Frequency - Scaled	LINE_FREQ
16	Thermal memory Percent	STATUS_OVLD_THERMAL_MEM_PERCENT
17	Signal Status Bits	STATUS_SIGNAL_BITS
18	Warning Status Bits	STATUS_WARNING_BITS
19	BCM Digital Input Status	LOGIC_INPUT_STATE_BITFIELD

Table 104. Motor Info Object—Class 0x9B (155)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	UINT	Rated Voltage	Motor rated voltage
2	2 (0x2)	Get/Set	UDINT	Motor Rated Hp Motor1 (Scaled by 100)	Motor Rated Hp Run1
3	3 (0x3)	Get/Set	UDINT	Motor Rated Hp Motor2 (Scaled by 100)	Motor Rated Hp Run2
4	4 (0x4)	Get/Set	UDINT	Motor Rated Watts Motor1	Motor Rated Watts Run1

Table 104. Motor Info Object—Class 0x9B (155), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
5	5 (0x5)	Get/Set	UDINT	Motor Rated Watts Motor2	Motor Rated Watts Run2
6	6 (0x6)	Get/Set	UINT	Motor Rated Speed Motor1	Motor Rated Speed RPM Run1
7	7 (0x7)	Get/Set	UINT	Motor Rated Speed Motor2	Motor Rated Speed RPM Run2
8	8 (0x8)	Get/Set	UINT	Rated Freq	Motor rated frequency in Hz
9	9 (0x9)	Get/Set	UINT	Motor Rated Efficiency	Motor rated efficiency in percentage
10	10 (0xA)	Get/Set	INT	Motor Rated PF (scaled by 100)	Motor rated power factor in percentage
11	11 (0xB)	Get/Set	USINT	Motor Rated Service Factor	Motor Rated Service Factor
12	12 (0xC)	Get/Set	UINT	Motor Rated Stator Resistance (Scaled x1000)	Motor Rated Stator Resistance (Scaled x1000)
13	13 (0xD)	Get	UDINT	Motor Rated Hp Active (Scaled by 100)	Motor Rated Hp Active
14	14 (0xE)	Get	UINT	Motor Rated Speed Active	Motor Rated Speed RPM active
15	15 (0xF)	Get	UDINT	Motor Rated Watts Active	Motor Rated Watts Active

Table 105. Operation Mode Object—Class 0x9F (159)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	USINT	Used to select the desired control profile (soft reset required)	Used to select the desired control profile (soft reset required)
2	2 (0x2)	Get/Set	UINT	Delay before control fault is issued (in 10ms)	Delay before control fault is issued (in 10ms)
3	3 (0x3)	Get/Set	UINT	Interlocking time between contactor direction changes (in 0.01sec)	Interlocking time between contactor direction changes (in 0.01sec)
4	4 (0x4)	Get/Set	UINT	Switching time between contactor speed changes (in 0.01sec)	Switching time between contactor speed changes (in 0.01sec)
5	5 (0x5)	Get/Set	UINT	Settling time delay when a network contactor is used. (in 10ms)	Settling time delay when a network contactor is used. (in 10ms)
6	6 (0x6)	Get/Set	UINT	Maximum star (wye) wiring time (in 0.1sec)	Maximum star (wye) wiring time (in 0.1sec)
7	7 (0x7)	Get/Set	BOOL	Enables MCCB Feeder actuation control	Enables MCCB Feeder actuation control
8	8 (0x8)	Get/Set	UINT	Output pulse width for MCCB actuation (in 1.0 ms)	Output pulse width for MCCB actuation (in 1.0 ms)

Table 105. Operation Mode Object—Class 0x9F (159), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
9	9 (0x9)	Get/Set	UINT	Delay time for solenoid valve to open (in 10ms)	Delay time for solenoid valve to open (in 10ms)
10	10 (0xA)	Get/Set	UINT	Delay time for solenoid valve to close (in 10ms)	Delay time for solenoid valve to close (in 10ms)
11	11 (0xB)	Get/Set	USINT	Non energized state of solenoid valve	Non energized state of solenoid valve
12	12 (0xC)	Get	USINT	Present source of control	Present source of control
13	13 (0xD)	Get/Set	USINT	Base Control Module Local Source Selector	Base Control Module Local Source Selector
14	14 (0xE)	Get/Set	USINT	Base Control Module Remote Source Selector	Base Control Module Remote Source Selector
15	15 (0xF)	Get/Set	USINT	Base Control Module Local/Remote Power up mode	Base Control Module Local/Remote Power up mode
16	16 (0x10)	Get/Set	USINT	Base Control Module Feedback Signal Source Selector	Base Control Module Feedback Signal Source Selector
17	17 (0x11)	Get/Set	USINT	Base Control Module Field Wiring Configuration Selector	Base Control Module Field Wiring Configuration Selector
18	18 (0x12)	Get/Set	USINT	Measurement Module Wire Configuration	Measurement Module Wire Configuration
19	19 (0x13)	Get	UINT	C445 Q1 Output function select	C445 Q1 Output function select
20	20 (0x14)	Get	USINT	C445 Q2 Output function select	C445 Q2 Output function select
21	21 (0x15)	Get	USINT	C445 Q3 Output function select	C445 Q3 Output function select
22	22 (0x16)	Get/Set	UINT	C445 Latching Q3 Relay Reset Source select	C445 Latching Q3 Relay Reset Source select
23	23 (0x17)	Get/Set	USINT	Relay 3 Behavior	Relay 3 Behavior
24	24 (0x18)	Get/Set	USINT	Latching Relay Behavior at Power-down	Latching Relay Behavior at Power-down

Table 106. Modbus Object—Class 0xA0 (160)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Table 106. Modbus Object—Class 0xA0 (160), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	USINT	Remote Modbus Address	Remote Modbus Address
2	2 (0x2)	Get/Set	USINT	Remote Modbus Baud Rate	Remote Modbus Baud Rate
3	3 (0x3)	Get/Set	USINT	Remote Modbus Parity and Stop Bits	Remote Modbus Parity and Stop Bits
4	4 (0x4)	Get/Set	USINT	Remote Modbus TX Mode	Remote Modbus TX Mode
5	5 (0x5)	Get/Set	UINT	Remote Modbus Communication Timeout	Remote Modbus Communication Timeout
6	6 (0x6)	Get/Set	UINT	Base Control Module USB Modbus CommTimeout	Base Control Module USB Modbus CommTimeout
7	7 (0x7)	Get/Set	UINT	User Interface USB Modbus CommTimeout	User Interface USB Modbus CommTimeout
8	8 (0x8)	Get/Set	UINT	Modbus Scan Data	Modbus Scan Data
9	9 (0x9)	Get/Set	UINT	Modbus Scan List	Modbus Scan List

Table 107. Motor Monitoring Object—Class 0xA1 (161)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get	USINT	Motor State (enum)	Motor State (enum)
2	2 (0x2)	Get	UINT	Speed (RPM)	Speed (RPM)
3	3 (0x3)	Get	INT	Torque	Torque
4	4 (0x4)	Get	UINT	Efficiency in percent	Efficiency in percent
5	5 (0x5)	Get	USINT	PTC Status	PTC Status
6	6 (0x6)	Get	UDINT	Number of Motor Starts	Number of Motor Starts
7	7 (0x7)	Get	UINT	Number of Contactor Operations During Last Hour	Number of Contactor Operations During Last Hour
8	8 (0x8)	Get/Set	UDINT	Number of Motor Starts User	Number of Motor Starts User
9	9 (0x9)	Get	UDINT	Number of Operating Seconds	Number of Operating Seconds
10	10 (0xA)	Get/Set	UDINT	Number of Operating Seconds (user)	Number of Operating Seconds (user)
11	11 (0xB)	Get	UINT	Last Measured Starting Time. Time to get up to speed.	Last Measured Starting Time. Time to get up to speed.
12	12 (0xC)	Get	UDINT	Motor Run Time Latest Run - How long the motor was running last time.	Motor Run Time Latest Run - How long the motor was running last time.
13	13 (0xD)	Get	UDINT	Motor Run Time Total	Motor Run Time Total

Table 107. Motor Monitoring Object—Class 0xA1 (161), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
14	14 (0xE)	Get/Set	UDINT	Motor Run Time Total Reset	Motor Run Time Total Reset
15	15 (0xF)	Get/Set	UINT	Motor Max Starting Current - Scaled	Motor Max Starting Current - Scaled
16	16 (0x10)	Get/Set	REAL	Motor Max Starting Current - Float	Motor Max Starting Current - Float
17	17 (0x11)	Get	INT	Power Apparent Power Factor	Power Apparent Power Factor
18	18 (0x12)	Get	UDINT	Current Demand Value	Current Demand Value
19	19 (0x13)	Get/Set	UDINT	Demand Peak Resettable	Demand Peak Resettable
20	20 (0x14)	Get	UDINT	Peak Demand Timestamp	Peak Demand Timestamp
21	21 (0x15)	Get	DINT	VA	VA
22	22 (0x16)	Get	DINT	VARS	VARS
23	23 (0x17)	Get	DINT	Total Watts for all three phases	Total Watts for all three phases
24	24 (0x18)	Get	DINT	Real Energy	Real Energy
25	25 (0x19)	Get/Set	DINT	Real Energy (Resettable)	Real Energy (Resettable)
26	26 (0x1A)	Get	DINT	Reactive Energy	Reactive Energy
27	27 (0x1B)	Get/Set	DINT	Reactive Energy (Resettable)	Reactive Energy (Resettable)
28	28 (0x1C)	Get	DINT	Apparent Energy	Apparent Energy
29	29 (0x1D)	Get/Set	DINT	Apparent Energy (Resettable)	Apparent Energy (Resettable)
30	30 (0x1E)	Get	INT	Seq Comp - I Pos Real	Seq Comp - I Pos Real
31	31 (0x1F)	Get	INT	Seq Comp - I Pos Imag	Seq Comp - I Pos Imag
32	32 (0x20)	Get	INT	Seq Comp - I Neg Real	Seq Comp - I Neg Real
33	33 (0x21)	Get	INT	Seq Comp - I Neg Imag	Seq Comp - I Neg Imag
34	34 (0x22)	Get	INT	Seq Comp - V Pos Real	Seq Comp - V Pos Real
35	35 (0x23)	Get	INT	Seq Comp - V Pos Imag	Seq Comp - V Pos Imag
36	36 (0x24)	Get	INT	Seq Comp - V Neg Real	Seq Comp - V Neg Real
37	37 (0x25)	Get	INT	Seq Comp - V Neg Imag	Seq Comp - V Neg Imag

Table 108. Motor Protection Object—Class 0xA2 (162)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Table 108. Motor Protection Object—Class 0xA2 (162), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	BYTE	Trip Enable Bit Field	Enabling bits for tripping. Bit location - condition 0 - under voltage 1 - over voltage 2 - Reserved 3 - ground current warning 4 - current phase loss 5 - current unbalance 6 - instantaneous over current 7 - jam 8 - PF deviation 9 - voltage phase loss 10 - voltage unbalance 11 - freq deviation fast 12 - freq deviation slow 13 - under current 14 - high power 15 - low power 16 - Reserved 17 - exceeds starts limit 18 - overload 19 - stall 20 - phase rotation mismatch 21 - PTC 22 - under voltage restart 23 - peak demand 24 - HRGF pulse detection
2	2 (0x2)	Get/Set	BYTE	Warn Enable Bit Field	Enabling bits for warning. Bit location - condition 0 - under voltage 1 - over voltage 2 - Reserved 3 - ground current warning 4 - current phase loss 5 - current unbalance 6 - instantaneous over current 7 - jam 8 - PF deviation 9 - voltage phase loss 10 - voltage unbalance 11 - freq deviation fast 12 - freq deviation slow 13 - under current 14 - high power 15 - low power 16 - Reserved 17 - exceeds starts limit 18 - overload 19 - stall 20 - phase rotation mismatch 21 - PTC 22 - under voltage restart 23 - peak demand 24 - HRGF pulse detection
3	3 (0x3)	Get/Set	UINT	Alarm Debounce Time	Alarm Debounce Time
4	4 (0x4)	Get/Set	BOOL	Global Auto Reset Enable (Boolean)	If disabled, no auto reset; if enabled, auto reset based on trip auto-reset bits

Table 108. Motor Protection Object—Class 0xA2 (162), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
5	5 (0x5)	Get/Set	BYTE	Auto reset enable capability for each trip bit	Per tripping type auto reset enable bits. Bit location - condition 0 - under voltage 1 - over voltage 2 - Reserved 3 - ground current fault 4 - current phase loss 5 - current unbalance 6 - instantaneous over current 7 - jam 8 - PF deviation 9 - voltage phase loss 10 - voltage unbalance 11 - freq deviation fast 12 - freq deviation slow 13 - under current 14 - high power 15 - low power 16 - Reserved 17 - exceeds starts limit 18 - overload 19 - stall 20 - phase rotation mismatch 21 - PTC 22 - under voltage restart 23 - peak demand 24 - HRGF pulse detection
6	6 (0x6)	Get/Set	UINT	Reset time delay. The amount of time to wait until we do an auto reset.	Time delay before auto-reset
7	7 (0x7)	Get/Set	BOOL	Perform reset on power up.	Protection allowed after delay since start
8	8 (0x8)	Get/Set	UINT	Motor State time delay after which the RUN state is declared if not reached via current thresholds.	Motor State time delay after which the RUN state is declared if not reached via current thresholds.
9	9 (0x9)	Get/Set	BOOL	Start inhibited protection enable when motor is up to speed.	If enabled, only allows protection when motor is up to speed
10	10 (0xA)	Get/Set	UINT	Phase Rotation	Phase Rotation
11	11 (0xB)	Get/Set	UINT	Protection Instantaneous Overcurrent Trip Level	Protection Instantaneous Overcurrent Trip Level
12	12 (0xC)	Get/Set	UINT	Protection Instantaneous Overcurrent Debounce	Protection Instantaneous Overcurrent Debounce
13	13 (0xD)	Get/Set	UINT	Protection Instantaneous Overcurrent Alarm Level	Protection Instantaneous Overcurrent Alarm Level
14	14 (0xE)	Get/Set	UINT	Protection Instantaneous Overcurrent Start Delay	Protection Instantaneous Overcurrent Start Delay
15	15 (0xF)	Get/Set	USINT	Protection UnderCurrent Trip Level	Protection UnderCurrent Trip Level
16	16 (0x10)	Get/Set	UINT	Protection UnderCurrent Trip Debounce	Protection UnderCurrent Trip Debounce
17	17 (0x11)	Get/Set	USINT	Protection UnderCurrent Alarm Level	Protection UnderCurrent Alarm Level
18	18 (0x12)	Get/Set	USINT	Protection I Unbalance Trip Percent Level	Protection I Unbalance Trip Percent Level
19	19 (0x13)	Get/Set	UINT	Protection I Unbalance Trip Debounce Time	Protection I Unbalance Trip Debounce Time
20	20 (0x14)	Get/Set	USINT	Protection I Unbalance Alarm Percent Level	Protection I Unbalance Alarm Percent Level
21	21 (0x15)	Get	USINT	I Phase Loss Trip Level in percent	I Phase Loss Trip Level in percent
22	22 (0x16)	Get	UINT	I Phase Loss Debounce	I Phase Loss Debounce

Table 108. Motor Protection Object—Class 0xA2 (162), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
23	23 (0x17)	Get/Set	UINT	Protection Jam Trip Level	Protection Jam Trip Level
24	24 (0x18)	Get/Set	UINT	Protection Jam Trip Debounce	Protection Jam Trip Debounce
25	25 (0x19)	Get/Set	UINT	Protection Jam Alarm Level	Protection Jam Alarm Level
26	26 (0x1A)	Get/Set	UINT	Protection Stall Trip Level	Protection Stall Trip Level
27	27 (0x1B)	Get/Set	INT	Protection High KW Trip Level	Protection High KW Trip Level
28	28 (0x1C)	Get/Set	UINT	Protection High KW Trip Time Debounce	Protection High KW Trip Time Debounce
29	29 (0x1D)	Get/Set	INT	Protection High KW Alarm Level	Protection High KW Alarm Level
30	30 (0x1E)	Get/Set	INT	Protection Low KW Trip Level	Protection Low KW Trip Level
31	31 (0x1F)	Get/Set	UINT	Protection Low KW Trip Time Debounce	Protection Low KW Trip Time Debounce
32	32 (0x20)	Get/Set	INT	Protection Low KW Alarm Level	Protection Low KW Alarm Level
33	33 (0x21)	Get/Set	INT	Power Factor Deviation Trip Level High	Power Factor Deviation Trip Level High
34	34 (0x22)	Get/Set	INT	Power Factor Deviation Trip Level	Power Factor Deviation Trip Level
35	35 (0x23)	Get/Set	INT	Power Factor Deviation Debounce	Power Factor Deviation Debounce
36	36 (0x24)	Get/Set	INT	Power Factor Deviation Alarm Level High	Power Factor Deviation Alarm Level High
37	37 (0x25)	Get/Set	INT	Power Factor Deviation Alarm Level Low	Power Factor Deviation Alarm Level Low
38	38 (0x26)	Get/Set	UDINT	Peak Demand Warning Threshold	Peak Demand Warning Threshold
39	39 (0x27)	Get/Set	UINT	Demand Window Duration	Demand Window Duration
40	40 (0x28)	Get/Set	UINT	Ground Fault Threshold - Scaled	Ground Fault Threshold - Scaled
41	41 (0x29)	Get/Set	UINT	Ground Fault Debounce	Ground Fault Debounce
42	42 (0x2A)	Get/Set	UINT	Ground Fault Alarm Threshold - Scaled	Ground Fault Alarm Threshold - Scaled
43	43 (0x2B)	Get/Set	UINT	Ground Fault Start Delay	Ground Fault Start Delay
44	44 (0x2C)	Get/Set	BOOL	Ground Fault Apply Inhibit Current	Ground Fault Apply Inhibit Current
45	45 (0x2D)	Get/Set	UINT	Ground Fault Inhibit Current - Percent	Ground Fault Inhibit Current - Percent
46	46 (0x2E)	Get/Set	UINT	Frequency Deviation Fast Trip Level	Frequency Deviation Fast Trip Level
47	47 (0x2F)	Get/Set	UINT	Frequency Deviation Fast Debounce	Frequency Deviation Fast Debounce
48	48 (0x30)	Get/Set	UINT	Frequency Deviation Fast Alarm Level	Frequency Deviation Fast Alarm Level
49	49 (0x31)	Get/Set	UINT	Frequency Deviation Slow Trip Level	Frequency Deviation Slow Trip Level
50	50 (0x32)	Get/Set	UINT	Frequency Deviation Slow Debounce	Frequency Deviation Slow Debounce
51	51 (0x33)	Get/Set	UINT	Frequency Deviation Slow Alarm Level	Frequency Deviation Slow Alarm Level
52	52 (0x34)	Get/Set	UINT	Number of Starts per Hour allowed before trip	Number of Starts per Hour allowed before trip
53	53 (0x35)	Get/Set	UINT	Backspin reset inhibit time	Backspin reset inhibit time
54	54 (0x36)	Get/Set	USINT	Motor Start Threshold Percentage	Motor Start Threshold Percentage
55	55 (0x37)	Get/Set	USINT	Motor Stop Threshold Percentage	Motor Stop Threshold Percentage
56	56 (0x38)	Get/Set	USINT	Motor Transition Threshold Percentage	Motor Transition Threshold Percentage

Table 109. Snapshot Object—Class 0xA5 (165)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get	UINT	Fault Snap Shot Log Year	Fault Snap Shot Log Year
2	2 (0x2)	Get	USINT	Fault Snap Shot Log Month	Fault Snap Shot Log Month
3	3 (0x3)	Get	USINT	Fault Snap Shot Log Day	Fault Snap Shot Log Day
4	4 (0x4)	Get	USINT	Fault Snap Shot Log Hour	Fault Snap Shot Log Hour
5	5 (0x5)	Get	USINT	Fault Snap Shot Log Minute	Fault Snap Shot Log Minute
6	6 (0x6)	Get	USINT	Fault Snap Shot Log Second	Fault Snap Shot Log Second
7	7 (0x7)	Get	UINT	Fault Snap Shot Trip Reason	Fault Snap Shot Trip Reason
8	8 (0x8)	Get	USINT	Fault Snap Shot Log TP	Fault Snap Shot Log TP
9	9 (0x9)	Get	UINT	Fault Snap Shot Log Ia	Fault Snap Shot Log Ia
10	10 (0xA)	Get	UINT	Fault Snap Shot Log Ib	Fault Snap Shot Log Ib
11	11 (0xB)	Get	UINT	Fault Snap Shot Log Ic	Fault Snap Shot Log Ic
12	12 (0xC)	Get	UINT	Fault Snap Shot Log Vab	Fault Snap Shot Log Vab
13	13 (0xD)	Get	UINT	Fault Snap Shot Log Vbc	Fault Snap Shot Log Vbc
14	14 (0xE)	Get	UINT	Fault Snap Shot Log Vca	Fault Snap Shot Log Vca
15	15 (0xF)	Get	UINT	Fault Snap Shot Log Frequency	Fault Snap Shot Log Frequency
16	16 (0x10)	Get	DINT	Fault Snap Shot Log Real Power (watts)	Fault Snap Shot Log Real Power (watts)
17	17 (0x11)	Get	DINT	Fault Snap Shot Log Apparent Power (VA)	Fault Snap Shot Log Apparent Power (VA)
18	18 (0x12)	Get	INT	Fault Snap Shot Log Power Factor	Fault Snap Shot Log Power Factor
19	19 (0x13)	Get	UINT	Fault Snap Shot Log Ground Fault RMS	Fault Snap Shot Log Ground Fault RMS

Table 110. Parameter Access Object—Class 0xAA (170)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	UDINT	Set Admin Password	Set Admin Password
2	2 (0x2)	Get/Set	UDINT	Admin Login	Admin Login
3	3 (0x3)	Get/Set	UDINT	Set USB Password	Set USB Password
4	4 (0x4)	Get/Set	UDINT	USB Login	USB Login
5	5 (0x5)	Get/Set	BOOL	Motor Running Parameter Lock Override	Motor Running Parameter Lock Override
6	6 (0x6)	Get	USINT	Motor Running Parameter Lock	Motor Running Parameter Lock
7	7 (0x7)	Get	USINT	Password Parameter Lock	Password Parameter Lock
8	8 (0x8)	Get	USINT	USB Parameter Lock	USB Parameter Lock
9	9 (0x9)	Get/Set	UDINT	Set Manufacturing Password	Set Manufacturing Password
10	10 (0xA)	Get/Set	UDINT	Manufacturing Login	Manufacturing Login

Table 111. RTC Object—Class 0xB0 (176)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Table 111. RTC Object—Class 0xB0 (176), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	USINT	RTC Time	RTC Time in hh:mm:ss format (24 hour format)
2	2 (0x2)	Get/Set	UINT	RTC Year	RTC year
3	3 (0x3)	Get/Set	USINT	RTC Month	RTC month
4	4 (0x4)	Get/Set	USINT	RTC Day of Month	RTC day of month
5	5 (0x5)	Get/Set	USINT	RTC Disable Oscillator	If a 1 is set, oscillator on RTC will be stopped to save batter power
6	6 (0x6)	Get/Set	USINT	RTC Power Interrupted	RTC backup power has been interrupted
7	7 (0x7)	Get	USINT	RTC Status	RTC Status Enum
8	8 (0x8)	Get	USINT	RTC Time Set Status	If 0 successful, 1 pending, 2 failure
9	9 (0x9)	Get/Set	USINT	RTC Time Zone Hours and Minutes	hh:mm in time zone assignment (UTC+/-hh:mm)
10	10 (0xA)	Get/Set	USINT	RTC Time Zone Ahead of UTC	If true, UTC+hh:mm; otherwise UTC-hh:mm
11	11 (0xB)	Get	USINT	RTC Time Zone DST Setting Status	RTC Time Zone DST Setting Status
12	12 (0xC)	Get/Set	USINT	RTC DST Rule	RTC DST Rule
13	13 (0xD)	Get/Set	USINT	RTC Manual DST Rule Start Time	RTC Manual DST Rule Start Spec (month, week, weekday, hour, minute)
14	14 (0xE)	Get/Set	USINT	RTC Manual DST Rule End Time	RTC Manual DST Rule End Spec (month, week, weekday, hour, minute)
15	15 (0xF)	Get	UDINT	RTC Time UNIX format	RTC time in seconds from UNIX epoch
16	16 (0x10)	Get/Set	USINT	RTC Time Hours	RTC Time Hours
17	17 (0x11)	Get/Set	USINT	RTC Time Minutes	RTC Time Minutes
18	18 (0x12)	Get/Set	USINT	RTC Time Seconds	RTC Time Seconds
19	19 (0x13)	Get	UINT	RTC Time	RTC Time
20	20 (0x14)	Get	USINT	RTC Month and Date	RTC Month and Date

Table 112. BCM Object—Class 0xB1 (177)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Table 112. BCM Object—Class 0xB1 (177), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get	Word	Base Control Module DIP Switches	Base Control Module DIP Switches
2	2 (0x2)	Get	UINT	Base Control Module Control Voltage (24VDC)	Base Control Module Control Voltage (24VDC)
3	3 (0x3)	Get	INT	Base Control Module Ambient Board Temperature	Base Control Module Ambient Board Temperature
4	4 (0x4)	Get/Set	INT	Base Control Module Maximum Control Board Temperature	Base Control Module Maximum Control Board Temperature

Table 113. Option Card Object—Class 0xB3 (179)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Class Attributes

Sr. No.	Attribute ID	Access Rule	Data Type	Name	Attribute Description
1	1 (0x1)	Get	UINT	Revision	Revision of this object
2	2 (0x2)	Get	UINT	Max Instance	Maximum instance number of an object currently created in this class level of the device.
3	3 (0x3)	Get	UINT	Number of Instances	Number of object instances currently created at this class level of the device.

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	UINT	Modbus Comm Loss Timeout Value (ms)	Modbus Comm Loss Timeout Value (ms)
2	2 (0x2)	Get/Set	UINT	Web services Comm Loss Timeout Value (ms)	Web services Comm Loss Timeout Value (ms)
3	3 (0x3)	Get/Set	BOOL	Master Key for Hardcoded IP Address Selection	Master Key for Hardcoded IP Address Selection
4	4 (0x4)	Get	Array of 4 USINT	Active IP Address	Active IP Address

Table 113. Option Card Object—Class 0xB3 (179), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
5	5 (0x5)	Get	Array of 4 USINT	Active Subnet Mask	Active Subnet Mask
6	6 (0x6)	Get	Array of 4 USINT	Active Default Gateway	Active Default Gateway
7	7 (0x7)	Get/Set	Array of 4 USINT	Static IP Address	Static IP Address
8	8 (0x8)	Get/Set	Array of 4 USINT	Static Subnet Mask	Static Subnet Mask
9	9 (0x9)	Get/Set	Array of 4 USINT	Static Default Gateway	Static Default Gateway
10	10 (0xA)	Get/Set	UINT	Ethernet PHY 1 - Link Speed Select	Ethernet PHY 1 - Link Speed Select
11	11 (0xB)	Get	UINT	Ethernet PHY 1 - Link Speed Actual	Ethernet PHY 1 - Link Speed Actual
12	12 (0xC)	Get/Set	BOOL	Ethernet PHY 1 - Duplex Select	Ethernet PHY 1 - Duplex Select
13	13 (0xD)	Get	BOOL	Ethernet PHY 1 - Duplex Actual	Ethernet PHY 1 - Duplex Actual
14	14 (0xE)	Get/Set	BOOL	Ethernet PHY 1 - Link Auto-Negotiate Enable	Ethernet PHY 1 - Link Auto-Negotiate Enable
15	15 (0xF)	Get	USINT	Ethernet PHY 1 - Link Auto-Negotiate State	Ethernet PHY 1 - Link Auto-Negotiate State
16	16 (0x10)	Get/Set	BOOL	Ethernet PHY 1 - Port Enable	Ethernet PHY 1 - Port Enable
17	17 (0x11)	Get/Set	UINT	Ethernet PHY 2 - Link Speed Select	Ethernet PHY 2 - Link Speed Select
18	18 (0x12)	Get	UINT	Ethernet PHY 2 - Link Speed Actual	Ethernet PHY 2 - Link Speed Actual
19	19 (0x13)	Get/Set	BOOL	Ethernet PHY 2 - Duplex Select	Ethernet PHY 2 - Duplex Select
20	20 (0x14)	Get	BOOL	Ethernet PHY 2 - Duplex Actual	Ethernet PHY 2 - Duplex Actual
21	21 (0x15)	Get/Set	BOOL	Ethernet PHY 2 - Link Auto-Negotiate Enable	Ethernet PHY 2 - Link Auto-Negotiate Enable
22	22 (0x16)	Get	USINT	Ethernet PHY 2 - Link Auto-Negotiate State	Ethernet PHY 2 - Link Auto-Negotiate State
23	23 (0x17)	Get/Set	BOOL	Ethernet PHY 2 - Port Enable	Ethernet PHY 2 - Port Enable
24	24 (0x18)	Get/Set	BOOL	ACD Enable	ACD Enable
25	25 (0x19)	Ge	USINT	ACD Conflict State	ACD Conflict State
26	26 (0x1A)	Get/Set	USINT	ACD Conflicted State	ACD Conflicted State
27	27 (0x1B)	Get/Set	USINT	ACD Conflicted Device MAC	ACD Conflicted Device MAC
28	28 (0x1C)	Get	Array of 6 USINT	Ethernet MAC Address	Ethernet MAC Address

Table 114. Port Object—Class 0xF4 (244)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single
0x01	Get Attributes All

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x01	Get Attributes All

Table 114. Port Object—Class 0xF4 (244), continued

Class Attributes					
Sr. No.	**ID**	**Description**	**Access Rule**	**Data Type**	**Remarks/Default**
1	1 (0x1)	Revision	Get	UINT	1
2	2 (0x2)	Max Instance	Get	UINT	2
3	3 (0x3)	Number of Instances	Get	UINT	2
4	6 (0x6)	Maximum ID Class Attribute	Get	UINT	9
5	7 (0x7)	Maximum ID Instance Attribute	Get	UINT	7
6	8 (0x8)	Entry Port	Get	UINT	2
7	9 (0x9)	Port Instance Info	Get	Array of Struct of	
		Port Type		UINT	See Instance attribute
		Port Number		UINT	See Instance attribute
Instance Attributes					
Number of instances: 2					
Sr. No.	**ID**	**Description**	**Access Rule**	**Data Type**	**Remarks/Default**
1	1 (0x1)	Port Type	Get	UINT	4
2	2 (0x2)	Port Number	Get	UINT	1 or 2
3	3 (0x3)	Link Object	Get	Struct of:	
		Path Length		UINT	2
		Link Path		Padded EPATH	20 F5 24 01
4	4 (0x4)	Port Name	Get	Short String	Ethernet/IP Port (in ASCII)
7	7 (0x7)	Port Number and Node address	Get	Padded EPATH	Active IP address (in ASCII)

Table 115. TCP/IP Object—Class 0xF5 (245)

Class Services					
Service Code	**Service Name**				
0x0E	Get Attribute Single				
0x01	Get Attributes All				
Instance Services					
Service Code	**Service Name**				
0x0E	Get Attribute Single				
0x10	Set Attribute Single				
0x01	Get Attributes All				
Class Services					
Sr. No.	**ID**	**Description**	**Access Rule**	**Data**	**Remarks/Default**
1	1 (0x1)	Revision	Get	UINT	4
2	2 (0x2)	Max Instance	Get	UINT	1
3	3 (0x3)	Number of instances	Get	UINT	1
4	4 (0x4)	Optional attribute list	Get	Array of UINT	04 00 08 00 09 00 0A 00 0B 00
5	6 (0x6)	Maximum ID Class Attribute	Get	UINT	
6	7 (0x7)	Maximum ID Instance Attribute	Get	UINT	0B 00

Table 115. TCP/IP Object—Class 0xF5 (245), continued

Instance Attributes

Sr. No.	ID	Description	Access Rule	Data Type	Remarks
1	1 (0x1)	Status	Get	DWORD	01 00 00 00
2	2 (0x2)	Configuration Capability	Get	DWORD	F4 00 00 00
3	3 (0x3)	Configuration Control	Get / Set	DWORD	02-dhcp, 0- static
4	4 (0x4)	Physical Link	Get	STRUCT of	
		Path Size		UINT	0
		Path		Padded EPATH	0
5	5 (0x5)	Interface Configuration	Get / Set	Struct of:-NV	
		IP Address		UDINT	192.168.1.254
		Network Mask		UDINT	255.255.255.0
		Gateway Address		UDINT	192.168.1.1
		Name Server		UDINT	0
		Name Server 2		UDINT	0
		Domain Name		STRING	0
6	6 (0x6)	Host Name	Get / Set	STRING	0
7	8 (0x8)	TTL Value	Get	USINT	1
8	9 (0x9)	Multicast Configuration	Get	Struct of:	
		Alloc Control		USINT	0
		Reserved		USINT	0
		Number of Mcast		UINT	0x20
		Starting Multicast Address		DWORD	80 20 C0 EE
9	10 (0xA)	SelectAcd	Set / Get	BOOL	1
10	11 (0xB)	Last Conflict Detected	Set / Get	Struct of:	
		ACD activity		USINT	0
		Remote MAC		Array of 6 USINT	0
		ARP PDU		Array of28 USINT	0
11	13 (0xD)	Encapsulation Inactivity Timeout	Set / Get	UINT	0 = Disable 1-3600 = timeout in seconds Default = 120

Table 116. Ethernet Link Object—Class 0xF6 (246)

Class Services

Service Code	Service Name
0x0E	Get Attribute Single
0x01	Get Attributes All

Instance Services

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single
0x01	Get Attributes All

Table 116. Ethernet Link Object—Class 0xF6 (246), continued

Sr. No.	ID	Description	Access Rule	Data Type	Remarks/Default
Class Attributes					
1	1 (0x1)	Revision	Get	UINT	3
2	2 (0x2)	Max Instance	Get	UINT	2
3	3 (0x3)	Number of Instances	Get	UINT	2
4	4 (0x4)	Optional Attribute List	Get	Struct of:	
		Number of Attributes		UINT	03 00 04 00
		Array of Attributes		Array of UINT	07 00 08 00 09 00 0A 00
5	6 (0x6)	Maximum ID Class Attribute	Get	UINT	7
6	7 (0x7)	Maximum ID Instance Attribute	Get	UINT	0A
Instance Attributes					
Number of instances: 2					
Sr. No.	**ID**	**Description**	**Access Rule**	**Data Type**	**Remarks/Default**
1	1 (0x1)	Interface Speed	Get	UDINT	64 00 00 00
2	2 (0x2)	Interface Flags	Get	DWORD	2D
3	3 (0x3)	Physical Address	Get	ARRAY of 6 USINTs	Range of 00:D0:AF:1A:00:00 to 00:D0:AF:1D:D0:FF
4	6 (0x6)	Interface Control	Get/Set	Struct of:	
		Control Bits		WORD	1
		Forced Interface Speed		UINT	0A (10) or 64 (100)
5	7 (0x7)	Interface Type	Get	USINT	2
6	8 (0x8)	Interface State	Get	USINT	1
7	9 (0x9)	Admin State	Set	USINT	As per EIP Specs
8	10 (0xA)	Interface Label	Get	Short String	“Port 1” for Instance 1 and “Port 2” for Instance 2

Modbus TCP Protocol

The C445 Ethernet Card supports the Modbus TCP protocol as a server device.

The supported function codes are shown below. The Modbus register map for the C445 is identical for the Modbus TCP and the Modbus serial protocols and may be found in **Appendix D** of this user manual.

Table 117. Modbus TCP Function Codes

Function Code	Name
Standard Function Codes	
0x01	Read Coils
0x02	Read Discrete Inputs
0x03	Read Holding registers
0x04	Read input registers
0x05	Write single coil
0x06	Preset Single register
0x07	Read exception status
0x08	Diagnostics
0x0F	Write Multiple Coils
0x10	Write Multiple Registers
0x17	Read/Write Multiple Registers
0x2B/0x0E	Read device identification
Vendor Specific Function Codes	
0x42	Device Services
0x43	Read Attribute
0x44	Write Attribute
0x45	Read/Write attribute

PROFIBUS Communication Card

Introduction

The PROFIBUS communication card is an optional add on to the C445 Base Control Module that allows the user to communicate via PROFIBUS. This module allows a PROFIBUS master to fully control and monitor the C445. This module functionally supports both PROFIBUS DPV0 and DPV1 functionality.

The main purpose of PROFIBUS DPV0 is fast Cyclic Data exchange between the DP master and periphery devices such as the C445 Motor Management Relay.

PROFIBUS DPV1 is an extension of the DP protocol. The main purpose for PROFIBUS DPV1 is to add Acyclic Data exchange of parameters.

Installing the PROFIBUS Communication Card

The PROFIBUS Communication Card is installed directly into the Base Control Module. To install the module, follow the step by step directions:

1. Remove the blank cover when the unit is not powered
2. Locate the communication card slot
3. Plug the PROFIBUS communication card into location

Figure 133. Installing the PROFIBUS Communication Card

PROFIBUS Communication Card & DIP Switches

The DIP Switches on the Base Control Module are used for two purposes when an optional PROFIBUS card is installed – to set the node address and baud rate for an optional Modbus port if included and for the PROFIBUS node address. Per the diagram, if the optional RS-485 Modbus serial port is present, DIP Switches 1 – 7 are used to determine the node address on both the PROFIBUS and Modbus serial protocols. When the Modbus serial port is present, it also uses switches 8 – 9 to set the baud rate for that port. If the optional Modbus serial port is not present, the DIP Switches are used for the PROFIBUS node address only. The C445 PROFIBUS card auto-detects the data rate set by the PROFIBUS master.

Supported PROFIBUS Data Rates

- 9600
- 19200
- 45450
- 93750
- 187500
- 500000
- 1.5M
- 3M
- 6M
- 12M

Figure 134. Base Control Module DIP Switches with PROFIBUS Card

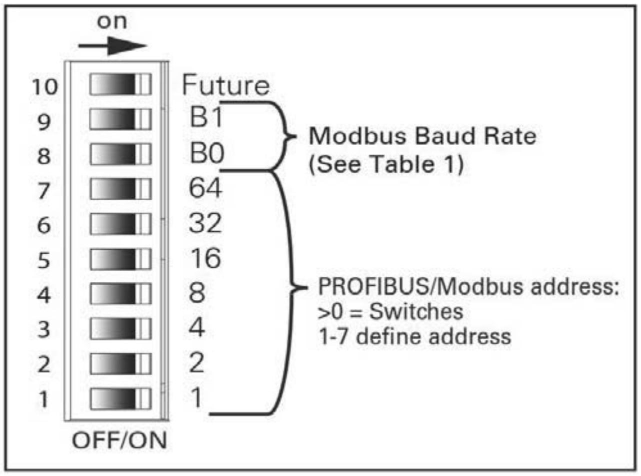


Table 118. Modbus Data Rate

B1	B0	Rate
0	0	Software Configurable
0	1	9600
1	0	115200
1	1	19200

PROFIBUS Cable Connection Options

The PROFIBUS card provides two options for PROFIBUS cable connections

1. PROFIBUS 9-pin D-SUB connector
2. 3-position screw connector with the following pin assignment:

- Pin 1 – RxD/TxD negative (green)
- Pin 2 – RxD/TxD positive (red)
- Pin 3 – Protective Earth

Note: The DIP Switches located beside the 3-position connector are only used when the 3-position connector is used for connecting the card to the PROFIBUS network. These switches must be turned Off if the D-shell connector is used to connect this card to PROFIBUS. These switches are used to turn network termination On/Off. If the 3-position connector is used to connect the C445 PROFIBUS card to the PROFIBUS network and if this card is an end device on the network, turn both switches On to enable termination. Otherwise, turn both switches Off to disable termination.

PROFIBUS D-shell connector information is shown below.

Table 119. PROFIBUS D-Shell Connector Specifications

Items	Value
Terminal	DB9 connector (Female) or 5.00mm connector (male)
Data transfer method	RS-485 half-duplex
Cable	Twisted pair (1pair and shield)
Isolation	500 Vdc
Protocol	PROFIBUS DP-V1
Baud rate	9.6K~12M
Addresses	3~125

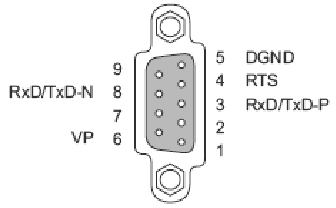


Table 120. DB-9 Connector

Pin #	Purpose
Housing	Shield, Connected to PE
1	Not used (or Shield, shield or protect GND)
2	Not used (or M24, Minus 24V output Voltage)
3	RXD/TXD-P, Positive of Receive or Transmit signal
4	RTS, Request To Send
5	DGND, GND of signal (Isolated GND from RS-485 side)
6	VP, +5V, (Voltage- Plus, Isolated 5V from RS-485side)
7	Not used (or P24, Plus 24V Output Voltage)
8	RXD/TXD-N, Negative of Receive or Transmit signal
9	Not used (or CNTR_N, Control-N)

Configuring using the *in*Control software tool

There is a Modbus serial DTM/Driver for the *in*Control software tool. This DTM is used to communicate from a computer running the *in*Control software tool using either a USB to micro USB cable or a USB to RS-485 serial cable. These interfaces may be used to connect to the C445 Motor Management Relay. Refer to the *in*Control software tool user manual for additional information (publication MN040013EN).

Configuring using The C445 PROFIBUS GSD file

The GSD file for the C445 Motor Management Relay may be found at the Eaton website:

http://www.eaton.com/C445

This file is compatible with any PROFIBUS software used to configure a PROFIBUS network. It provides input/output information for cyclic polling, configuration file parameters and diagnostic data. It also contains parameter information that may be used for acyclic messaging.

PROFIBUS Card LED Definitions

Table 121. PROFIBUS Card LED Definitions

State	Wait_Param state	Wait_CFG state	Data exchange	DP_Error state	Fault State
PROFIBUS display state ①	No Communication, Master Offline	Communication No Data Ex	Everything OK	CFG_Error, Parameterization Error,	H/W ID Fault, Board revision Fault, Incorrect Slave address, Fault on BCM
LED Profibus Active (Green)	ON	ON	ON	ON	NA
LED_SF (Red)	OFF	OFF	OFF	OFF	ON
LED_BF (Red)	ON	Flashing (500 mSec)	OFF	Flashing (500 mSec)	NA

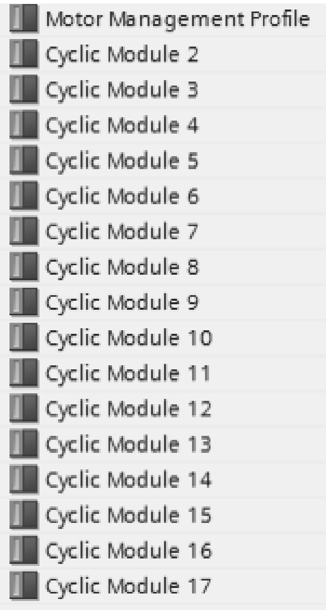
Note

① In the table above, while there are only two LEDs, the LED labeled BF acts as both the Active and BF LED.

C445 Cyclic (Polling)

The most common way of exchanging data with the C445 is via cyclic messages from a PROFIBUS master. The master sends control data to the C445 and reads monitoring data from the C445. Typically the control information involves a single or more bytes to instruct the C445 to run the motor or reset a fault. Data read from the C445 typically involves running status and fault state, along with motor parameters such as motor current, voltage, power and so on. The GSD file for the C445, available from the Eaton website defines the cyclic modules used to read and write to a C445 by the PROFIBUS master. The GSD file is installed into the PROFIBUS master's programming software and used to configure the master for the data it will exchange with the C445.

The following are the various modules from the C445 GSD file:



Motor Management Profile
Cyclic Module 2
Cyclic Module 3
Cyclic Module 4
Cyclic Module 5
Cyclic Module 6
Cyclic Module 7
Cyclic Module 8
Cyclic Module 9
Cyclic Module 10
Cyclic Module 11
Cyclic Module 12
Cyclic Module 13
Cyclic Module 14
Cyclic Module 15
Cyclic Module 16
Cyclic Module 17

Select a maximum of 2 cyclic modules, as long as only one of them includes output/control words. A maximum of 8 control words from any one cyclic module containing output data is allowed.

Each module contains a different number of input and output bytes. There are 15 different Modules, where any 1 or 2 of these modules may be selected for each C445.

Module 1: Motor Management Profile as per IEC 61915-2, Command format 200 and Monitor Format 200

This profile is the only one that does not have selectable data. The I/O data is fixed. This profile includes the following:

Output data: The Motor Control Word (2 bytes).

Input data: The Motor Status word and Average Current Scaled (4 bytes total).

The Motor Control Word is defined as follows.

Bit 0: Run Reverse
Bit 1: Reserved
Bit 2: Run Forward
Bit 3: Reserved
Bit 4: Reserved
Bit 5: Reserved
Bit 6: Reset
Bit 7: Reserved
Bits 8-15: Reserved

The Motor Status Word is defined as follows:

Bit 0: Running Reverse
Bit 1: Reserved
Bit 2: Running Forward
Bit 3: Overload Warning
Bit 4: Reserved
Bit 5: Reserved
Bit 6: Fault
Bit 7: Warning
Bits 8-15: Reserved

Fieldbus Motor Control Word

This control word applies to all Cyclic Modules with output data except the Motor Management Profile shown above.

The Fieldbus Motor Control word is defined as follows:

Bit 0: Run1
Bit 1: Run2
Bit 2: Switch To Remote
Bit 3: Reset Fault
Bit 4: Reserved
Bit 5: Test Trip
Bits 6-15: Reserved

Bit 2, the Switch To Remote bit is only active when the "Allow Remote Control Switch" parameter is Enabled. This parameter can be found in the Operation Mode category, in the Advanced parameters. This feature only works with the Fieldbus Motor Control word.

The Motor Control bits cannot be assigned if the Fieldbus Motor Control word is assigned.

If the Motor Control bits are assigned, then the Fieldbus Motor Control word should not be assigned. In addition, when the Motor Control bits are assigned, the first output word to the C445 is a control word based on the bit assignments. Subsequent word assignments such as assigning the System Services or digital or analog output words actually begin with the second output word sent to the C445.

Module 2: Cyclic Module 2

This profile includes one input byte. Each bit is selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool.

Module 3: Cyclic Module 3

This profile includes 2 input bytes. Each bit is selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool.

Module 4: Cyclic Module 4

This profile includes 1 output byte. The output data is under the "Slave" module, after the Configuration Parameters.

Module 5: Cyclic Module 5

This profile includes 2 output bytes. The output data is under the "Slave" module, after the Configuration Parameters.

Module 6: Cyclic Module 6

This profile includes 2 input bytes and 2 output bytes. The input data is selectable under the cyclic module in the PROFIBUS master's programming software. The output data is under the "Slave" module, after the Configuration Parameters.

Module 7: Cyclic Module 7

This profile includes 8 input bytes and 4 output bytes. The input data is selectable under the cyclic module in the PROFIBUS master's programming software. The output data is under the "Slave" module, after the Configuration Parameters.

Module 8: Cyclic Module 8

This profile includes total 6 output bytes and 10 input bytes. The input data is selectable under the cyclic module in the PROFIBUS master's programming software. The output data is under the "Slave" module, after the Configuration Parameters.

Module 9: Cyclic Module 9

This profile includes 2 input bytes. 1 word parameter may be selected for the input data. The input data is selectable under the module in the PROFIBUS master's programming software.

Module 10: Cyclic Module 10

This profile includes 4 input bytes. 2 word parameters may be selected for the input data. The input data is selectable under the module in the PROFIBUS master's programming software.

Module 11: Cyclic Module 11

This profile includes 8 input bytes. 4 word parameters may be selected for the input data. The input data is selectable under the module in the PROFIBUS master's programming software.

Module 12: Cyclic Module 12

This profile includes 16 input bytes. 8 word parameters may be selected for the input data. The input data is selectable under the module in the PROFIBUS master's programming software.

Module 13: Cyclic Module 13

This profile includes 32 input bytes and 4 output bytes. The input data is selectable under the cyclic module in the PROFIBUS master's programming software. The output data is under the "Slave" module, after the Configuration Parameters.

Module 14: Cyclic Module 14

This profile includes 2 output bytes. 1 word parameter may be selected. This output data is selectable under the "Slave module in the PROFIBUS master's programming software.

Module 15: Cyclic Module 15

This profile includes 4 output bytes. 2 word parameters may be selected. This output data is selectable under the "Slave module in the PROFIBUS master's programming software.

Module 16: Cyclic Module 16

This profile includes 32 input bytes. 16 word parameters may be selected along with 16 input bytes where 8 word parameters may be selected. The input data is selectable under the cyclic module in the PROFIBUS master's programming software and the output data is under the "Slave" module itself, after the Configuration Parameters.

Module 17: Cyclic Module 17

This profile includes 64 input bytes. 32 word parameters may be selected along with 32 input bytes where 16 word parameters may be selected. The input data is selectable under the cyclic module in the PROFIBUS master's programming software and the output data is under the "Slave" module itself, after the Configuration Parameters.

Acyclic PROFIBUS Messages

The C445 supports the acyclic messages added with the DPV1 version of PROFIBUS. All parameters in the C445 are mapped using Modbus Register addresses. This register map can be found in **Appendix D**. Modbus commands and registers are used to read and write parameters for the C445 via acyclic PROFIBUS messages.

Reading Data from a C445 via Acyclic Messages

1. An acyclic write message must be sent by the master containing a Modbus read command.
2. An acyclic read message must be sent by the master to obtain the data.

Reading data:

1. Send an acyclic write message per the following:

   Slot number (always 0 for the C445)

   Index: 45

   Data length including the Modbus command in bytes

   Data Field:

   a. 03 Modbus Read command (1 byte)

   b. Two bytes representing the Modbus register address in hexadecimal or decimal depending on what the master requires. (2 bytes)

   c. Length of data to be read. This is the number of 16-bit registers being requested.

2. Send acyclic read message to obtain the requested data per the following:

   Slot number (always 0 for the C445)

   Index: 45

   Data Length in bytes (example, if 1 register is being read, this length would be 2)

Writing data:

Only one step is needed to write data as follows:

Slot number (always 0 for the C445)

Index 45

Length in bytes, including the Modbus command in bytes

Data Field:

a. 06 Modbus single register write command (1 byte)

b. Two bytes representing the Modbus register address in hexadecimal or decimal depending on what the master requires. (2 bytes)

c. The two bytes (1 word) of data

Acyclic Message Examples

Example #1: Read the Active Fault Code from the C445.

The Active Fault Code is Modbus register 312 (address = 311) from **Appendix D**. This register address is converted to two hexadecimal bytes and two decimal bytes below:

01 37 hexadecimal

01 55 decimal

Note: The byte format depends on the PROFIBUS master.

The following two acyclic messages must be sent by the PROFIBUS master to the C445 to read the Active Fault Code:

1. Acyclic write message:

   Slot 0
   Index 45
   Length 4 bytes
   03 Modbus read command
   01 37 hex or 01 55 decimal
   01 length (1 register to read)

2. Acyclic read message:

   Slot 0
   Index 45
   Length 2 bytes

Example #2: Write to the Base Control Module Field Output Control word.

The Modbus register address for this parameter from **Appendix D** is 601 (address = 600). This register is converted to two hexadecimal bytes or two decimal bytes below:

02 58 hexadecimal

02 88 decimal

Note: The byte format depends on the PROFIBUS master.

The following acyclic message must be sent to write a value of 128 to the System Services register to issue a Soft Reset (bit 6 = 1, so the value is 64 decimal).

1. Acyclic write message:

   Slot 0
   Index 45
   Length 5 bytes

   Data Field:

   06 Command

   02 58 hexadecimal or 02 88 decimal

   Data: 00 40 hexadecimal or 00 64 decimal

PROFIBUS Diagnostics

The C445 PROFIBUS communication card uses extended diagnostics to provide the status information along with fault and warning data relevant to the operation of the system.

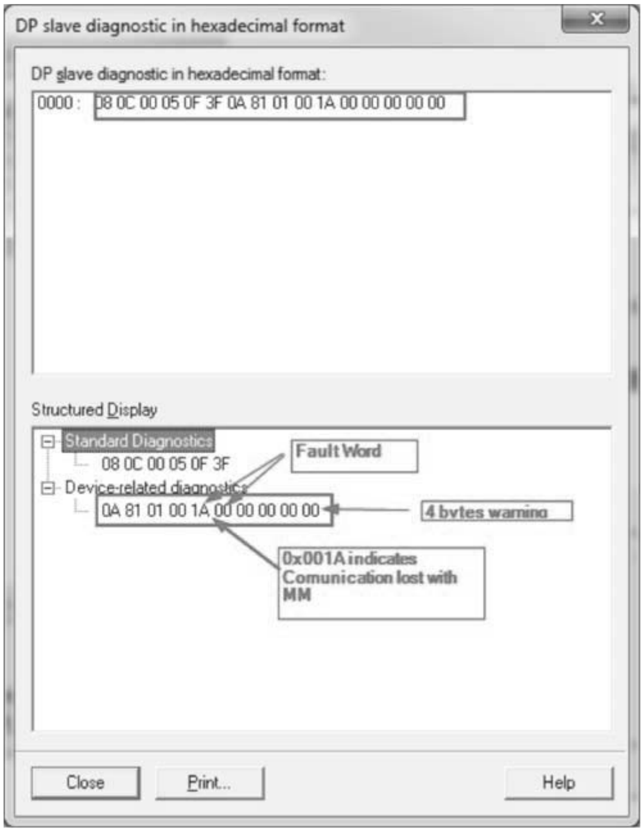
Any time a fault condition is present in the system, the “ext.diag.” bit (bit3 in first diagnostic data byte) will be set high, indicating to the Master, a high level diagnostic message and fault is present. The C445 PROFIBUS communication card will also set the appropriate word/bit/bits in diagnostic data bytes 11 and 16 to indicate to the user the reason for the fault/warning condition.

When the fault condition is cleared, the “ext. diag.” bit (bit3 in first diagnostic data byte) will also clear, indicating to the Master that the C445 system is healthy and ready for operation.

Table 122. C445 Diagnostic Telegram Details

Byte No.	Description
1 to 6	PROFIBUS DP standard diagnostics
7 to 10	Extended diagnostics header
11 to 12	Active Fault Code (Modbus Register No.312)
13 to 16	Warning Status Bits (Modbus Register No.318)

Below picture shows how diagnostics message is sent to Master.



```
0000 :  08 0C 00 05 0F 3F 0A 81 01 00 1A 00 00 00 00 00
```

```
Standard Diagnostics
  08 0C 00 05 0F 3F
Device-related diagnostics
  0A 81 01 00 1A 00 00 00 00 00
```

Fault Word

4 bytes warning

0x001A indicates Comunication lost with MM

Extended diagnostics frame has 10 bytes where first 4 bytes are header followed by 6 bytes fault and warning data. For example in above picture 0A 81 01 00 bytes are header information. 1A 00 00 00 00 00 are diagnostics information where 1A 00 forms a fault code word 0x001A, which means Communication lost with MM. 00 00 00 00 are the warning bits per Modbus register 318. When there is no fault or warning in the system, all 6 bytes of diagnostics data will be 0.

Optional Features

Freeze Mode

Freeze Mode is supported in the C445 PROFIBUS communication card.

Sync Mode

Sync Mode is supported in the C445 PROFIBUS communication card.

Fail Safe Mode

Fail Safe Mode is supported in the C445 PROFIBUS communication card. On the reception of a Clear Data frame from the Master, the C445 PROFIBUS communication module outputs will go to fail safe mode–outputs disabled.

C445 PROFIBUS Configuration File

PROFIBUS communication uses “User Parameterization” to configure the device. C445 PROFIBUS card has several parameters added to “User Parameterization” to aid the configuration. At situations when user does not want PROFIBUS to do the configuration, this configuration can be disabled by parameter “Parameterization Download Enable.”

Table 123. PROFIBUS Configuration File

Operation Mode
Parameterization Download Enable
Active Starter Profile
Remote Control Source Select
Local Motor Control Select
Motor Control Communication Loss Behavior
Motor Control Network Idle Behavior
Delay before control fault is issued (in 10ms)
Interlocking time between contactor direction changes (in 0.1sec)
Output function select 0
Output function select 1
Output function select 2
Latching Relay Behavior at Power-down
Motor Overload Trip Class
Motor Overload Trip FLA Motor1
Motor Overload Trip FLA Motor2
Rated Voltage
Rated Freq
Motor Rated Efficiency
Motor Rated Watts Motor1
Motor Rated Watts Motor2
Global Auto Reset Enable (boolean)
Motor Rated PF
Motor Rated Service Factor
Phase Rotation
Perform reset on power up.
Auto reset enable capability for each trip bit
Reset time delay. The amount of time to wait until we do an auto reset
Trip Enable Bit Field
Warn Enable Bit Field
Protection Instantaneous Overcurrent Alarm Level
Protection Instantaneous Overcurrent Start Delay
Protection Instantaneous Overcurrent Trip Level
Protection UnderCurrent Alarm Level
Protection UnderCurrent Trip Level
Protection I Unbalance Trip Percent Level
Protection I Unbalance Alarm Percent Level
Protection Stall Trip Level
Protection Jam Trip Level
Protection Jam Alarm Level
Motor Overload Alarm Threshold
Residual Ground Fault Threshold - Scaled
Residual Ground Fault Alarm Threshold - Scaled
Residual Ground Fault Start Delay
Residual Ground Fault Apply Inhibit Current
Protection UnderVoltage Alarm Level
Protection UnderVoltage Start Delay
Protection UnderVoltage Trip Level
Protection V Unbalance Trip Percent Level
Protection V Unbalance Alarm Percent Level
Protection V Unbalance Trip Debounce Time
Protection OverVoltage Alarm Level
Protection OverVoltage Trip Level
Protection OverVoltage Trip Level
Protection High KW Alarm Level
Protection High KW Trip Level
Protection Low KW Alarm Level
Protection Low KW Trip Time Debounce
Protection Low KW Trip Level
Peak Demand Warning Threshold
Protection Under Voltage Restart Fault Level (Percent)
Undervoltage restart max time for delayed restart long
Undervoltage restart delay long
Undervoltage restart delay short
Protection Under Voltage Restart Restoration Level (Percent)
Undervoltage restart max time for delayed restart short
Undervoltage restart max time for immediate restart
Backspin reset inhibit time
Number of Starts per Hour allowed before trip
Motor State time delay after which the RUN state is declared if not reached via current thresholds.
Protection start inhibit enable

C445 PROFIBUS Bit Mapping Parameters

C445 has option of mapping individual bits in input/output modules. Below are the bits available for bit mapping.

C445 PROFIBUS Cyclic/Acyclic Writable Parameters

Table 124. Bit Mapping Parameters for Cyclic/Acyclic Writeable Parameters

Bit Description	Parameter Description
Run 1	Fieldbus Motor Control
Run 2	Fieldbus Motor Control
Reserved	Fieldbus Motor Control
Fault Reset	Fieldbus Motor Control
Reserved	Fieldbus Motor Control
Test Trip	Fieldbus Motor Control
Reserved	Fieldbus Motor Control
Reserved	Fieldbus Motor Control
BCM Field Output control0	BCM Field Output control
BCM Field Output control1	BCM Field Output control
BCM Field Output control2	BCM Field Output control
BCM Field Output control3	BCM Field Output control

Note: For more information about any of the parameters listed above, refer to **System Configuration and Commissioning** on **Page 45** or **Appendix E**.

Table 125. Fieldbus Motor Control Bits

Bit Position	Bit Description
Bit 0	Run 1
Bit 1	Run 2
Bit 2	Switch to Remote
Bit 3	Fault Reset
Bit 4	Reserved
Bit 5	Test Trip
Bit 6	Reserved
Bit 7	Reserved

C445 PROFIBUS Cyclic/Acyclic Readable Parameters

Table 126. Bit Mapping Parameters for Cyclic/Acyclic Readable Parameters

Bit Description	Parameter Description
Running 1	Status Word
Running 2	Status Word
Remote Enabled	Status Word
Faulted	Status Word
Warning	Status Word
Inhibited	Status Word
Ready	Status Word
Up to Speed	Status Word

System Services is one of the selections for an output data word. The following are decimal values that when sent to the C445 with the System Services word cause the C445 to perform the designated function:

0: No Active Service
1: Clear Fault Queue
2: Clear Trip Snapshot
3: Test Trip
4: Re-pair external modules
5: Factory Reset
6: Soft Reset
7: Reset Fault
8: Proof Test

BCM Field Output Control Word is one of the selections for an output data word. The following are the bits that control the 3 outputs on the Base Control Module:

Bit 0: Output 1
Bit 1: Output 2
Bit 2: Output 3 (if a Base Control Module with the latching relay option is being used, this bit is used to Set this output)
Bit 3: This bit is only used when a BCM with the latching relay option is used. This bit resets the latching relay output.

Table 127. PROFIBUS Cyclic/Acyclic Readable Parameters

Parameter Description
Motor Control Status (Running1, Running2, Auto, Tripped, Warned)
Active Fault
Active Inhibit
Active Warning
Motor Current Phase A - Scaled
Motor Current Average Percent FLA
Motor Current Average - Scaled
Motor Current Phase B - Scaled
Motor Current Phase C - Scaled
Motor Current Scale Factor
Motor I Unbalance Percent
Line Frequency - Scaled
Line Voltage LL Phases AB
Line Voltage LL Average
Line Voltage LL Phases BC
Line Voltage LL Phases CA
Line V Unbalance Percent
Power Apparent Power Factor
Efficiency in percent
Config Inhibit Reason
Motor State (enum)
Number of Contactor Operations During Last Hour
Thermal memory Percent
BCM Control Voltage (24VDC)
Fault Snap Shot Log Day
Fault Snap Shot Log Hour
Fault Snap Shot Log Minute
Fault Snap Shot Log Month
Fault Snap Shot Log Second
Fault Snap Shot Log Year
Digital Input Status
Line Voltage Phase Order
GF Residual - RMS
PTC Status
Torque
Motor Rated Speed Active
MM Voltage Scale Factor
Proof Test Status

Appendix D—Modbus Register Map

C445 Modbus Register Map

Table 128. C445 Modbus Register Map

<table>
<thead>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
</thead>
<tbody>
<tr><td>300</td><td>Motor Control Status</td><td>BYTE RO
Bitfield</td><td>Present Motor Control Status Bits (Running1, Running2, Remote, Tripped, Warned).
<table>
<thead><tr><th>Bit</th><th>Description</th><th>Coil</th></tr></thead>
<tbody>
<tr><td>0</td><td>Running 1</td><td>4785</td></tr>
<tr><td>1</td><td>Running 2</td><td>4786</td></tr>
<tr><td>2</td><td>Remote enabled</td><td>4787</td></tr>
<tr><td>3</td><td>Faulted</td><td>4788</td></tr>
<tr><td>4</td><td>Warning</td><td>4789</td></tr>
<tr><td>5</td><td>Inhibited</td><td>4790</td></tr>
<tr><td>6</td><td>Ready</td><td>4791</td></tr>
<tr><td>7</td><td>Motor at speed</td><td>4792</td></tr>
</tbody>
</table>
</td></tr>
<tr><td>301</td><td>I Phase A (L1) Scaled</td><td>UINT16 RO
Units: scaled A</td><td>Phase A (L1) Motor Current Scaled. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>302</td><td>I Phase B (L2) Scaled</td><td>UINT16 RO
Units: scaled A</td><td>Phase B (L2) Motor Current Scaled. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>303</td><td>I Phase C (L3) Scaled</td><td>UINT16 RO
Units: scaled A</td><td>Phase C (L3) Motor Current Scaled. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>304</td><td>Avg Current Scaled</td><td>UINT16 RO
Units: scaled A</td><td>Average motor Current Scaled. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>305</td><td>I Scale Factor</td><td>UINT16 RO</td><td>This scale factor is applied to all current values monitored via a communication network.</td></tr>
<tr><td>306</td><td>Current Unbalance</td><td>UINT8 RO
Units: %</td><td>Motor Current Unbalance Percent</td></tr>
<tr><td>307</td><td>GF Current RMS Scaled</td><td>UINT16 RO
Units: scaled A</td><td>Motor Ground Fault scaled current RMS. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>308</td><td>Thermal Capacity</td><td>UINT8 RO
Default: 0
Units: %</td><td>Thermal Capacity in Percent - An overload trip occurs when the Thermal Capacity reaches 100%.</td></tr>
<tr><td>309</td><td>Time to Trip Overload</td><td>UINT16 RO
Units: seconds</td><td>Estimated Time for Overload to Reach Trip Threshold (100% Thermal Memory)</td></tr>
<tr><td>310</td><td>Remaining Thermal Capacity</td><td>UINT8 RO
Units: %</td><td>Thermal Capacity (Percent) Remaining to Trip</td></tr>
<tr><td>311</td><td>Time to Reset Overload</td><td>UINT16 RO
Units: seconds</td><td>Time for overload to reach reset threshold. The Thermal Memory must drop below 75% (default value) before a reset is allowed.</td></tr>
</tbody>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
312	Active Fault	UINT16 RO Default: 0 Enum	Current Active Fault

Value	Description
0	No Faults
1	Under voltage
2	Over voltage
3	Reserved
4	Ground current fault
5	Current phase loss
6	Current unbalance
7	Instantaneous over current
8	Jam
9	PF Deviation
10	Voltage phase loss
11	Voltage unbalance
12	Frequency deviation fast
13	Frequency deviation slow
14	Under current
15	High power
16	Low power
17	Contactor failure
18	Starts limit exceeded
19	Overload
20	Stall
21	Phase rotation mismatch
22	PTC - See PTC State for details
23	Under voltage restart
24	Measurement Module fault
25	Communication loss on active fieldbus
26	Measurement Module not available or communication loss with the module
27	User Interface not available or communication loss with the module
28	Test trip was triggered
29	Option Card not available or communication loss with the module
30	RTC / Backup Memory Option Board NV memory fail
31	Currently connected User Interface does not match with what was connected before
32	Currently connected Measurement Module does not match with what was connected before
33	Currently connected Option Card does not match with what was connected before
34	Measurement Module firmware is incompatible
35	User Interface firmware is incompatible
36	Ethernet Option Card firmware is incompatible
37	Profi Option Card firmware is incompatible

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
312	Active Fault	UINT16 RO Default: 0 Enum	Current Active Fault, continued

Value	Description
38	Ground Fault Module firmware is incompatible
39	External ground fault module not available or
40	Currently connected Ground Fault Module does not match current configuration
41	GFM CT connection is open
42	GFM CT connection is shorted
43	GFM CT input has no calibration values
44	HRGF pulse detection trip
200	Logic Internal Fault
201	Logic call stack overflow
202	Logic call stack underflow
203	Logic memory read violation
204	Logic memory write violation
205	Logic invalid program
206	Logic incompatible program
207	Logic invalid instruction
220	Logic program underrun
221	Logic program overrun
222	Logic task watchdog
223	Logic instruction invalid instance number
224	Logic instruction invalid argument
225	Logic math - divide by zero
226	Logic math - underflow
227	Logic math - overflow
228	ELC IO Comm Loss
229	ELC IO is connected but unable to read/write
230	Generic Modbus Slave Comm Loss
231	Generic Modbus slave device is connected but read/write returned an error
232	Logic Program accessing ELC IO but ELC IO not configured
500	Internal - communication loss with Power Supply Board
501	Internal - Power Supply Board is not responding to SPI
502	Internal - Checksums in NV memory (FRAM) didn't match during read (neither pair)
503	Internal - Checksums in NV memory (FRAM) didn't match during write (neither pair)
504	Internal - RTC / Backup Memory Option Card is missing
505	Internal - RTC / Backup Memory Option Card does not match actual
506	Internal - RTC / Backup Memory Option Card has NV Fault.
507	Internal - serial flash memory fault (Attempt Factory Reset first. Return to manufacturer if not cleared)
508	Internal - logic mapping error (Attempt factory reset)
509	Internal - UI NV memory error
510	Internal - Option card NV memory error
511	Internal - GFM NV memory error

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
312	Active Fault	UINT16 RO Default: 0 Enum	Current Active Fault, continued

Value	Description
1000	Logic User Fault 1
1001	Logic User Fault 2
1002	Logic User Fault 3
1003	Logic User Fault 4
1004	Logic User Fault 5
1005	Logic User Fault 6
1006	Logic User Fault 7
1007	Logic User Fault 8
1008	Logic User Fault 9
1009	Logic User Fault 10
1010	Logic User Fault 11
1011	Logic User Fault 12
1012	Logic User Fault 13
1013	Logic User Fault 14
1014	Logic User Fault 15
1015	Logic User Fault 16
1016	Logic User Fault 17
1017	Logic User Fault 18
1018	Logic User Fault 19
1019	Logic User Fault 20
1020	Logic User Fault 21
1021	Logic User Fault 22
1022	Logic User Fault 23
1023	Logic User Fault 24
1024	Logic User Fault 25
1025	Logic User Fault 26
1026	Logic User Fault 27
1027	Logic User Fault 28
1028	Logic User Fault 29
1029	Logic User Fault 30
1030	Logic User Fault 31
1031	Logic User Fault 32
1032	Logic User Fault 33
1033	Logic User Fault 34
1034	Logic User Fault 35
1035	Logic User Fault 36
1036	Logic User Fault 37
1037	Logic User Fault 38
1038	Logic User Fault 39
1039	Logic User Fault 40
1040	Logic User Fault 41
1041	Logic User Fault 42
1042	Logic User Fault 43

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>312</td><td>Active Fault</td><td>UINT16 RO
Default: 0
Enum</td><td>Current Active Fault, continued
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>1043</td><td>Logic User Fault 44</td></tr>
<tr><td>1044</td><td>Logic User Fault 45</td></tr>
<tr><td>1045</td><td>Logic User Fault 46</td></tr>
<tr><td>1046</td><td>Logic User Fault 47</td></tr>
<tr><td>1047</td><td>Logic User Fault 48</td></tr>
<tr><td>1048</td><td>Logic User Fault 49</td></tr>
<tr><td>1049</td><td>Logic User Fault 50</td></tr>
</table></td></tr>
<tr><td>313</td><td>Active Warning</td><td>UINT16 RO
Enum</td><td>Current Active Warning
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Warnings</td></tr>
<tr><td>1</td><td>Under voltage</td></tr>
<tr><td>2</td><td>Over voltage</td></tr>
<tr><td>3</td><td>Reserved</td></tr>
<tr><td>4</td><td>Ground current warning</td></tr>
<tr><td>5</td><td>Current phase loss</td></tr>
<tr><td>6</td><td>Current unbalance</td></tr>
<tr><td>7</td><td>Instantaneous over current</td></tr>
<tr><td>8</td><td>Jam</td></tr>
<tr><td>9</td><td>PF Deviation</td></tr>
<tr><td>10</td><td>Voltage phase loss</td></tr>
<tr><td>11</td><td>Voltage unbalance</td></tr>
<tr><td>12</td><td>Frequency deviation fast</td></tr>
<tr><td>13</td><td>Frequency deviation slow</td></tr>
<tr><td>14</td><td>Under current</td></tr>
<tr><td>15</td><td>High power</td></tr>
<tr><td>16</td><td>Low power</td></tr>
<tr><td>17</td><td>Contactor failure</td></tr>
<tr><td>18</td><td>Starts limit exceeded</td></tr>
<tr><td>19</td><td>Overload</td></tr>
<tr><td>20</td><td>Stall</td></tr>
<tr><td>21</td><td>Phase rotation mismatch</td></tr>
<tr><td>22</td><td>PTC - See PTC State for details</td></tr>
<tr><td>23</td><td>Peak demand</td></tr>
<tr><td>24</td><td>Measurement Module warning</td></tr>
<tr><td>25</td><td>Real Time Clock requires setting (has not been set)</td></tr>
<tr><td>26</td><td>RTC Battery Low. Replacement is recommended</td></tr>
<tr><td>27</td><td>Device ambient temperature high</td></tr>
<tr><td>28</td><td>MM high ambient temperature</td></tr>
<tr><td>29</td><td>UI high ambient temperature</td></tr>
<tr><td>30</td><td>Option card high ambient temperature</td></tr>
<tr><td>31</td><td>Ground fault module high ambient temperature</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
313	Active Warning	UINT16 RO Enum	Current Active Warning, continued

Value	Description
41	GFM CT connection is open
42	GFM CT connection is shorted
43	GFM CT calibration is missing
44	HRGF pulse detection
220	Logic program underrun
221	Logic program overrun
222	Logic task watchdog
223	Logic instruction invalid instance number
224	Logic instruction invalid argument
225	Logic math - divide by zero
226	Logic math - underflow
227	Logic math - overflow
228	ELC IO Comm Loss
229	ELC IO is connected but unable to read/write
230	Generic Modbus Slave Comm Loss
231	Generic Modbus slave device is connected but read/write returned an error
232	Logic Program accessing ELC IO but ELC IO not configured
1000	Logic User Warning 1
1001	Logic User Warning 2
1002	Logic User Warning 3
1003	Logic User Warning 4
1004	Logic User Warning 5
1005	Logic User Warning 6
1006	Logic User Warning 7
1007	Logic User Warning 8
1008	Logic User Warning 9
1009	Logic User Warning 10
1010	Logic User Warning 11
1011	Logic User Warning 12
1012	Logic User Warning 13
1013	Logic User Warning 14
1014	Logic User Warning 15
1015	Logic User Warning 16
1016	Logic User Warning 17
1017	Logic User Warning 18
1018	Logic User Warning 19
1019	Logic User Warning 20
1020	Logic User Warning 21
1021	Logic User Warning 22
1022	Logic User Warning 23
1023	Logic User Warning 24
1024	Logic User Warning 25

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
313	Active Warning	UINT16 RO Enum	Current Active Warning, continued

Value	Description
1025	Logic User Warning 26
1026	Logic User Warning 27
1027	Logic User Warning 28
1028	Logic User Warning 29
1029	Logic User Warning 30
1030	Logic User Warning 31
1031	Logic User Warning 32
1032	Logic User Warning 33
1033	Logic User Warning 34
1034	Logic User Warning 35
1035	Logic User Warning 36
1036	Logic User Warning 37
1037	Logic User Warning 38
1038	Logic User Warning 39
1039	Logic User Warning 40
1040	Logic User Warning 41
1041	Logic User Warning 42
1042	Logic User Warning 43
1043	Logic User Warning 44
1044	Logic User Warning 45
1045	Logic User Warning 46
1046	Logic User Warning 47
1047	Logic User Warning 48
1048	Logic User Warning 49
1049	Logic User Warning 50

Register	Name	Attribute	Description
314	Active Inhibit	UINT16 RO Enum	Current Active Inhibit

Value	Description
0	No inhibits
1	Incorrect configuration. See configuration inhibit reason
2	A soft reset is required
3	Backspin prevention
4	Under voltage restart timer active
5	Control voltage is low
6	Under voltage condition
7	Voltage unbalance
8	Starts per hour limit has been exceeded
9	Over voltage condition
10	ELC IO hardware does not match the configuration
11	Run interlock input is open

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
314	Active Inhibit	UINT16 RO Enum	Current Active Inhibit, continued

Value	Description
1000	Logic User Inhibit 1
1001	Logic User Inhibit 2
1002	Logic User Inhibit 3
1003	Logic User Inhibit 4
1004	Logic User Inhibit 5
1005	Logic User Inhibit 6
1006	Logic User Inhibit 7
1007	Logic User Inhibit 8
1008	Logic User Inhibit 9
1009	Logic User Inhibit 10
1010	Logic User Inhibit 11
1011	Logic User Inhibit 12
1012	Logic User Inhibit 13
1013	Logic User Inhibit 14
1014	Logic User Inhibit 15
1015	Logic User Inhibit 16
1016	Logic User Inhibit 17
1017	Logic User Inhibit 18
1018	Logic User Inhibit 19
1019	Logic User Inhibit 20
1020	Logic User Inhibit 21
1021	Logic User Inhibit 22
1022	Logic User Inhibit 23
1023	Logic User Inhibit 24
1024	Logic User Inhibit 25
1025	Logic User Inhibit 26
1026	Logic User Inhibit 27
1027	Logic User Inhibit 28
1028	Logic User Inhibit 29
1029	Logic User Inhibit 30
1030	Logic User Inhibit 31
1031	Logic User Inhibit 32
1032	Logic User Inhibit 33
1033	Logic User Inhibit 34
1034	Logic User Inhibit 35
1035	Logic User Inhibit 36
1036	Logic User Inhibit 37
1037	Logic User Inhibit 38
1038	Logic User Inhibit 39
1039	Logic User Inhibit 40

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>314</td><td>Active Inhibit</td><td>UINT16 RO
Enum</td><td>Current Active Inhibit, continued
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>1040</td><td>Logic User Inhibit 41</td></tr>
<tr><td>1041</td><td>Logic User Inhibit 42</td></tr>
<tr><td>1042</td><td>Logic User Inhibit 43</td></tr>
<tr><td>1043</td><td>Logic User Inhibit 44</td></tr>
<tr><td>1044</td><td>Logic User Inhibit 45</td></tr>
<tr><td>1045</td><td>Logic User Inhibit 46</td></tr>
<tr><td>1046</td><td>Logic User Inhibit 47</td></tr>
<tr><td>1047</td><td>Logic User Inhibit 48</td></tr>
<tr><td>1048</td><td>Logic User Inhibit 49</td></tr>
<tr><td>1049</td><td>Logic User Inhibit 50</td></tr>
</table></td></tr>
<tr><td>315</td><td>Configuration Inhibit Reason</td><td>UINT8 RO
Enum</td><td>The reason for an active inhibit due to an incorrect or out-of-range configuration parameter.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No active inhibits</td></tr>
<tr><td>1</td><td>Local and Remote motor control sources both point to Fieldwire</td></tr>
<tr><td>2</td><td>Local motor control source is set to User Interface but the User Interface type does not match</td></tr>
<tr><td>3</td><td>One or more enabled protection features requires a voltage option card in the Measurement Module</td></tr>
<tr><td>4</td><td>One or more enabled protection features requires a PTC (Temperature) option card in the Measurement Module</td></tr>
<tr><td>5</td><td>Selected operational mode is incompatible with 3wire cfg fieldwire as local control</td></tr>
<tr><td>6</td><td>Cannot choose fieldwire as the feedback source when the fieldwire is used as a local / remote source with the selected starter</td></tr>
<tr><td>7</td><td>UI Custom Overlay - Multiple buttons assigned to same function</td></tr>
<tr><td>8</td><td>UI Custom Overlay - Multiple button LEDs assigned to the same function</td></tr>
<tr><td>9</td><td>UI Custom Overlay - Multiple status LEDs assigned to the same function</td></tr>
<tr><td>10</td><td>Selected operational mode is incompatible with the connected UI</td></tr>
<tr><td>11</td><td>The General Purpose I/O operational mode does not use fieldwire as a control source</td></tr>
<tr><td>12</td><td>Q3 configured for both latching relay and shunt trip output</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
316	Trip Reason	BYTE RO Array size: 4 Bitfield	Indicates the Trip Reason for the current trip. Each trip type has a bit.

Bit	Description	Coil
0	Under voltage	5041
1	Over voltage	5042
2	Reserved	5043
3	Ground current fault	5044
4	Current phase loss	5045
5	Current unbalance	5046
6	Instantaneous over current	5047
7	Jam	5048
8	Power factor deviation	5049
9	Voltage phase loss	5050
10	Voltage unbalance	5051
11	Frequency deviation fast	5052
12	Frequency deviation slow	5053
13	Under current	5054
14	High power	5055
15	Low power	5056
16	Reserved	5057
17	Starts limit exceeded	5058
18	Overload	5059
19	Stall	5060
20	Phase rotation mismatch	5061
21	PTC	5062
22	Under voltage restart	5063
23	Peak demand	5064
24	HRGF pulse detection	5065

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>318</td><td>Warning Reason</td><td>BYTE RO
Array size: 4
Bitfield</td><td>Indicates the Reason for a Warning condition. Each Alarm type has a bit.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Under voltage</td><td>5073</td></tr>
<tr><td>1</td><td>Over voltage</td><td>5074</td></tr>
<tr><td>2</td><td>Reserved</td><td>5075</td></tr>
<tr><td>3</td><td>Ground current warning</td><td>5076</td></tr>
<tr><td>4</td><td>Current phase loss</td><td>5077</td></tr>
<tr><td>5</td><td>Current unbalance</td><td>5078</td></tr>
<tr><td>6</td><td>Instantaneous over current</td><td>5079</td></tr>
<tr><td>7</td><td>Jam</td><td>5080</td></tr>
<tr><td>8</td><td>Power factor deviation</td><td>5081</td></tr>
<tr><td>9</td><td>Voltage phase loss</td><td>5082</td></tr>
<tr><td>10</td><td>Voltage unbalance</td><td>5083</td></tr>
<tr><td>11</td><td>Frequency deviation fast</td><td>5084</td></tr>
<tr><td>12</td><td>Frequency deviation slow</td><td>5085</td></tr>
<tr><td>13</td><td>Under current</td><td>5086</td></tr>
<tr><td>14</td><td>High power</td><td>5087</td></tr>
<tr><td>15</td><td>Low power</td><td>5088</td></tr>
<tr><td>16</td><td>Reserved</td><td>5089</td></tr>
<tr><td>17</td><td>Starts limit exceeded</td><td>5090</td></tr>
<tr><td>18</td><td>Overload</td><td>5091</td></tr>
<tr><td>19</td><td>Stall</td><td>5092</td></tr>
<tr><td>20</td><td>Phase rotation mismatch</td><td>5093</td></tr>
<tr><td>21</td><td>PTC</td><td>5094</td></tr>
<tr><td>22</td><td>Under voltage restart</td><td>5095</td></tr>
<tr><td>23</td><td>Peak demand</td><td>5096</td></tr>
<tr><td>24</td><td>HRGF pulse detection</td><td>5065</td></tr>
</table></td></tr>
<tr><td>320</td><td>Base Control Module Control Voltage Scaled</td><td>UINT16 RO
Units: mV</td><td>Base Control Module measured control Voltage scaled in millivolts.</td></tr>
<tr><td>321</td><td>Voltage L1-L2 (AB)</td><td>UINT16 RO
Units: V</td><td>Supply Line-to-Line Voltage AB (L1-L2)</td></tr>
<tr><td>322</td><td>Voltage L2-L3 (BC)</td><td>UINT16 RO
Units: V</td><td>Supply Line-to-Line Voltage BC (L2-L3)</td></tr>
<tr><td>323</td><td>Voltage L3-L1 (CA)</td><td>UINT16 RO
Units: V</td><td>Supply Line-to-Line Voltage CA (L3-L1)</td></tr>
<tr><td>324</td><td>Average Voltage</td><td>UINT16 RO
Units: V</td><td>Supply Line-to-Line Voltage, Average of the three phases</td></tr>
<tr><td>325</td><td>Voltage Unbalance</td><td>UINT8 RO
Units: %</td><td>Supply Voltage Unbalance Percentage</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>326</td><td>Phase Order</td><td>UINT8 RO
Enum</td><td>Supply Phase Order. 0: unknown; 1: ABC (L1-L2-L3); 2: ACB (L1-L3-L2); 3: Voltage (L1-L2-L3) Current (L1-L3-L2); 4: Voltage (L1-L3-L2) Current (L1-L2-L3). If a Phase order is set here, a Phase Rotation Fault will occur if the phases detected do not match that order.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Unknown</td></tr>
<tr><td>1</td><td>ABC (L1-L2-L3)</td></tr>
<tr><td>2</td><td>ACB (L1-L3-L2)</td></tr>
<tr><td>3</td><td>Voltage (L1-L2-L3) Current (L1-L3-L2)</td></tr>
<tr><td>4</td><td>Voltage (L1-L3-L2) Current (L1-L2-L3)</td></tr>
</table></td></tr>
<tr><td>327</td><td>Watts Total</td><td>SINT32 RO
Units: W</td><td>Total Real Power</td></tr>
<tr><td>329</td><td>VA Total</td><td>SINT32 RO
Units: VA</td><td>Total Apparent Power which is the vector sum of Reactive Power and Real Power</td></tr>
<tr><td>331</td><td>VARS Total</td><td>SINT32 RO
Units: VAR</td><td>Total Reactive Power which is the power component that does no work. Reactive power primarily represents the power needed to magnetize the motor. It is stored and discharged by inductive motors.</td></tr>
<tr><td>333</td><td>Power Factor Scaled</td><td>SINT16 RO
Units: 0.01%</td><td>Apparent Power Factor in Percent (scaled 0.01%)</td></tr>
<tr><td>334</td><td>Real Energy Scaled</td><td>SINT32 RO
Default: 0
Units: 0.1kWh
Backup Mem</td><td>The total energy used to do work, not resettable (scaled by 0.1).</td></tr>
<tr><td>336</td><td>Reactive Energy Scaled</td><td>SINT32 RO
Default: 0
Units: 0.1kVARh
Backup Mem</td><td>The component of Apparent Energy that does no work (scaled by 0.1). The energy used over time to magnetize the motor. Not Resettable</td></tr>
<tr><td>338</td><td>Apparent Energy Scaled</td><td>SINT32 RO
Default: 0
Units: 0.1kVAh
Backup Mem</td><td>Total Energy used is the vector sum of Reactive and Real Energy (scaled by 0.1). The total amount of energy used, not resettable.</td></tr>
<tr><td>340</td><td>Real Energy Resettable Scaled</td><td>SINT32 RW NV
Default: 0
Units: 0.1kWh
Admin Lock
USB Lock
Backup Mem</td><td>The total energy used to do work, resettable (scaled by 0.1). Resettable values can be zero-ed out by the user at any time.</td></tr>
<tr><td>342</td><td>Reactive Energy Resettable Scaled</td><td>SINT32 RW NV
Default: 0
Units: 0.1kVARh
Admin Lock
USB Lock
Backup Mem</td><td>The component of Apparent Energy that does no work (scaled by 0.1). The energy used over time to magnetize the motor. Resettable. Resettable values can be zero-ed out by the user at any time.</td></tr>
<tr><td>344</td><td>Apparent Energy Resettable Scaled</td><td>SINT32 RW NV
Default: 0
Units: 0.1kVAh
Admin Lock
USB Lock
Backup Mem</td><td>Apparent Energy, User Resettable (scaled by 0.1). Resettable values can be zero-ed out by the user at any time.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
346	Run Time Lifetime	UINT32 RO Units: seconds Backup Mem	Total motor run time in seconds
348	Number Starts Lifetime	UINT32 RO Manufacturing Lock Backup Mem	Total Number of Motor Starts in lifetime, not resettable.
350	Operating Seconds Lifetime	UINT32 RO Units: seconds Backup Mem	Total number of Seconds the motor has been running. Not resettable.
352	Run Time Resettable	UINT32 RW NV Default: 0 Units: seconds Admin Lock USB Lock Backup Mem	Total motor run time in seconds (Resettable). Resettable values can be zero-ed out by the user at any time.
354	Number Starts Resettable	UINT32 RW NV Default: 0 Admin Lock USB Lock Backup Mem	Total number of motor starts (Resettable).
356	Operating Seconds Resettable	UINT32 RW NV Default: 0 Units: seconds Backup Mem	Total number of Seconds the motor has been running since this value was last reset. This value is resettable.
358	Contactor Operations Last Hour	UINT16 RO Backup Mem	Number of Contactor Operations During the Last Hour
359	Last Run Time	UINT32 RO Default: 0 Units: seconds	Duration in Seconds of the Last Start-to-Stop Motor Run Time
361	Last Starting Time	UINT16 RO Default: 0 Units: seconds	The amount of time the motor took to get up to speed on the last start.
362	I Average % of FLA	UINT16 RO Units: %	Monitored Average Motor Current as Percentage of FLA (Nominal Current)
363	Current Demand Value	UINT32 RO Units: W	Latest estimate of the Demand measured over the demand window duration.
365	Demand (Resettable)	UINT32 RW NV Default: 0 Range: 0 to 0 Units: W Admin Lock USB Lock Backup Mem	Peak Demand, User Resettable. The peak demand is updated if the new demand calculated over the demand window is greater than the previous peak.
367	Peak Demand Time Stamp	UINT32 RO Default: 0 Units: seconds Admin Lock USB Lock Backup Mem	Peak Demand Time Stamped (in Unix time)

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>369</td><td>Max Starting Current</td><td>FLOAT RW NV
Default: 0
Units: A
Admin Lock
USB Lock</td><td>Maximum Motor Starting Current Floating Point Format. This value can be set (typically to 0) before starting the motor.</td></tr>
<tr><td>371</td><td>Max Starting Current Scaled</td><td>UINT16 RW NV
Default: 0
Units: scaled A
Admin Lock
USB Lock</td><td>Max Motor Starting Current Scaled. Scaled by parameter “I Scale Factor”. This value can be set to any value but is typically reset to 0.</td></tr>
<tr><td>372</td><td>Motor State (Current Based)</td><td>UINT8 RO
Enum</td><td>Current based motor state. The motor state is determined by using the current presently measured. This state indication runs independent of the actual command being provided.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Motor current indicates a stop</td></tr>
<tr><td>1</td><td>Motor current indicates motor is accelerating</td></tr>
<tr><td>2</td><td>Motor current indicates a running or at speed condition</td></tr>
</table></td></tr>
<tr><td>373</td><td>Speed RPM Scaled</td><td>UINT16 RO
Units: 0.1 RPM</td><td>The speed of the motor in scaled RPM (0.1RPM).</td></tr>
<tr><td>374</td><td>Torque Scaled</td><td>SINT16 RO
Units: 0.01 Nm</td><td>The motor torque in scaled Newton-meters (0.01Nm).</td></tr>
<tr><td>375</td><td>Efficiency Percent Scaled</td><td>UINT16 RO
Units: 0.01%</td><td>Motor Efficiency in scaled percentage (0.01%)</td></tr>
<tr><td>376</td><td>PTC Status</td><td>UINT8 RO
Enum</td><td>PTC Status as follows: 0 - No Fault, 1 - Over Temperature fault, 2 - PTC Shorted fault, 3 - PTC Open fault
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>PTC ok - No fault</td></tr>
<tr><td>1</td><td>PTC over temperature fault</td></tr>
<tr><td>2</td><td>PTC shorted fault</td></tr>
<tr><td>3</td><td>PTC open fault</td></tr>
</table></td></tr>
<tr><td>377</td><td>I Phase A (L1)</td><td>FLOAT RO
Units: A</td><td>Monitored Phase A (L1) Motor Current in Floating Point Format</td></tr>
<tr><td>379</td><td>I Phase B (L2)</td><td>FLOAT RO
Units: A</td><td>Monitored Phase B (L2) Motor Current in Floating Point Format</td></tr>
<tr><td>381</td><td>I Phase C (L3)</td><td>FLOAT RO
Units: A</td><td>Monitored Phase C (L3) Motor Current in Floating Point Format</td></tr>
<tr><td>383</td><td>Avg Current</td><td>FLOAT RO
Units: A</td><td>Monitored Average Motor Current in Floating Point Format</td></tr>
<tr><td>385</td><td>I Positive Sequence Real</td><td>SINT16 RO</td><td>Monitor Positive Sequence Current, Real Component</td></tr>
<tr><td>386</td><td>I Positive Sequence Imaginary</td><td>SINT16 RO</td><td>Monitor Positive Sequence Current, Imaginary Component</td></tr>
<tr><td>387</td><td>I Negative Sequence Real</td><td>SINT16 RO</td><td>Monitor Negative Sequence Current, Real Component</td></tr>
<tr><td>388</td><td>I Negative Sequence Imaginary</td><td>SINT16 RO</td><td>Monitor Negative Sequence Current, Imaginary Component</td></tr>
<tr><td>389</td><td>V Positive Sequence Real</td><td>SINT16 RO</td><td>Monitor Positive Sequence Voltage, Real Component</td></tr>
<tr><td>390</td><td>V Positive Sequence Imaginary</td><td>SINT16 RO</td><td>Monitor Positive Sequence Voltage, Imaginary Component</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>391</td><td>V Negative Sequence Real</td><td>SINT16 RO</td><td>Monitor Negative Sequence Voltage, Real Component</td></tr>
<tr><td>392</td><td>V Negative Sequence Imaginary</td><td>SINT16 RO</td><td>Monitor Negative Sequence Voltage, Imaginary Component</td></tr>
<tr><td>393</td><td>Frequency Scaled</td><td>UINT16 RO
Units: 0.01Hz</td><td>Line frequency scaled in 0.01Hz.</td></tr>
<tr><td>394</td><td>Digital Input Status</td><td>BYTE RO
Array size: 2
Bitfield</td><td>ON/OFF status of digital inputs from both the Base Control Module and the inputs on the optional User Interface (C445UC... versions only). Bits 0-3 are the status for the inputs from the Base Control Module and bits 4-7 are the status of the 4 inputs from the Control User Interface.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Base Control Module Input I1</td><td>6289</td></tr>
<tr><td>1</td><td>Base Control Module Input I2</td><td>6290</td></tr>
<tr><td>2</td><td>Base Control Module Input I3</td><td>6291</td></tr>
<tr><td>3</td><td>Base Control Module Input I4</td><td>6292</td></tr>
<tr><td>4</td><td>User Interface Input I1</td><td>6293</td></tr>
<tr><td>5</td><td>User Interface Input I2</td><td>6294</td></tr>
<tr><td>6</td><td>User Interface Input I3</td><td>6295</td></tr>
<tr><td>7</td><td>User Interface Input I4</td><td>6296</td></tr>
</table></td></tr>
<tr><td>395</td><td>Output Status</td><td>BYTE RO
Default: 0
Bitfield</td><td>The status of the output relays on the Base Control Module.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Q1 state: (0)Open not energized / (1)Closed energized</td><td>6305</td></tr>
<tr><td>1</td><td>Q2 state: (0)Open not energized / (1)Closed energized</td><td>6306</td></tr>
<tr><td>2</td><td>Q3 State: (0)Open (latching: relay reset) / (1)Closed (latching: relay set)</td><td>6307</td></tr>
</table></td></tr>
<tr><td>396</td><td>DIP Switches</td><td>WORD RO
Bitfield</td><td>Base Control Module DIP Switch Settings value. This is the weighted binary value of the DIP switches that are currently set to the ON position.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Switch 1 (close to connector)</td><td>6321</td></tr>
<tr><td>1</td><td>Switch 2</td><td>6322</td></tr>
<tr><td>2</td><td>Switch 3</td><td>6323</td></tr>
<tr><td>3</td><td>Switch 4</td><td>6324</td></tr>
<tr><td>4</td><td>Switch 5</td><td>6325</td></tr>
<tr><td>5</td><td>Switch 6</td><td>6326</td></tr>
<tr><td>6</td><td>Switch 7</td><td>6327</td></tr>
<tr><td>7</td><td>Switch 8</td><td>6328</td></tr>
<tr><td>8</td><td>Switch 9</td><td>6329</td></tr>
<tr><td>9</td><td>Switch 10 (USB - close to top)</td><td>6330</td></tr>
</table></td></tr>
<tr><td>397</td><td>Base Control Module Control Bd Amb Temp</td><td>SINT16 RO
Units: °C</td><td>Ambient temperature measured on the PCB of the Base Control Module.</td></tr>
<tr><td>398</td><td>Base Control Module Max Bd Amb Temp</td><td>SINT16 RW NV
Default: –40
Units: °C</td><td>Base Control Module Maximum ambient temperature for the PCB. This value can be set (typically to -40).</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>400</td><td>Proof Test Status</td><td>UINT8 RO
Default: 0
Enum</td><td>Proof Test Status. 0: Proof test is idle (not triggered), 1: Proof test is running, 2: Proof test passed, 3: Proof test failed.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Proof test is idle (not triggered)</td></tr>
<tr><td>1</td><td>Proof test is running</td></tr>
<tr><td>2</td><td>Proof test passed</td></tr>
<tr><td>3</td><td>Proof test failed</td></tr>
</table></td></tr>
<tr><td>401</td><td>Ground Fault Current Scale Factor</td><td>UINT16 RO
Default: 1000</td><td>Ground Fault Current Fractional Scale Factor
Divide integer ground current value by this value to convert the value to Amps.</td></tr>
<tr><td>402</td><td>Ground Current Percent</td><td>UINT16 RO
Units: Scaled Amps</td><td>Ground current percent of trip threshold
Ground current percent of trip threshold</td></tr>
<tr><td>403</td><td>GFM CT Diagnostic Status</td><td>UINT8 RO
Enum</td><td>CT input connection diagnostic status passed to BCM: Disabled, OK, High-Z, Low-Z. GFM CT connection diagnostic status.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>GFM CT connection diagnostics are disabled</td></tr>
<tr><td>1</td><td>GFM CT connection status is good</td></tr>
<tr><td>2</td><td>GFM CT connection status is open</td></tr>
<tr><td>3</td><td>GFM CT connection status is shorted</td></tr>
<tr><td>255</td><td>GFM CT calibration is missing</td></tr>
</table></td></tr>
<tr><td>500</td><td>FLA Active Motor Scaled</td><td>UINT16 RO
Default: 101 (RW)
Range: 1 to 65535 (RW)
Units: scaled A</td><td>Active Overload FLA (Nominal Current) Scaled is a read only parameter indicating the active FLA. For example, if the application has two windings (and two FLA settings), this parameter will indicate the currently active motor winding setting. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>501</td><td>Rated Speed RPM Active</td><td>UINT16 RO
Default: 1750
Range: 300 to 3600
Units: RPM</td><td>RPM nameplate rating of the active motor winding.</td></tr>
<tr><td>502</td><td>Rated HP Active Scaled</td><td>UINT32 RO
Units: HPx100</td><td>HP nameplate rating of the active motor winding. This value is scaled by 0.01. For example if the motor is rated at 123.25 HP then this parameter should contain 12325.</td></tr>
<tr><td>504</td><td>Rated Watts Active</td><td>UINT32 RO
Default: 14914
Range: 10 to 3728500
Units: W</td><td>Watts nameplate rating of the active motor winding.</td></tr>
<tr><td>506</td><td>Active Control Source</td><td>UINT8 RO
Enum</td><td>The control source that is currently active: User Interface, Fieldbus or Fieldwire
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No active control source</td></tr>
<tr><td>1</td><td>User Interface is the active control source</td></tr>
<tr><td>2</td><td>FieldBus is the active control source</td></tr>
<tr><td>3</td><td>FieldWire is the active control source</td></tr>
<tr><td>4</td><td>User Logic is the active control source</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>600</td><td>Fieldbus Motor Control</td><td>BYTE RW
Bitfield
USB Lock</td><td>Fieldbus Motor Control - Run 1 Command Bit: This bit is Profile dependent. For example, this is the Run bit for a FVNR motor application or the Run FWD bit for a FVR applications. - Run 2 Command Bit: This bit is Profile dependent. For example, this is not used for a FVNR motor application or is the Run REV Run for a FVR applications. - Fault Reset: This resets an active fault if the fault condition is no longer present. - Test Trip: This allows the user to trip the unit for test purposes. Use Fault Reset to reset the test trip condition.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Run1 command bit</td><td>9585</td></tr>
<tr><td>1</td><td>Run2 command bit</td><td>9586</td></tr>
<tr><td>2</td><td>Switch Control To Remote</td><td>9587</td></tr>
<tr><td>3</td><td>Reset fault bit</td><td>9588</td></tr>
<tr><td>4</td><td>Reserved bit</td><td>9589</td></tr>
<tr><td>5</td><td>Test trip the device bit</td><td>9590</td></tr>
</table></td></tr>
<tr><td>601</td><td>Output Control</td><td>BYTE RW
Bitfield</td><td>ON / OFF Control for Available Base Control Module Field Outputs. The Profile type dictates which of these outputs are available as general purpose outputs. For example, Outputs 2 and 3 are available when the Direct profile is selected, while only Output 3 is available when the Reverser Profile is selected. The bits are assigned to specific physical outputs in the Operation Mode category and the parameters are called Output x Function Select.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Bit 0</td><td>9601</td></tr>
<tr><td>1</td><td>Bit 1</td><td>9602</td></tr>
<tr><td>2</td><td>Bit 2</td><td>9603</td></tr>
<tr><td>3</td><td>Bit 3</td><td>9604</td></tr>
</table></td></tr>
<tr><td>602</td><td>Remote Feedback Signal Parameter</td><td>BYTE RW
Bitfield</td><td>This parameter only applies if the Operation mode being used includes digital feedback (Solenoid, MCCB Actuation and Contactor Feeder) and the selection for the Feedback Signal Source Select parameter is “Feedback Signals Provided by Network”. If both of these conditions are met, then this parameter is a read only parameter that allows monitoring the state of the inputs with this software. Inputs 2 and 3 indicate the following based on the operation mode. Solenoid: Input 2 (bit 1) = Open, Input 3 (bit 2) = Closed Contactor/Feeder: Input 2 (Bit 1) = AUX On MCCB Feeder: Input 2 (Bit 1) = CB On, Input 3 (Bit 2) = CB Alarm
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Network feedback input I1</td><td>9617</td></tr>
<tr><td>1</td><td>Network feedback input I2</td><td>9618</td></tr>
<tr><td>2</td><td>Network feedback input I3</td><td>9619</td></tr>
<tr><td>3</td><td>Network feedback input I4</td><td>9620</td></tr>
<tr><td>4</td><td>Network feedback input I5</td><td>9621</td></tr>
<tr><td>5</td><td>Network feedback input I6</td><td>9622</td></tr>
<tr><td>6</td><td>Network feedback input I7</td><td>9623</td></tr>
<tr><td>7</td><td>Network feedback input I8</td><td>9624</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>603</td><td>System Services</td><td>UINT8 RW
Enum</td><td>System services are used to execute device level commands. The command is automatically cleared after being processed.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Active Service</td></tr>
<tr><td>1</td><td>Clear fault queue</td></tr>
<tr><td>2</td><td>Clear trip snapshot</td></tr>
<tr><td>3</td><td>Test trip</td></tr>
<tr><td>4</td><td>Re-pair external modules</td></tr>
<tr><td>5</td><td>Factory reset</td></tr>
<tr><td>6</td><td>Soft reset</td></tr>
<tr><td>7</td><td>Reset Fault</td></tr>
<tr><td>8</td><td>Proof Test</td></tr>
</table></td></tr>
<tr><td>700</td><td>Active Operation Mode</td><td>UINT8 RW NV
Default: 1
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Active Operation Mode is a read/write parameter used to configure the C445 for the application mode. - Overload Only uses Output 1 as a fault contact. The output is closed when the unit is powered and no fault is present. It opens on a fault. - Direct is FVNR Motor Control and uses Output 1. - Reverser is FVR Motor Control and uses Outputs 1 and 2. - Star/Delta or Wye/Delta applications use all three Base Control Module Outputs. - Two Speed Poll Changing is for Fast/Slow Motor Control applications and uses Outputs 1 and 2. - Two Speed Dahlander is for Slow/Fast Variable Torque Motor Control Applications. All 3 outputs are used. - HMCP/MCCP Actuation is for feeder breakers - Contactor Feeder is for controlling a contactor feeder with Output 1 - Solenoid Valve is for Solenoid Valve Motor Control Applications and uses Output 1. - Auto Transformer is for starting a motor at the voltage reduced by the transformer, with a correspondingly smaller current and uses all 3 Outputs.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Overload only</td></tr>
<tr><td>1</td><td>Direct online</td></tr>
<tr><td>2</td><td>Reverser</td></tr>
<tr><td>3</td><td>Star/Delta</td></tr>
<tr><td>4</td><td>Two speed pole changing</td></tr>
<tr><td>5</td><td>Two speed Dahlander</td></tr>
<tr><td>6</td><td>Auto transformer</td></tr>
<tr><td>7</td><td>Solenoid valve</td></tr>
<tr><td>8</td><td>HMCP/MCCP actuation</td></tr>
<tr><td>9</td><td>Contactor feeder</td></tr>
<tr><td>10</td><td>General purpose input / output</td></tr>
<tr><td>11</td><td>Standalone GF Module</td></tr>
</table></td></tr>
<tr><td>701</td><td>Contactor Fault Delay</td><td>UINT16 RW NV
Default: 0
Range: 0 to 2000
Units: 10ms
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Delay Before a “Contactor Failure” Fault is Issued after a change of control state. For example, if the user commands C445 to run the motor but no current is seen by the device, it indicates the contactor did not close as commanded. This is meant as a delay in case the Fault clears itself a short time after a change of control state. A value of 0 will disable the contactor failure fault mode and this fault will never occur regardless of whether the current detected matches the state being commanded by C445.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
702	Control Interlocking Time	UINT16 RW NV Default: 10 Range: 0 to 60000 Units: 10ms Config CRC Run Lock Admin Lock USB Lock Backup Mem	Time delay between “forward to reverse” or “reverse to forward” direction change (in 0.1sec). Used in the Reverser operation mode.
703	Control Switching Time	UINT16 RW NV Default: 10 Range: 0 to 60000 Units: 10ms Config CRC Run Lock Admin Lock USB Lock Backup Mem	Time delay between switching from fast to slow which allows the motor time to slow down. (in 0.1sec). Used in operation modes with two speeds.
704	Network contactor delay	UINT16 RW NV Default: 5 Range: 0 to 2000 Units: 10ms	Settling time for network contactor before RUN contactor engages (in 10ms). Used with the Star/Delta operation mode.
705	Max Star Winding Time	UINT16 RW NV Default: 100 Range: 1 to 6000 Units: 100ms Config CRC Run Lock Admin Lock USB Lock Backup Mem	Parameters used in Star/Delta Operation Mode.The time after which the controller will transition to delta wiring when “up to speed” is NOT detected in the star winding
706	Enable HMCP Actuation	BOOL RW NV Default: 0 Config CRC Run Lock Admin Lock USB Lock Backup Mem	Enable HMCP Actuation Control when using the MCCB Feeder Operation Mode. This allows the C445 Outputs 1 and 2 to turn the Circuit Breaker On and Off.
707	HMCP Actuation Pulse Width	UINT16 RW NV Default: 500 Range: 100 to 60000 Units: ms Config CRC Run Lock Admin Lock USB Lock Backup Mem	HMCP actuation pulse width or length of on-time to trigger motor operator (in 1.0 ms).
708	Solenoid Open Delay Time	UINT16 RW NV Default: 0 Units: 10ms Config CRC Admin Lock USB Lock Backup Mem	Delay time for solenoid valve to open (in 10ms). Used in Solenoid Valve operation mode.

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>709</td><td>Solenoid Close Delay Time</td><td>UINT16 RW NV
Default: 0
Units: 10ms
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Delay time for solenoid valve to close (in 10ms). Used in Solenoid Valve operation mode.</td></tr>
<tr><td>710</td><td>Solenoid Normal State</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Non energized state of solenoid valve. Used in Solenoid Valve operation mode.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Solenoid Valve normally closed - energize to open</td></tr>
<tr><td>1</td><td>Solenoid Valve normally open - energize to close</td></tr>
</table></td></tr>
<tr><td>711</td><td>Local Control Source</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Allows the user to select the local source of control. The default if a User Interface is included is “Auto Detect User Interface”. Other choices are no local control and fieldwire control.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Auto detect User Interface</td></tr>
<tr><td>1</td><td>No local control</td></tr>
<tr><td>2</td><td>User Interface local control</td></tr>
<tr><td>3</td><td>Fieldwire local control</td></tr>
</table></td></tr>
<tr><td>712</td><td>Remote Control Source</td><td>UINT8 RW NV
Default: 1
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Remote Control Source Select. Selects the control source when in “Auto” mode.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No remote control source</td></tr>
<tr><td>1</td><td>Fieldbus is remote control source</td></tr>
<tr><td>2</td><td>Fieldwire is remote control source</td></tr>
<tr><td>3</td><td>User Logic is the remote control source</td></tr>
</table></td></tr>
<tr><td>713</td><td>Feedback Signal Source Select</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Selects the source of the digital inputs used for the feedback signals for certain operation modes. The operation modes that require digital input feedback are: Solenoid, MCCB Actuation and Contactor Feeder. This parameter allows the user to select where the inputs are wired to the C445. To the Base Control Module, the User Interface or to a controller where they are sent to the C445 via a communication network. For all three locations these input feedback signals may be wired, the actual input or bit is pre-defined for each as follows. Solenoid Operation Mode: 1. Base Control Module: Input 2 (open), Input 3 (closed) 3. Input Register 602 from a controller: Bit 1 (open) and Bit 2 (closed) Contactor Feeder Operation Mode: 1. Base Control Module: Input 2 (AUX On) 3. Input Register 602 from a controller: Bit 1 (AUX On) MCCB Feeder Operation Mode: 1. Base Control Module: Input 2 (CB On), Input 3 (CB Alarm) 3. Input Register 602 from a controller: Bit 1 (CB On), Bit 2 (CB Alarm)
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No feedback signals</td></tr>
<tr><td>1</td><td>Feedback signals connected to User Interface inputs</td></tr>
<tr><td>2</td><td>Feedback signals connected to Base Control Module field wiring inputs</td></tr>
<tr><td>3</td><td>Feedback signals provided by network</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>714</td><td>Local/Remote PowerUp Behavior</td><td>UINT8 RW NV
Default: 2
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Select the Local/Remote mode the Base Control Module will power up in. Selections: 0: Local control is active control on power up, 1: Remote control is active control on power up, 2: Hold last control state on power up.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Local control is active control on power-up</td></tr>
<tr><td>1</td><td>Remote control is active control on power-up</td></tr>
<tr><td>2</td><td>Hold last control state on power-up</td></tr>
</table></td></tr>
<tr><td>715</td><td>Q1 Function Select</td><td>UINT16 RW NV
Default: 54
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Output Function Select for General Purpose Output 1. Available when this output is not used by the Operation Mode. Default = none, If used by the Application Mode = Reserved. A soft reset is required after modifying this parameter.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>None</td></tr>
<tr><td>1</td><td>Fault Reason Type - Load fault (Power based)</td></tr>
<tr><td>2</td><td>Fault Reason Type - Supply fault (Voltage based)</td></tr>
<tr><td>3</td><td>Fault Reason Type - Motor fault (Current based)</td></tr>
<tr><td>4</td><td>Tripped Status Bits - PTC</td></tr>
<tr><td>5</td><td>Tripped Status Bits - Phase rotation mismatch</td></tr>
<tr><td>6</td><td>Tripped Status Bits - Stall</td></tr>
<tr><td>7</td><td>Tripped Status Bits - Overload</td></tr>
<tr><td>8</td><td>Tripped Status Bits - Starts limit exceeded</td></tr>
<tr><td>9</td><td>Tripped Status Bits - Low power</td></tr>
<tr><td>10</td><td>Tripped Status Bits - High power</td></tr>
<tr><td>11</td><td>Tripped Status Bits - Under current</td></tr>
<tr><td>12</td><td>Tripped Status Bits - Frequency deviation slow</td></tr>
<tr><td>13</td><td>Tripped Status Bits - Frequency deviation fast</td></tr>
<tr><td>14</td><td>Tripped Status Bits - Voltage unbalance</td></tr>
<tr><td>15</td><td>Tripped Status Bits - Voltage phase loss</td></tr>
<tr><td>16</td><td>Tripped Status Bits - Power factor deviation</td></tr>
<tr><td>17</td><td>Tripped Status Bits - Jam</td></tr>
<tr><td>18</td><td>Tripped Status Bits - Instantaneous over current</td></tr>
<tr><td>19</td><td>Tripped Status Bits - Current unbalance</td></tr>
<tr><td>20</td><td>Tripped Status Bits - Current phase loss</td></tr>
<tr><td>21</td><td>Tripped Status Bits - Ground fault</td></tr>
<tr><td>22</td><td>Motor Control Status - Motor at speed</td></tr>
<tr><td>23</td><td>Motor Control Status - Ready</td></tr>
<tr><td>24</td><td>Motor Control Status - Inhibited</td></tr>
<tr><td>25</td><td>Motor Control Status - Warning</td></tr>
<tr><td>26</td><td>Motor Control Status - Faulted</td></tr>
<tr><td>27</td><td>Motor Control Status - Remote enabled</td></tr>
<tr><td>28</td><td>Motor Control Status - Running 2</td></tr>
<tr><td>29</td><td>Motor Control Status - Running 1</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
715	Q1 Function Select	UINT16 RW NV Default: 54 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Output Function Select for General Purpose Output 1. Available when this output is not used by the Operation Mode. Default = none, If used by the Application Mode = Reserved. A soft reset is required after modifying this parameter, continued.

Value	Description
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast
40	Warning Status Bits - Voltage unbalance
41	Warning Status Bits - Voltage phase loss
42	Warning Status Bits - Power factor deviation
43	Warning Status Bits - Jam
44	Warning Status Bits - Instantaneous over current
45	Warning Status Bits - Current unbalance
46	Warning Status Bits - Current phase loss
47	Warning Status Bits - Ground current
48	Warning Status Bits - Reserved
49	Warning Status Bits - Over voltage
50	Warning Status Bits - Under voltage
51	Tripped Status Bits - Under voltage
52	Tripped Status Bits - Over voltage
53	Tripped Status Bits - Reserved
54	Base Control Module Field Output control word - Bit 0
55	Base Control Module Field Output control word - Bit 1
56	Base Control Module Field Output control word - Bit 2
57	Base Control Module Field Output control word - Bit 3
58	Shunt trip output bit - Shunt trip output bit
59	Warning Reason - HRGF pulse detection
60	Warning Reason - Peak demand
61	Digital Input Status - Base Control Module Input I4
62	Digital Input Status - Base Control Module Input I3
63	Digital Input Status - Base Control Module Input I2
64	Digital Input Status - Base Control Module Input I1
65	Fail Safe - Ground current fault
65535	Reserved

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
716	Q2 Function Select	UINT16 RW NV Default: 55 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Output Function Select for General Purpose Output 2. Available when this output is not used by the Operation Mode. Default = none, If used by the Application Mode = Reserved. A soft reset is required after modifying this parameter.

Value	Description
0	None
1	Fault Reason Type - Load fault (Power based)
2	Fault Reason Type - Supply fault (Voltage based)
3	Fault Reason Type - Motor fault (Current based)
4	Tripped Status Bits - PTC
5	Tripped Status Bits - Phase rotation mismatch
6	Tripped Status Bits - Stall
7	Tripped Status Bits - Overload
8	Tripped Status Bits - Starts limit exceeded
9	Tripped Status Bits - Low power
10	Tripped Status Bits - High power
11	Tripped Status Bits - Under current
12	Tripped Status Bits - Frequency deviation slow
13	Tripped Status Bits - Frequency deviation fast
14	Tripped Status Bits - Voltage unbalance
15	Tripped Status Bits - Voltage phase loss
16	Tripped Status Bits - Power factor deviation
17	Tripped Status Bits - Jam
18	Tripped Status Bits - Instantaneous over current
19	Tripped Status Bits - Current unbalance
20	Tripped Status Bits - Current phase loss
21	Tripped Status Bits - Ground current
22	Motor Control Status - Motor at speed
23	Motor Control Status - Ready
24	Motor Control Status - Inhibited
25	Motor Control Status - Warning
26	Motor Control Status - Faulted
27	Motor Control Status - Remote enabled
28	Motor Control Status - Running 2
29	Motor Control Status - Running 1
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
716	Q2 Function Select	UINT16 RW NV Default: 55 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Output Function Select for General Purpose Output 2. Available when this output is not used by the Operation Mode. Default = none, If used by the Application Mode = Reserved. A soft reset is required after modifying this parameter, continued.

Value	Description
40	Warning Status Bits - Voltage unbalance
41	Warning Status Bits - Voltage phase loss
42	Warning Status Bits - Power factor deviation
43	Warning Status Bits - Jam
44	Warning Status Bits - Instantaneous over current
45	Warning Status Bits - Current unbalance
46	Warning Status Bits - Current phase loss
47	Warning Status Bits - Ground current
48	Warning Status Bits - Reserved
49	Warning Status Bits - Over voltage
50	Warning Status Bits - Under voltage
51	Tripped Status Bits - Under voltage
52	Tripped Status Bits - Over voltage
53	Tripped Status Bits - Reserved
54	Base Control Module Field Output control word - Bit 0
55	Base Control Module Field Output control word - Bit 1
56	Base Control Module Field Output control word - Bit 2
57	Base Control Module Field Output control word - Bit 3
58	Shunt trip output bit - Shunt trip output bit
59	Warning Reason - HRGF pulse detection
60	Warning Reason - Peak demand
61	Digital Input Status - Base Control Module Input I4
62	Digital Input Status - Base Control Module Input I3
63	Digital Input Status - Base Control Module Input I2
64	Digital Input Status - Base Control Module Input I1
65	Fail Safe - Ground current fault
65535	Reserved

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
717	Q3 Function Select	UINT16 RW NV Default: 56 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Output Function Select for General Purpose Output 3. Available when this output is not used by the Operation Mode. Default = none, If used by the Application Mode = Reserved. (For non-latching relay, 0 = de-energized and 1 = energized. For latching relay, 0 = no change and 1 = set). A soft reset is required after modifying this parameter.

Value	Description
0	None
1	Fault Reason Type - Load fault (Power based)
2	Fault Reason Type - Supply fault (Voltage based)
3	Fault Reason Type - Motor fault (Current based)
4	Tripped Status Bits - PTC
5	Tripped Status Bits - Phase rotation mismatch
6	Tripped Status Bits - Stall
7	Tripped Status Bits - Overload
8	Tripped Status Bits - Starts limit exceeded
9	Tripped Status Bits - Low power
10	Tripped Status Bits - High power
11	Tripped Status Bits - Under current
12	Tripped Status Bits - Frequency deviation slow
13	Tripped Status Bits - Frequency deviation fast
14	Tripped Status Bits - Voltage unbalance
15	Tripped Status Bits - Voltage phase loss
16	Tripped Status Bits - Power factor deviation
17	Tripped Status Bits - Jam
18	Tripped Status Bits - Instantaneous over current
19	Tripped Status Bits - Current unbalance
20	Tripped Status Bits - Current phase loss
21	Tripped Status Bits - Ground current
22	Motor Control Status - Motor at speed
23	Motor Control Status - Ready
24	Motor Control Status - Inhibited
25	Motor Control Status - Warning
26	Motor Control Status - Faulted
27	Motor Control Status - Remote enabled
28	Motor Control Status - Running 2
29	Motor Control Status - Running 1
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
717	Q3 Function Select	UINT16 RW NV Default: 56 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Output Function Select for General Purpose Output 3. Available when this output is not used by the Operation Mode. Default = none, If used by the Application Mode = Reserved. (For non-latching relay, 0 = de-energized and 1 = energized. For latching relay, 0 = no change and 1 = set). A soft reset is required after modifying this parameter, continued.

Value	Description
40	Warning Status Bits - Voltage unbalance
41	Warning Status Bits - Voltage phase loss
42	Warning Status Bits - Power factor deviation
43	Warning Status Bits - Jam
44	Warning Status Bits - Instantaneous over current
45	Warning Status Bits - Current unbalance
46	Warning Status Bits - Current phase loss
47	Warning Status Bits - Ground current
48	Warning Status Bits - Reserved
49	Warning Status Bits - Over voltage
50	Warning Status Bits - Under voltage
51	Tripped Status Bits - Under voltage
52	Tripped Status Bits - Over voltage
53	Tripped Status Bits - Reserved
54	Base Control Module Field Output control word - Bit 0
55	Base Control Module Field Output control word - Bit 1
56	Base Control Module Field Output control word - Bit 2
57	Base Control Module Field Output control word - Bit 3
58	Shunt trip output bit - Shunt trip output bit
59	Warning Reason - HRGF pulse detection
60	Warning Reason - Peak demand
61	Digital Input Status - Base Control Module Input I4
62	Digital Input Status - Base Control Module Input I3
63	Digital Input Status - Base Control Module Input I2
64	Digital Input Status - Base Control Module Input I1
65	Fail Safe - Ground current fault
65535	Reserved

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
718	Q3 Latch Reset	UINT16 RW NV Default: 57 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Output Reset Function Select for General Purpose Output 3. Available when this output is not used by the Operation Mode and only when Output 3 is a latching relay. Default = none, If used by the Application Mode = Reserved. (For latching relay, 0 = no change and 1 = reset). A soft reset is required after modifying this parameter.

Value	Description
0	None
1	Fault Reason Type - Load fault (Power based)
2	Fault Reason Type - Supply fault (Voltage based)
3	Fault Reason Type - Motor fault (Current based)
4	Tripped Status Bits - PTC
5	Tripped Status Bits - Phase rotation mismatch
6	Tripped Status Bits - Stall
7	Tripped Status Bits - Overload
8	Tripped Status Bits - Starts limit exceeded
9	Tripped Status Bits - Low power
10	Tripped Status Bits - High power
11	Tripped Status Bits - Under current
12	Tripped Status Bits - Frequency deviation slow
13	Tripped Status Bits - Frequency deviation fast
14	Tripped Status Bits - Voltage unbalance
15	Tripped Status Bits - Voltage phase loss
16	Tripped Status Bits - Power factor deviation
17	Tripped Status Bits - Jam
18	Tripped Status Bits - Instantaneous over current
19	Tripped Status Bits - Current unbalance
20	Tripped Status Bits - Current phase loss
21	Tripped Status Bits - Ground current
22	Motor Control Status - Motor at speed
23	Motor Control Status - Ready
24	Motor Control Status - Inhibited
25	Motor Control Status - Warning
26	Motor Control Status - Faulted
27	Motor Control Status - Remote enabled
28	Motor Control Status - Running 2
29	Motor Control Status - Running 1
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>718</td><td>Q3 Latch Reset</td><td>UINT16 RW NV
Default: 57
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Output Reset Function Select for General Purpose Output 3. Available when this output is not used by the Operation Mode and only when Output 3 is a latching relay. Default = none, If used by the Application Mode = Reserved. (For latching relay, 0 = no change and 1 = reset). A soft reset is required after modifying this parameter, continued.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>40</td><td>Warning Status Bits - Voltage unbalance</td></tr>
<tr><td>41</td><td>Warning Status Bits - Voltage phase loss</td></tr>
<tr><td>42</td><td>Warning Status Bits - Power factor deviation</td></tr>
<tr><td>43</td><td>Warning Status Bits - Jam</td></tr>
<tr><td>44</td><td>Warning Status Bits - Instantaneous over current</td></tr>
<tr><td>45</td><td>Warning Status Bits - Current unbalance</td></tr>
<tr><td>46</td><td>Warning Status Bits - Current phase loss</td></tr>
<tr><td>47</td><td>Warning Status Bits - Ground current</td></tr>
<tr><td>48</td><td>Warning Status Bits - Reserved</td></tr>
<tr><td>49</td><td>Warning Status Bits - Over voltage</td></tr>
<tr><td>50</td><td>Warning Status Bits - Under voltage</td></tr>
<tr><td>51</td><td>Tripped Status Bits - Under voltage</td></tr>
<tr><td>52</td><td>Tripped Status Bits - Over voltage</td></tr>
<tr><td>53</td><td>Tripped Status Bits - Reserved</td></tr>
<tr><td>54</td><td>Base Control Module Field Output control word - Bit 0</td></tr>
<tr><td>55</td><td>Base Control Module Field Output control word - Bit 1</td></tr>
<tr><td>56</td><td>Base Control Module Field Output control word - Bit 2</td></tr>
<tr><td>57</td><td>Base Control Module Field Output control word - Bit 3</td></tr>
<tr><td>58</td><td>Shunt trip output bit - Shunt trip output bit</td></tr>
<tr><td>59</td><td>Warning Reason - HRGF pulse detection</td></tr>
<tr><td>60</td><td>Warning Reason - Peak demand</td></tr>
<tr><td>61</td><td>Digital Input Status - Base Control Module Input I4</td></tr>
<tr><td>62</td><td>Digital Input Status - Base Control Module Input I3</td></tr>
<tr><td>63</td><td>Digital Input Status - Base Control Module Input I2</td></tr>
<tr><td>64</td><td>Digital Input Status - Base Control Module Input I1</td></tr>
<tr><td>65</td><td>Fail Safe - Ground current fault</td></tr>
<tr><td>65535</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>719</td><td>Q3 Latch Behavior</td><td>UINT8 RW NV
Default: 1
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>If the Base Control Module is ordered with a latching relay for Output 3, the behavior of this output may be selected here as either a latching relay or non-latching relay functionality.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Behave like a non-latching relay</td></tr>
<tr><td>1</td><td>Behave like a latching relay</td></tr>
</table></td></tr>
<tr><td>720</td><td>Communication Loss Behavior</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Defines the behavior of the motor control when communication times out.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Stop (clear Run1/Run2) on communication loss event - no fault</td></tr>
<tr><td>1</td><td>Ignore communication loss and keep present state</td></tr>
<tr><td>2</td><td>Set network motor control Run1 on comloss event</td></tr>
<tr><td>3</td><td>Set network motor control Run2 on comloss event</td></tr>
<tr><td>4</td><td>Stop (clear Run1/Run2) on communication loss event and generate fault</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>721</td><td>Comm Idle Behavior</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Select the state for the motor when the network system controller is in communication idle mode (program mode for most PLCs and DCS controllers).
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Stop on idle event</td></tr>
<tr><td>1</td><td>Ignore idle and keep present state</td></tr>
<tr><td>2</td><td>Send RUN1 command on idle event</td></tr>
<tr><td>3</td><td>Send RUN2 command on idle event</td></tr>
</table></td></tr>
<tr><td>722</td><td>Comm Fault Output Action</td><td>BYTE RW NV
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>When a communication fault occurs the relays can execute two types of behavior. The behavior is selected on a per bit basis. Only valid for output relays used as general purpose field outputs. See Communication Loss Behavior parameter to set the behavior of outputs used in the control profile. Each available output is assigned a bit in the Comm Fault Output Action word. If the bit is “0” then the state of the output is determined by the (Comm Fault Output State) Parameter. If the bit is “1” it will hold last state.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Communication loss action for Field Output Control Word. Bit 0: (0) Use fault state
(1) Hold Last</td><td>11537</td></tr>
<tr><td>1</td><td>Communication loss action for Field Output Control Word. Bit 1: (0) Use fault state
(1) Hold Last</td><td>11538</td></tr>
<tr><td>2</td><td>Communication loss action for Field Output Control Word. Bit 2: (0) Use fault state
(1) Hold Last</td><td>11539</td></tr>
<tr><td>3</td><td>Communication loss action for Field Output Control Word. Bit 3: (0) Use fault state
(1) Hold Last</td><td>11540</td></tr>
</table></td></tr>
<tr><td>723</td><td>Comm Fault Output State</td><td>BYTE RW NV
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>This parameters works with the Comm Fault Output Action parameter. Only if that parameter is set to Use Fault State does this parameter apply. This parameter then selects the state of the outputs, On or Off when a communication fault occurs. The behavior is selected on a per bit basis. Only valid for output relays used as general purpose field outputs.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Communication loss action for Field Output Control Word. Bit 0: (0)Off (1)On</td><td>11553</td></tr>
<tr><td>1</td><td>Communication loss action for Field Output Control Word. Bit 1: (0)Off (1)On</td><td>11554</td></tr>
<tr><td>2</td><td>Communication loss action for Field Output Control Word. Bit 2: (0)Off (1)On</td><td>11555</td></tr>
<tr><td>3</td><td>Communication loss action for Field Output Control Word. Bit 3: (0)Off (1)On</td><td>11556</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>724</td><td>Comm Idle Output Action</td><td>BYTE RW NV
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>When a communication idle state occurs the relays can execute two types of behavior. Only valid for output relays used as general purpose field outputs. The behavior is selected on a per bit basis. See the Comm Idle Behavior parameter to set the behavior of outputs used in the control profile. Each available output is assigned a bit in the Comm Idle Output Action word. If the bit is “0” then the state of the output is determined by the (Comm Idle Output State) Parameter. If the bit is “1” it will hold last state.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Communication idle action for Field Output Control Word. Bit 0: (0) Use idle state (1) Hold Last</td><td>11569</td></tr>
<tr><td>1</td><td>Communication idle action for Field Output Control Word. Bit 1: (0) Use idle state (1) Hold Last</td><td>11570</td></tr>
<tr><td>2</td><td>Communication idle action for Field Output Control Word. Bit 2: (0) Use idle state (1) Hold Last</td><td>11571</td></tr>
<tr><td>3</td><td>Communication idle action for Field Output Control Word. Bit 3: (0) Use idle state (1) Hold Last</td><td>11572</td></tr>
</table></td></tr>
<tr><td>725</td><td>Comm Idle Output State</td><td>BYTE RW NV
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>This parameters works with the Comm Idle Output Action parameter. Only if that parameter is set to “Use Idle State” does this parameter apply. This parameter then selects the state of the outputs, On or Off when a communication Idle occurs. The behavior is selected on a per bit basis. Only valid for output relays used as general purpose field outputs.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Communication idle state for Field Output Control Word. Bit 0: (0) Off (1) On</td><td>11585</td></tr>
<tr><td>1</td><td>Communication idle state for Field Output Control Word. Bit 1: (0) Off (1) On</td><td>11586</td></tr>
<tr><td>2</td><td>Communication idle state for Field Output Control Word. Bit 2: (0) Off (1) On</td><td>11587</td></tr>
<tr><td>3</td><td>Communication idle state for Field Output Control Word. Bit 3: (0) Off (1) On</td><td>11588</td></tr>
</table></td></tr>
<tr><td>726</td><td>Q3 Latch Behavior Power Down</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Select the behavior of the Latching Relay (Output 3) when power is removed from the C445, provided the Base Control Module was ordered with the latching relay option. Default: Turn Off, emulating a non-latching relay.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Turn off (emulate a non-latching relay [reset]) (default)</td></tr>
<tr><td>1</td><td>Turn on (set)</td></tr>
<tr><td>2</td><td>Do nothing (maintain present state)</td></tr>
<tr><td>3</td><td>Toggle</td></tr>
</table></td></tr>
<tr><td>727</td><td>Phase Type</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Three-phase configuration is the default and is used for 3-phase motors. The C445 also supports single phase motors by changing this setting to Single Phase.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Three phase wire configuration</td></tr>
<tr><td>1</td><td>Single phase wire configuration (two wire)</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
728	2-Wire/3-Wire	UINT8 RW NV Default: 0 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	Selects 2 or 3 wire control. When 2-Wire Control is used, the fieldwire inputs are designed to a run signal. If a signal is present at the run input, it will command to run while if no signal is present, it will stop or not run. When 3-Wire control is Used, a second fieldwire input is designated to accept a Run input and a Permissive input. When in fieldwire control, the motor will not be allowed to run if the Permissive signal is not present. Additionally, if the permissive is removed while running, the motor will stop. The Run input in 3-Wire Control can accept a maintained or pulsed run command. Value / Description: 0 — Two wire field wiring configuration 1 — Three wire field wiring configuration
729	Digital Input Debounce	UINT16 RW NV Array size: 4 Default: 20 Range: 5 to 5000 Units: ms Backup Mem	Digital Input Debounce. One 16-bit value for each of the 4 inputs on the Base Control Module. The same value is used for both rising and falling edges. Array of 4 registers
733	LED Brightness Bank 0	INTERNAL UINT8 RW NV Default: 0 Enum Units: % Backup Mem	LED Brightness Configuration Bank 0 Value / Description: 0 — High LED brightness 1 — Medium LED brightness 2 — Low LED brightness
734	LED Brightness Bank 1	INTERNAL UINT8 RW NV Default: 0 Enum Units: % Backup Mem	LED Brightness Configuration Bank 1 Value / Description: 0 — High LED brightness 1 — Medium LED brightness 2 — Low LED brightness
735	LED Brightness Bank 2	INTERNAL UINT8 RW NV Default: 0 Enum Units: % Backup Mem	LED Brightness Configuration Bank 2 Value / Description: 0 — High LED brightness 1 — Medium LED brightness 2 — Low LED brightness
736	LED Brightness Bank 3	INTERNAL UINT8 RW NV Default: 0 Enum Units: % Backup Mem	LED Brightness Configuration Bank 3 Value / Description: 0 — High LED brightness 1 — Medium LED brightness 2 — Low LED brightness

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>737</td><td>Control User Interface Button LED 1 Purpose</td><td>UINT16 RW NV
Default: 1
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button LED 1. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No LED function</td></tr>
<tr><td>1</td><td>Stop LED function</td></tr>
<tr><td>2</td><td>Auto LED function</td></tr>
<tr><td>3</td><td>Run1 LED function</td></tr>
<tr><td>4</td><td>Run2 LED function</td></tr>
<tr><td>5</td><td>Reset LED function</td></tr>
</table></td></tr>
<tr><td>738</td><td>Control User Interface Button LED 2 Purpose</td><td>UINT16 RW NV
Default: 2
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button LED 2. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No LED function</td></tr>
<tr><td>1</td><td>Stop LED function</td></tr>
<tr><td>2</td><td>Auto LED function</td></tr>
<tr><td>3</td><td>Run1 LED function</td></tr>
<tr><td>4</td><td>Run2 LED function</td></tr>
<tr><td>5</td><td>Reset LED function</td></tr>
</table></td></tr>
<tr><td>739</td><td>Control User Interface Button LED 3 Purpose</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button LED 3. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No LED function</td></tr>
<tr><td>1</td><td>Stop LED function</td></tr>
<tr><td>2</td><td>Auto LED function</td></tr>
<tr><td>3</td><td>Run1 LED function</td></tr>
<tr><td>4</td><td>Run2 LED function</td></tr>
<tr><td>5</td><td>Reset LED function</td></tr>
</table></td></tr>
<tr><td>740</td><td>Control User Interface Button LED 4 Purpose</td><td>UINT16 RW NV
Default: 4
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button LED 4. Applies only to C445UC… Control Family of User Interfaces. UINT16 RW NV
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No LED function</td></tr>
<tr><td>1</td><td>Stop LED function</td></tr>
<tr><td>2</td><td>Auto LED function</td></tr>
<tr><td>3</td><td>Run1 LED function</td></tr>
<tr><td>4</td><td>Run2 LED function</td></tr>
<tr><td>5</td><td>Reset LED function</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>741</td><td>Control User Interface Status LED 1 Purpose</td><td>UINT16 RW NV
Default: 6
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface status LED 1. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No status LED function</td></tr>
<tr><td>1</td><td>Fault status LED function</td></tr>
<tr><td>2</td><td>Warning status LED function</td></tr>
<tr><td>3</td><td>Ready status LED function</td></tr>
<tr><td>4</td><td>Up to speed status LED function</td></tr>
<tr><td>5</td><td>Overload fault status LED function</td></tr>
<tr><td>6</td><td>Ground fault status LED function</td></tr>
</table></td></tr>
<tr><td>742</td><td>Control User Interface Status LED 2 Purpose</td><td>UINT16 RW NV
Default: 1
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface status LED 2. Applies only to C445UC… Control Family of User Interfaces. UINT16 RW NV
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No status LED function</td></tr>
<tr><td>1</td><td>Fault status LED function</td></tr>
<tr><td>2</td><td>Warning status LED function</td></tr>
<tr><td>3</td><td>Ready status LED function</td></tr>
<tr><td>4</td><td>Up to speed status LED function</td></tr>
<tr><td>5</td><td>Overload fault status LED function</td></tr>
<tr><td>6</td><td>Ground fault status LED function</td></tr>
</table></td></tr>
<tr><td>743</td><td>Control User Interface Status LED 3 Purpose</td><td>UINT16 RW NV
Default: 2
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface status LED 3. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No status LED function</td></tr>
<tr><td>1</td><td>Fault status LED function</td></tr>
<tr><td>2</td><td>Warning status LED function</td></tr>
<tr><td>3</td><td>Ready status LED function</td></tr>
<tr><td>4</td><td>Up to speed status LED function</td></tr>
<tr><td>5</td><td>Overload fault status LED function</td></tr>
<tr><td>6</td><td>Ground fault status LED function</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
744	Control User Interface User LED 1 Purpose	UINT16 RW NV Default: 2 Enum Config CRC Admin Lock USB Lock Backup Mem	User Interface, User Defined LED 1 Function Selection - Default: Supply Voltage Related Fault. Applies only to C445UC… Control Family of User Interfaces.

Value	Description
0	None
1	Fault Reason Type - Load fault (Power based)
2	Fault Reason Type - Supply fault (Voltage based)
3	Fault Reason Type - Motor fault (Current based)
4	Tripped Status Bits - PTC
5	Tripped Status Bits - Phase rotation mismatch
6	Tripped Status Bits - Stall
7	Tripped Status Bits - Overload
8	Tripped Status Bits - Starts limit exceeded
9	Tripped Status Bits - Low power
10	Tripped Status Bits - High power
11	Tripped Status Bits - Under current
12	Tripped Status Bits - Frequency deviation slow
13	Tripped Status Bits - Frequency deviation fast
14	Tripped Status Bits - Voltage unbalance
15	Tripped Status Bits - Voltage phase loss
16	Tripped Status Bits - Power factor deviation
17	Tripped Status Bits - Jam
18	Tripped Status Bits - Instantaneous over current
19	Tripped Status Bits - Current unbalance
20	Tripped Status Bits - Current phase loss
21	Tripped Status Bits - Ground current
22	Motor Control Status - Motor at speed
23	Motor Control Status - Ready
24	Motor Control Status - Inhibited
25	Motor Control Status - Warning
26	Motor Control Status - Faulted
27	Motor Control Status - Remote enabled
28	Motor Control Status - Running 2
29	Motor Control Status - Running 1
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>744</td><td>Control User Interface User LED 1 Purpose</td><td>UINT16 RW NV
Default: 2 Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface, User Defined LED 1 Function Selection - Default: Supply Voltage Related Fault. Applies only to C445UC… Control Family of User Interfaces, continued.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>40</td><td>Warning Status Bits - Voltage unbalance</td></tr>
<tr><td>41</td><td>Warning Status Bits - Voltage phase loss</td></tr>
<tr><td>42</td><td>Warning Status Bits - Power factor deviation</td></tr>
<tr><td>43</td><td>Warning Status Bits - Jam</td></tr>
<tr><td>44</td><td>Warning Status Bits - Instantaneous over current</td></tr>
<tr><td>45</td><td>Warning Status Bits - Current unbalance</td></tr>
<tr><td>46</td><td>Warning Status Bits - Current phase loss</td></tr>
<tr><td>47</td><td>Warning Status Bits - Ground current</td></tr>
<tr><td>48</td><td>Warning Status Bits - Reserved</td></tr>
<tr><td>49</td><td>Warning Status Bits - Over voltage</td></tr>
<tr><td>50</td><td>Warning Status Bits - Under voltage</td></tr>
<tr><td>51</td><td>Tripped Status Bits - Under voltage</td></tr>
<tr><td>52</td><td>Tripped Status Bits - Over voltage</td></tr>
<tr><td>53</td><td>Tripped Status Bits - Reserved</td></tr>
<tr><td>54</td><td>Base Control Module Field Output control word - Bit 0</td></tr>
<tr><td>55</td><td>Base Control Module Field Output control word - Bit 1</td></tr>
<tr><td>56</td><td>Base Control Module Field Output control word - Bit 2</td></tr>
<tr><td>57</td><td>Base Control Module Field Output control word - Bit 3</td></tr>
<tr><td>58</td><td>Shunt trip output bit - Shunt trip output bit</td></tr>
<tr><td>59</td><td>Warning Reason - HRGF pulse detection</td></tr>
<tr><td>60</td><td>Warning Reason - Peak demand</td></tr>
<tr><td>61</td><td>Digital Input Status - Base Control Module Input I4</td></tr>
<tr><td>62</td><td>Digital Input Status - Base Control Module Input I3</td></tr>
<tr><td>63</td><td>Digital Input Status - Base Control Module Input I2</td></tr>
<tr><td>64</td><td>Digital Input Status - Base Control Module Input I1</td></tr>
<tr><td>65</td><td>Fail Safe - Ground current fault</td></tr>
<tr><td>65535</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>745</td><td>Control User Interface User LED 2 Purpose</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Defined LED 2 Function Selection - Default: Motor Current Related Fault. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>None</td></tr>
<tr><td>1</td><td>Fault Reason Type - Load fault (Power based)</td></tr>
<tr><td>2</td><td>Fault Reason Type - Supply fault (Voltage based)</td></tr>
<tr><td>3</td><td>Fault Reason Type - Motor fault (Current based)</td></tr>
<tr><td>4</td><td>Tripped Status Bits - PTC</td></tr>
<tr><td>5</td><td>Tripped Status Bits - Phase rotation mismatch</td></tr>
<tr><td>6</td><td>Tripped Status Bits - Stall</td></tr>
<tr><td>7</td><td>Tripped Status Bits - Overload</td></tr>
<tr><td>8</td><td>Tripped Status Bits - Starts limit exceeded</td></tr>
<tr><td>9</td><td>Tripped Status Bits - Low power</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
745	Control User Interface User LED 2 Purpose	UINT16 RW NV Default: 3 Enum Config CRC Admin Lock USB Lock Backup Mem	User Defined LED 2 Function Selection - Default: Motor Current Related Fault. Applies only to C445UC… Control Family of User Interfaces, continued.

Value	Description
10	Tripped Status Bits - High power
11	Tripped Status Bits - Under current
12	Tripped Status Bits - Frequency deviation slow
13	Tripped Status Bits - Frequency deviation fast
14	Tripped Status Bits - Voltage unbalance
15	Tripped Status Bits - Voltage phase loss
16	Tripped Status Bits - Power factor deviation
17	Tripped Status Bits - Jam
18	Tripped Status Bits - Instantaneous over current
19	Tripped Status Bits - Current unbalance
20	Tripped Status Bits - Current phase loss
21	Tripped Status Bits - Ground current
22	Motor Control Status - Motor at speed
23	Motor Control Status - Ready
24	Motor Control Status - Inhibited
25	Motor Control Status - Warning
26	Motor Control Status - Faulted
27	Motor Control Status - Remote enabled
28	Motor Control Status - Running 2
29	Motor Control Status - Running 1
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast
40	Warning Status Bits - Voltage unbalance
41	Warning Status Bits - Voltage phase loss
42	Warning Status Bits - Power factor deviation
43	Warning Status Bits - Jam
44	Warning Status Bits - Instantaneous over current
45	Warning Status Bits - Current unbalance
46	Warning Status Bits - Current phase loss
47	Warning Status Bits - Ground current
48	Warning Status Bits - Reserved
49	Warning Status Bits - Over voltage
50	Warning Status Bits - Under voltage
51	Tripped Status Bits - Under voltage

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>745</td><td>Control User Interface User LED 2 Purpose</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Defined LED 2 Function Selection - Default: Motor Current Related Fault. Applies only to C445UC… Control Family of User Interfaces, continued.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>52</td><td>Tripped Status Bits - Over voltage</td></tr>
<tr><td>53</td><td>Tripped Status Bits - Reserved</td></tr>
<tr><td>54</td><td>Base Control Module Field Output control word - Bit 0</td></tr>
<tr><td>55</td><td>Base Control Module Field Output control word - Bit 1</td></tr>
<tr><td>56</td><td>Base Control Module Field Output control word - Bit 2</td></tr>
<tr><td>57</td><td>Base Control Module Field Output control word - Bit 3</td></tr>
<tr><td>58</td><td>Shunt trip output bit - Shunt trip output bit</td></tr>
<tr><td>59</td><td>Warning Reason - HRGF pulse detection</td></tr>
<tr><td>60</td><td>Warning Reason - Peak demand</td></tr>
<tr><td>61</td><td>Digital Input Status - Base Control Module Input I4</td></tr>
<tr><td>62</td><td>Digital Input Status - Base Control Module Input I3</td></tr>
<tr><td>63</td><td>Digital Input Status - Base Control Module Input I2</td></tr>
<tr><td>64</td><td>Digital Input Status - Base Control Module Input I1</td></tr>
<tr><td>65</td><td>Fail Safe - Ground current fault</td></tr>
<tr><td>65535</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>746</td><td>Control User Interface User LED 3 Purpose</td><td>UINT16 RW NV
Default: 1 Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Defined LED 3 Function Selection - Default: Power Related Fault. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>None</td></tr>
<tr><td>1</td><td>Fault Reason Type - Load fault (Power based)</td></tr>
<tr><td>2</td><td>Fault Reason Type - Supply fault (Voltage based)</td></tr>
<tr><td>3</td><td>Fault Reason Type - Motor fault (Current based)</td></tr>
<tr><td>4</td><td>Tripped Status Bits - PTC</td></tr>
<tr><td>5</td><td>Tripped Status Bits - Phase rotation mismatch</td></tr>
<tr><td>6</td><td>Tripped Status Bits - Stall</td></tr>
<tr><td>7</td><td>Tripped Status Bits - Overload</td></tr>
<tr><td>8</td><td>Tripped Status Bits - Starts limit exceeded</td></tr>
<tr><td>9</td><td>Tripped Status Bits - Low power</td></tr>
<tr><td>10</td><td>Tripped Status Bits - High power</td></tr>
<tr><td>11</td><td>Tripped Status Bits - Under current</td></tr>
<tr><td>12</td><td>Tripped Status Bits - Frequency deviation slow</td></tr>
<tr><td>13</td><td>Tripped Status Bits - Frequency deviation fast</td></tr>
<tr><td>14</td><td>Tripped Status Bits - Voltage unbalance</td></tr>
<tr><td>15</td><td>Tripped Status Bits - Voltage phase loss</td></tr>
<tr><td>16</td><td>Tripped Status Bits - Power factor deviation</td></tr>
<tr><td>17</td><td>Tripped Status Bits - Jam</td></tr>
<tr><td>18</td><td>Tripped Status Bits - Instantaneous over current</td></tr>
<tr><td>19</td><td>Tripped Status Bits - Current unbalance</td></tr>
<tr><td>20</td><td>Tripped Status Bits - Current phase loss</td></tr>
<tr><td>21</td><td>Tripped Status Bits - Ground current</td></tr>
<tr><td>22</td><td>Motor Control Status - Motor at speed</td></tr>
<tr><td>23</td><td>Motor Control Status - Ready</td></tr>
</table>
</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
746	Control User Interface User LED 3 Purpose	UINT16 RW NV Default: 1 Enum Config CRC Admin Lock USB Lock Backup Mem	User Defined LED 3 Function Selection - Default: Power Related Fault. Applies only to C445UC… Control Family of User Interfaces, continued.

Value	Description
24	Motor Control Status - Inhibited
25	Motor Control Status - Warning
26	Motor Control Status - Faulted
27	Motor Control Status - Remote enabled
28	Motor Control Status - Running 2
29	Motor Control Status - Running 1
30	Warning Status Bits - PTC
31	Warning Status Bits - Phase rotation mismatch
32	Warning Status Bits - Stall
33	Warning Status Bits - Overload
34	Warning Status Bits - Starts limit exceeded
35	Warning Status Bits - Low power
36	Warning Status Bits - High power
37	Warning Status Bits - Under current
38	Warning Status Bits - Frequency deviation slow
39	Warning Status Bits - Frequency deviation fast
40	Warning Status Bits - Voltage unbalance
41	Warning Status Bits - Voltage phase loss
42	Warning Status Bits - Power factor deviation
43	Warning Status Bits - Jam
44	Warning Status Bits - Instantaneous over current
45	Warning Status Bits - Current unbalance
46	Warning Status Bits - Current phase loss
47	Warning Status Bits - Ground current
48	Warning Status Bits - Reserved
49	Warning Status Bits - Over voltage
50	Warning Status Bits - Under voltage
51	Tripped Status Bits - Under voltage
52	Tripped Status Bits - Over voltage
53	Tripped Status Bits - Reserved
54	Base Control Module Field Output control word - Bit 0
55	Base Control Module Field Output control word - Bit 1
56	Base Control Module Field Output control word - Bit 2
57	Base Control Module Field Output control word - Bit 3
58	Shunt trip output bit - Shunt trip output bit
59	Warning Reason - HRGF pulse detection
60	Warning Reason - Peak demand
61	Digital Input Status - Base Control Module Input I4
62	Digital Input Status - Base Control Module Input I3
63	Digital Input Status - Base Control Module Input I2
64	Digital Input Status - Base Control Module Input I1
65	Fail Safe - Ground current fault
65535	Reserved

Table 128. C445 Modbus Register Map, continued

<table>
<thead>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
</thead>
<tbody>
<tr><td>747</td><td>Control User Interface Button 1 Config</td><td>UINT16 RW NV
Default: 1
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button 1 function. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No User Interface button present</td></tr>
<tr><td>1</td><td>User Interface button configured as STOP</td></tr>
<tr><td>2</td><td>User Interface button configured as AUTO</td></tr>
<tr><td>3</td><td>User Interface button configured as RUN1</td></tr>
<tr><td>4</td><td>User Interface button configured as RUN2</td></tr>
<tr><td>5</td><td>User Interface button configured as RESET</td></tr>
</table></td></tr>
<tr><td>748</td><td>Control User Interface Button 2 Config</td><td>UINT16 RW NV
Default: 2
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button 2 function. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No User Interface button present</td></tr>
<tr><td>1</td><td>User Interface button configured as STOP</td></tr>
<tr><td>2</td><td>User Interface button configured as AUTO</td></tr>
<tr><td>3</td><td>User Interface button configured as RUN1</td></tr>
<tr><td>4</td><td>User Interface button configured as RUN2</td></tr>
<tr><td>5</td><td>User Interface button configured as RESET</td></tr>
</table></td></tr>
<tr><td>749</td><td>Control User Interface Button 3 Config</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button 3 function. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No User Interface button present</td></tr>
<tr><td>1</td><td>User Interface button configured as STOP</td></tr>
<tr><td>2</td><td>User Interface button configured as AUTO</td></tr>
<tr><td>3</td><td>User Interface button configured as RUN1</td></tr>
<tr><td>4</td><td>User Interface button configured as RUN2</td></tr>
<tr><td>5</td><td>User Interface button configured as RESET</td></tr>
</table></td></tr>
<tr><td>750</td><td>Control User Interface Button 4 Config</td><td>UINT16 RW NV
Default: 4
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button 4 function. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No User Interface button present</td></tr>
<tr><td>1</td><td>User Interface button configured as STOP</td></tr>
<tr><td>2</td><td>User Interface button configured as AUTO</td></tr>
<tr><td>3</td><td>User Interface button configured as RUN1</td></tr>
<tr><td>4</td><td>User Interface button configured as RUN2</td></tr>
<tr><td>5</td><td>User Interface button configured as RESET</td></tr>
</table></td></tr>
</tbody>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>751</td><td>Control User Interface Button 5 Config</td><td>UINT16 RW NV
Default: 5
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Configuration parameter for the User Interface button 5 function. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No User Interface button present</td></tr>
<tr><td>1</td><td>User Interface button configured as STOP</td></tr>
<tr><td>2</td><td>User Interface button configured as AUTO</td></tr>
<tr><td>3</td><td>User Interface button configured as RUN1</td></tr>
<tr><td>4</td><td>User Interface button configured as RUN2</td></tr>
<tr><td>5</td><td>User Interface button configured as RESET</td></tr>
</table></td></tr>
<tr><td>752</td><td>Control User Interface LED 1 Color Config</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 1 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
<tr><td>3</td><td>Sets LED color to white</td></tr>
</table></td></tr>
<tr><td>753</td><td>Control User Interface LED 2 Color Config</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 2 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
<tr><td>3</td><td>Sets LED color to white</td></tr>
</table></td></tr>
<tr><td>754</td><td>Control User Interface LED 3 Color Config</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 3 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
<tr><td>3</td><td>Sets LED color to white</td></tr>
</table></td></tr>
<tr><td>755</td><td>Control User Interface LED 4 Color Config</td><td>UINT16 RW NV
Default: 3
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 4 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
<tr><td>3</td><td>Sets LED color to white</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>756</td><td>Control User Interface LED 5 Color Config</td><td>UINT16 RW NV
Default: 1
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 5 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
<tr><td>3</td><td>Sets LED color to white</td></tr>
</table></td></tr>
<tr><td>757</td><td>Control User Interface LED 6 Color Config</td><td>UINT16 RW NV
Default: 1
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 6 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
</table></td></tr>
<tr><td>758</td><td>Control User Interface LED 7 Color Config</td><td>UINT16 RW NV
Default: 2
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>User Interface LED 7 Color parameter. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
</table></td></tr>
<tr><td>759</td><td>Control User Interface User LED 1 Color Config</td><td>UINT16 RW NV
Default: 1
Enum</td><td>User Defined LED 1 Color Selection, Default Red. Other selections are green and amber. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
</table></td></tr>
<tr><td>760</td><td>Control User Interface User LED 2 Color Config</td><td>UINT16 RW NV
Default: 1
Enum</td><td>User Defined LED 2 Color Selection, Default Red. Other selections are green and amber. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
</table></td></tr>
<tr><td>761</td><td>Control User Interface User LED 3 Color Config</td><td>UINT16 RW NV
Default: 1
Enum</td><td>User Defined LED 3 Color Selection, Default Red. Other selections are green and amber. Applies only to C445UC… Control Family of User Interfaces.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Sets LED color to green</td></tr>
<tr><td>1</td><td>Sets LED color to red</td></tr>
<tr><td>2</td><td>Sets LED color to amber</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>762</td><td>Default Measure Param</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Backup Mem</td><td>User selectable default parameter that will be displayed in the Measure run screen at startup.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Remember Last</td></tr>
<tr><td>1</td><td>Avg Current (Iavg)</td></tr>
<tr><td>2</td><td>Iavg %FLA (I%FLA)</td></tr>
<tr><td>3</td><td>Current Unbalance (IUnb)</td></tr>
<tr><td>4</td><td>GF Current RMS (IGF)</td></tr>
<tr><td>5</td><td>I Phase A (IA)</td></tr>
<tr><td>6</td><td>I Phase B (IB)</td></tr>
<tr><td>7</td><td>I Phase C (IC)</td></tr>
<tr><td>8</td><td>Avg Voltage (Vavg)</td></tr>
<tr><td>9</td><td>Voltage Unbalance (VUnb)</td></tr>
<tr><td>10</td><td>Phase Order (Ph Ord)</td></tr>
<tr><td>11</td><td>L1-L2</td></tr>
<tr><td>12</td><td>L2-L3</td></tr>
<tr><td>13</td><td>L3-L1</td></tr>
<tr><td>14</td><td>Watts Total (P Watts)</td></tr>
<tr><td>15</td><td>Power Factor (PF)</td></tr>
<tr><td>16</td><td>VA Total (P VA)</td></tr>
<tr><td>17</td><td>VARS Total (P VARS)</td></tr>
<tr><td>18</td><td>Real Energy Resettable (P kWh)</td></tr>
<tr><td>19</td><td>Thermal Cap % (TC%)</td></tr>
<tr><td>20</td><td>Time to Reset (T to Rst)</td></tr>
<tr><td>21</td><td>PTC Status (PTC)</td></tr>
<tr><td>22</td><td>Run Time Resettable (Run Time)</td></tr>
<tr><td>23</td><td># Starts Resettable (#Starts)</td></tr>
<tr><td>24</td><td>Max Starting I (MaxStrt)</td></tr>
<tr><td>25</td><td>Last Starting Time (LastStrt)</td></tr>
<tr><td>26</td><td>Frequency (Freq)</td></tr>
<tr><td>27</td><td>RTC Time</td></tr>
<tr><td>28</td><td>Present IP Address (IP Addr)</td></tr>
<tr><td>29</td><td>Op. Sec Resettable (Op Time)</td></tr>
<tr><td>30</td><td>Contactor Ops Lst Hr (Ctr Ops)</td></tr>
<tr><td>31</td><td>Speed RPM</td></tr>
</table>
</td></tr>
<tr><td>763</td><td>LED Brightness</td><td>UINT8 RW NV
Default: 50
Range: 0 to 100
Units: %
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>LED Brightness</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
764	Brightness	UINT8 RW NV Default: 30 Range: 0 to 100 Units: % Config CRC Admin Lock USB Lock Backup Mem	LCD Active Brightness
765	Idle Brightness	UINT8 RW NV Default: 10 Range: 0 to 100 Units: % Config CRC Admin Lock USB Lock Backup Mem	LCD Idle Brightness
766	Contrast	UINT8 RW NV Default: 5 Range: 0 to 10 Config CRC Admin Lock USB Lock Backup Mem	LCD Contrast
767	Inactivity Timeout	UINT16 RW NV Default: 15 Range: 1 to 65535 Units: Min Config CRC Admin Lock USB Lock Backup Mem	MUI Screen Inactive Timeout
768	Timeout Behavior	BYTE RW NV Default: 1 Bitfield Config CRC Admin Lock USB Lock Backup Mem	MUI Screen Inactive Timeout Behavior Bit 0: Set Brightness to Idle Level — Coil 12273 Bit 1: Return to Home Screen — Coil 12274 Bit 2: Local Logout — Coil 12275 Bit 3: Admin Logout — Coil 12276
769	Enable Cntrl Buttons	BYTE RW NV Default: 3 Bitfield Config CRC Admin Lock USB Lock Backup Mem	MUI Motor Control Buttons Enable Bit 0: Start — Coil 12289 Bit 1: Reset — Coil 12290
770	Start LED Color	UINT8 RW NV Default: 1 Enum Config CRC Admin Lock USB Lock Backup Mem	MUI Start Button LED Color Value 0: Green Value 1: Red Value 2: Amber Value 3: White Value 255: Off

Register 768 — MUI Screen Inactive Timeout Behavior

Bit	Description	Coil
0	Set Brightness to Idle Level	12273
1	Return to Home Screen	12274
2	Local Logout	12275
3	Admin Logout	12276

Register 769 — MUI Motor Control Buttons Enable

Bit	Description	Coil
0	Start	12289
1	Reset	12290

Register 770 — MUI Start Button LED Color

Value	Description
0	Green
1	Red
2	Amber
3	White
255	Off

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>771</td><td>Stop LED Color</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>MUI Stop Button LED Color
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Green</td></tr>
<tr><td>1</td><td>Red</td></tr>
<tr><td>2</td><td>Amber</td></tr>
<tr><td>3</td><td>White</td></tr>
<tr><td>255</td><td>Off</td></tr>
</table></td></tr>
<tr><td>772</td><td>Auto LED Color</td><td>UINT8 RW NV
Default: 2
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>MUI Auto Button LED Color
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>2</td><td>Amber</td></tr>
<tr><td>3</td><td>White</td></tr>
<tr><td>255</td><td>Off</td></tr>
</table></td></tr>
<tr><td>773</td><td>Start Button Debounce</td><td>UINT16 RW NV
Default: 50
Units: mSec
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>MUI start button debounce time in milliseconds.</td></tr>
<tr><td>774</td><td>Stop Button Debounce</td><td>UINT16 RW NV
Default: 50
Units: mSec
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>MUI stop button debounce time in milliseconds.</td></tr>
<tr><td>775</td><td>Auto Button Debounce</td><td>UINT16 RW NV
Default: 50
Units: mSec
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>MUI auto button debounce time in milliseconds.</td></tr>
<tr><td>776</td><td>Reset Button Debounce</td><td>UINT16 RW NV
Default: 250
Units: mSec
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>MUI reset button debounce time in milliseconds.</td></tr>
<tr><td>777</td><td>Enable Fieldwire Inputs</td><td>BYTE RW NV
Default: 0x0F
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>BCM Fieldwire Control Inputs Enable
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Input1 (I1)</td><td>12417</td></tr>
<tr><td>1</td><td>Input1 (I2)</td><td>12418</td></tr>
<tr><td>2</td><td>Input1 (I3)</td><td>12419</td></tr>
<tr><td>3</td><td>Input1 (I4)</td><td>12420</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
778	Run Interlock inputs	BYTE RW NV Array size: 18 Default: 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 Bitfield Config CRC Run Lock Admin Lock USB Lock Backup Mem	Define which inputs are run interlock inputs, If set, corresponding input must be enabled to run motor.

Bit	Description	Coil
0	C445 field input I1	12433
1	C445 field input I2	12434
2	C445 field input I3	12435
3	C445 field input I4	12436
4	C445 user interface input I1	12437
5	C445 user interface input I2	12438
6	C445 user interface input I3	12439
7	C445 user interface input I4	12440
16	ELC input x0	12449
17	ELC input x1	12450
18	ELC input x2	12451
19	ELC input x3	12452
20	ELC input x4	12453
21	ELC input x5	12454
22	ELC input x6	12455
23	ELC input x7	12456
24	ELC input x10	12457
25	ELC input x11	12458
26	ELC input x12	12459
27	ELC input x13	12460
28	ELC input x14	12461
29	ELC input x15	12462
30	ELC input x16	12463
31	ELC input x17	12464
32	ELC input x20	12465
33	ELC input x21	12466
34	ELC input x22	12467
35	ELC input x23	12468
36	ELC input x24	12469
37	ELC input x25	12470
38	ELC input x26	12471
39	ELC input x27	12472
40	ELC input x30	12473
41	ELC input x31	12474
42	ELC input x32	12475
43	ELC input x33	12476
44	ELC input x34	12477
45	ELC input x35	12478
46	ELC input x36	12479
47	ELC input x37	12480
48	ELC input x40	12481
49	ELC input x41	12482
50	ELC input x42	12483

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
778	Run Interlock inputs	BYTE RW NV Array size: 18 Default: 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 Bitfield Config CRC Run Lock Admin Lock USB Lock Backup Mem	Define which inputs are run interlock inputs, If set, corresponding input must be enabled to run motor, continued.

Bit	Description	Coil
51	ELC input x43	12484
52	ELC input x44	12485
53	ELC input x45	12486
54	ELC input x46	12487
55	ELC input x47	12488
56	ELC input x50	12489
57	ELC input x51	12490
58	ELC input x52	12491
59	ELC input x53	12492
60	ELC input x54	12493
61	ELC input x55	12494
62	ELC input x56	12495
63	ELC input x57	12496
64	ELC input x60	12497
65	ELC input x61	12498
66	ELC input x62	12499
67	ELC input x63	12500
68	ELC input x64	12501
69	ELC input x65	12502
70	ELC input x66	12503
71	ELC input x67	12504
72	ELC input x70	12505
73	ELC input x71	12506
74	ELC input x72	12507
75	ELC input x73	12508
76	ELC input x74	12509
77	ELC input x75	12510
78	ELC input x76	12511
79	ELC input x77	12512
80	ELC input x100	12513
81	ELC input x101	12514
82	ELC input x102	12515
83	ELC input x103	12516
84	ELC input x104	12517
85	ELC input x105	12518
86	ELC input x106	12519
87	ELC input x107	12520
88	ELC input x110	12521
89	ELC input x111	12522
90	ELC input x112	12523
91	ELC input x113	12524
92	ELC input x114	12525
93	ELC input x115	12526

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>778</td><td>Run Interlock inputs</td><td>BYTE RW NV
Array size: 18
Default:
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Define which inputs are run interlock inputs, If set, corresponding input must be enabled to run motor, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>94</td><td>ELC input x116</td><td>12527</td></tr>
<tr><td>95</td><td>ELC input x117</td><td>12528</td></tr>
<tr><td>96</td><td>ELC input x120</td><td>12529</td></tr>
<tr><td>97</td><td>ELC input x121</td><td>12530</td></tr>
<tr><td>98</td><td>ELC input x122</td><td>12531</td></tr>
<tr><td>99</td><td>ELC input x123</td><td>12532</td></tr>
<tr><td>100</td><td>ELC input x124</td><td>12533</td></tr>
<tr><td>101</td><td>ELC input x125</td><td>12534</td></tr>
<tr><td>102</td><td>ELC input x126</td><td>12535</td></tr>
<tr><td>103</td><td>ELC input x127</td><td>12536</td></tr>
<tr><td>104</td><td>ELC input x130</td><td>12537</td></tr>
<tr><td>105</td><td>ELC input x131</td><td>12538</td></tr>
<tr><td>106</td><td>ELC input x132</td><td>12539</td></tr>
<tr><td>107</td><td>ELC input x133</td><td>12540</td></tr>
<tr><td>108</td><td>ELC input x134</td><td>12541</td></tr>
<tr><td>109</td><td>ELC input x135</td><td>12542</td></tr>
<tr><td>110</td><td>ELC input x136</td><td>12543</td></tr>
<tr><td>111</td><td>ELC input x137</td><td>12544</td></tr>
<tr><td>112</td><td>ELC input x140</td><td>12545</td></tr>
<tr><td>113</td><td>ELC input x141</td><td>12546</td></tr>
<tr><td>114</td><td>ELC input x142</td><td>12547</td></tr>
<tr><td>115</td><td>ELC input x143</td><td>12548</td></tr>
<tr><td>116</td><td>ELC input x144</td><td>12549</td></tr>
<tr><td>117</td><td>ELC input x145</td><td>12550</td></tr>
<tr><td>118</td><td>ELC input x146</td><td>12551</td></tr>
<tr><td>119</td><td>ELC input x147</td><td>12552</td></tr>
<tr><td>120</td><td>ELC input x150</td><td>12553</td></tr>
<tr><td>121</td><td>ELC input x151</td><td>12554</td></tr>
<tr><td>122</td><td>ELC input x152</td><td>12555</td></tr>
<tr><td>123</td><td>ELC input x153</td><td>12556</td></tr>
<tr><td>124</td><td>ELC input x154</td><td>12557</td></tr>
<tr><td>125</td><td>ELC input x155</td><td>12558</td></tr>
<tr><td>126</td><td>ELC input x156</td><td>12559</td></tr>
<tr><td>127</td><td>ELC input x157</td><td>12560</td></tr>
<tr><td>128</td><td>ELC input x160</td><td>12561</td></tr>
<tr><td>129</td><td>ELC input x161</td><td>12562</td></tr>
<tr><td>130</td><td>ELC input x162</td><td>12563</td></tr>
<tr><td>131</td><td>ELC input x163</td><td>12564</td></tr>
<tr><td>132</td><td>ELC input x164</td><td>12565</td></tr>
<tr><td>133</td><td>ELC input x165</td><td>12566</td></tr>
<tr><td>134</td><td>ELC input x166</td><td>12567</td></tr>
<tr><td>135</td><td>ELC input x167</td><td>12568</td></tr>
</table>
</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>778</td><td>Run Interlock inputs</td><td>BYTE RW NV
Array size: 18
Default:
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Define which inputs are run interlock inputs, If set, corresponding input must be enabled to run motor, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>136</td><td>ELC input x170</td><td>12569</td></tr>
<tr><td>137</td><td>ELC input x171</td><td>12570</td></tr>
<tr><td>138</td><td>ELC input x172</td><td>12571</td></tr>
<tr><td>139</td><td>ELC input x173</td><td>12572</td></tr>
<tr><td>140</td><td>ELC input x174</td><td>12573</td></tr>
<tr><td>141</td><td>ELC input x175</td><td>12574</td></tr>
<tr><td>142</td><td>ELC input x176</td><td>12575</td></tr>
<tr><td>143</td><td>ELC input x177</td><td>12576</td></tr>
</table>
Define Run Interlock Inputs.</td></tr>
<tr><td>787</td><td>Remote Switch from Fieldbus</td><td>BOOL RW NV
Default: 0
Range: 0 to 1
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Remote Switch from Fieldbus - when set to true, allows fieldbus to set control mode to remote Remote Switch from Fieldbus.</td></tr>
<tr><td>900</td><td>FLA Motor1 Scaled</td><td>UINT16 RW NV
Default: 101
Range: 1 to 65535 (RW)
Units: scaled A
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Motor1 Overload FLA (Nominal Current) Scaled - Scaled Full Load Amperes for the motor from the motor nameplate. If this is an application with a 2 motor profile, this is the first motor. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>901</td><td>FLA Motor2 Scaled</td><td>UINT16 RW NV
Default: 101
Range: 1 to 65535 (RW)
Units: scaled A
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Motor2 Overload FLA (Nominal Current) Scaled - Scaled Full Load Amperes for the motor from the motor nameplate. If this is an application with a 2 motor profile, this is the second motor. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>902</td><td>Rated Service Factor Scaled</td><td>UINT8 RW NV
Default: 115
Range: 100 to 255
Units: 0.01%
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>This is the percentage of overloading the motor can handle for short periods of time when operating normally within the correct voltage tolerances. This value is from the motor nameplate.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
903	Rated Voltage	UINT16 RW NV Default: 480 Range: 100 to 5000 Units: V Config CRC Run Lock Admin Lock USB Lock Backup Mem	The rated voltage of the motor from the motor nameplate.
904	Rated Frequency	UINT16 RW NV Default: 60 Range: 50 to 60 Units: Hz Config CRC Run Lock Admin Lock USB Lock Backup Mem	Motor Rated Frequency in Hz from the motor nameplate.
905	Rated Watts Motor1	UINT32 RW NV Default: 14914 (RW) Range: 10 to 3728500 Units: W Config CRC Run Lock Admin Lock USB Lock Backup Mem	Watts nameplate rating for motor winding#1 (Used in all control profiles). Motors will either have a Watts or HP rating on the nameplate. When Watts is entered for Motor1 the Motor Rated HP will be calculated and displayed for Motor1.
907	Rated Watts Motor2	UINT32 RW NV Default: 14914 (RW) Range: 10 to 3728500 Units: W Config CRC Run Lock Admin Lock USB Lock Backup Mem	Watts nameplate rating for motor winding#2 (Used in star/delta, two speed and dahlander profiles). Motors will either have a Watts or HP rating on the nameplate. When Watts is entered for Motor2 the Motor Rated HP will be calculated and displayed for Motor2.
909	Rated HP Motor1 Scaled	UINT32 RW NV Default: 2000 (RW) Range: 1 to 500000 Units: HPx100 Config CRC Run Lock Admin Lock USB Lock Backup Mem	HP nameplate rating for motor winding #1 (Used in all control profiles). Motors will either have a Watts or HP rating on the nameplate. When HP is entered for Motor1 the Motor Rated Watts will be calculated and displayed for Motor1. This value is scaled by 0.01. For example if the motor is rated at 123.25 HP then this parameter should contain 12325.
911	Rated HP Motor2 Scaled	UINT32 RW NV Default: 2000 Range: 1 to 500000 Units: HPx100 Config CRC Run Lock Admin Lock USB Lock Backup Mem	HP nameplate rating for motor winding #2 (used in star/delta, two speed and dahlander profiles). Motors will either have a Watts or HP rating on the nameplate. When HP is entered for Motor2 the Motor Rated Watts will be calculated and displayed for Motor2. This value is scaled by 0.01. For example if the motor is rated at 123.25 HP then this parameter should contain 12325.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
913	Rated Power Factor Scaled	SINT16 RW NV Default: 8350 Range: 5000 to 10000 Units: 0.01% Config CRC Run Lock Admin Lock USB Lock Backup Mem	Motor Rated Power Factor in Percent from the motor nameplate.
914	Rated Speed Motor1	UINT16 RW NV Default: 1750 (RW) Range: 300 to 3600 (RW) Units: RPM Config CRC Admin Lock USB Lock Backup Mem	RPM nameplate rating for motor winding#1 (Used in all control profiles).
915	Rated Speed Motor2	UINT16 RW NV Default: 1750 (RW) Range: 300 to 3600 (RW) Units: RPM Config CRC Admin Lock USB Lock Backup Mem	RPM nameplate rating for motor winding#2 (Used in star/delta, two speed and dahlander profiles).
916	Rated Efficiency **removed from PCTool**	UINT16 RW NV Default: 8500 Range: 5000 to 10000 Units: 0.01% Config CRC Admin Lock USB Lock Backup Mem	Motor rated efficiency in scaled percent (0.01%).
917	Rated Stator Resistance Scaled	UINT16 RW NV Default: 280 Units: mOhms Config CRC Admin Lock USB Lock Backup Mem	Motor Rated Stator Resistance from motor nameplate in milliohms.
918	CT Ratio Primary	UINT16 RW NV Default: 1 Config CRC Run Lock Admin Lock USB Lock Backup Mem	CT Ratio - Primary (Only used with external Current Transformers)
919	CT Ratio Secondary	UINT16 RW NV Default: 1 Config CRC Run Lock Admin Lock USB Lock Backup Mem	CT Ratio - Secondary (Only used with external Current Transformers)

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>920</td><td>PT Ratio Primary</td><td>UINT16 RW NV
Default: 1
Run Lock</td><td>PT Ratio - Primary (Only used with external Potential Transformers)</td></tr>
<tr><td>921</td><td>PT Ratio Secondary</td><td>UINT16 RW NV
Default: 1
Run Lock</td><td>PT Ratio - Secondary (Only used with external Potential Transformers)</td></tr>
<tr><td>922</td><td>CT Ratio - Primary
External Ground Current CT</td><td>UINT16 RW NV
Default: 500
Range: 1 to 65535
Units: A
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>CT Ratio - Primary
CBCT ratio is adjusted by changing the CT Primary Current Input vs CT Secondary Output Ratings</td></tr>
<tr><td>923</td><td>CT Ratio - Secondary
External Ground Current CT</td><td>UINT16 RW NV
Default: 1
Range: 1 to 65535
Units: A
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>CT Ratio - Secondary
CBCT ratio is adjusted by changing the CT Primary Current Input vs CT Secondary Output Ratings</td></tr>
<tr><td>924</td><td>CT Secondary Multiplier
External Ground Current CT</td><td>UINT16 RW NV
Default: 1
Range: 1 to 65535
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>GFM CBCT CT Ratio Interposing Multiplier
Multiplier allows support for configurations where effective CT ratio is very high. When using an interposing CT this register would contain the interposing CT ratio.</td></tr>
<tr><td>1000</td><td>Trip Enable</td><td>BYTE RW NV
Array size: 4
Default: 0x38, 0x00, 0x04, 0x00
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Enable protections by selecting the box next to each protection to place a check mark in it. Each protection selected will enable those protections that the C445 will trip on.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Under voltage</td><td>15985</td></tr>
<tr><td>1</td><td>Over voltage</td><td>15986</td></tr>
<tr><td>2</td><td>Reserved</td><td>15987</td></tr>
<tr><td>3</td><td>Ground current fault</td><td>15988</td></tr>
<tr><td>4</td><td>Current phase loss</td><td>15989</td></tr>
<tr><td>5</td><td>Current unbalance</td><td>15990</td></tr>
<tr><td>6</td><td>Instantaneous over current</td><td>15991</td></tr>
<tr><td>7</td><td>Jam</td><td>15992</td></tr>
<tr><td>8</td><td>Power factor deviation</td><td>15993</td></tr>
<tr><td>9</td><td>Voltage phase loss</td><td>15994</td></tr>
<tr><td>10</td><td>Voltage unbalance</td><td>15995</td></tr>
<tr><td>11</td><td>Frequency deviation fast</td><td>15996</td></tr>
<tr><td>12</td><td>Frequency deviation slow</td><td>15997</td></tr>
<tr><td>13</td><td>Under current</td><td>15998</td></tr>
<tr><td>14</td><td>High power</td><td>15999</td></tr>
<tr><td>15</td><td>Low power</td><td>16000</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>1000</td><td>Trip Enable</td><td>BYTE RW NV
Array size: 4
Default: 0x38, 0x00, 0x04, 0x00
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Enable protections by selecting the box next to each protection to place a check mark in it. Each protection selected will enable those protections that the C445 will trip on, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>16</td><td>Reserved</td><td>16001</td></tr>
<tr><td>17</td><td>Starts limit exceeded</td><td>16002</td></tr>
<tr><td>18</td><td>Overload</td><td>16003</td></tr>
<tr><td>19</td><td>Stall</td><td>16004</td></tr>
<tr><td>20</td><td>Phase rotation mismatch</td><td>16005</td></tr>
<tr><td>21</td><td>PTC</td><td>16006</td></tr>
<tr><td>22</td><td>Under voltage restart</td><td>16007</td></tr>
<tr><td>23</td><td>Peak demand</td><td>16008</td></tr>
<tr><td>24</td><td>HRGF pulse detection</td><td>16009</td></tr>
</table></td></tr>
<tr><td>1002</td><td>Warning Enable</td><td>BYTE RW NV
Array size: 4
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Any Warnings needed for an application may be enabled by selecting the box next to each to place a check mark in it. Each protection selected will enable those protections the C445 will provide a warning for when that condition occurs.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Under voltage</td><td>16017</td></tr>
<tr><td>1</td><td>Over voltage</td><td>16018</td></tr>
<tr><td>2</td><td>Reserved</td><td>16019</td></tr>
<tr><td>3</td><td>Ground current warning</td><td>16020</td></tr>
<tr><td>4</td><td>Current phase loss</td><td>16021</td></tr>
<tr><td>5</td><td>Current unbalance</td><td>16022</td></tr>
<tr><td>6</td><td>Instantaneous over current</td><td>16023</td></tr>
<tr><td>7</td><td>Jam</td><td>16024</td></tr>
<tr><td>8</td><td>Power factor deviation</td><td>16025</td></tr>
<tr><td>9</td><td>Voltage phase loss</td><td>16026</td></tr>
<tr><td>10</td><td>Voltage unbalance</td><td>16027</td></tr>
<tr><td>11</td><td>Frequency deviation fast</td><td>16028</td></tr>
<tr><td>12</td><td>Frequency deviation slow</td><td>16029</td></tr>
<tr><td>13</td><td>Under current</td><td>16030</td></tr>
<tr><td>14</td><td>High power</td><td>16031</td></tr>
<tr><td>15</td><td>Low power</td><td>16032</td></tr>
<tr><td>16</td><td>Reserved</td><td>16033</td></tr>
<tr><td>17</td><td>Starts limit exceeded</td><td>16034</td></tr>
<tr><td>18</td><td>Overload</td><td>16035</td></tr>
<tr><td>19</td><td>Stall</td><td>16036</td></tr>
<tr><td>20</td><td>Phase rotation mismatch</td><td>16037</td></tr>
<tr><td>21</td><td>PTC</td><td>16038</td></tr>
<tr><td>22</td><td>Under voltage restart</td><td>16039</td></tr>
<tr><td>23</td><td>Peak demand</td><td>16040</td></tr>
<tr><td>24</td><td>HRGF pulse detection</td><td>16041</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1004	Trip Class	UINT8 RW NV Default: 5 Range: 5 to 40 Config CRC Run Lock Admin Lock USB Lock Backup Mem	Trip classes are defined by industry standard and affect the time to trip once an overload condition is realized. This delay is to avoid nuisance tripping, but still properly protect the motor. This is from the motor nameplate.
1005	Overload Alarm Level	UINT8 RW NV Default: 90 Range: 1 to 100 Units: % Config CRC Admin Lock USB Lock Backup Mem	Overload alarm level, generates a warning when the thermal capacity reaches this percent.
1006	Overload Reset Threshold	UINT8 RW NV Default: 75 Range: 1 to 99 Units: % Config CRC Run Lock Admin Lock USB Lock Backup Mem	Thermal Overload Reset Threshold. Level where reset is allowed.
1007	Stall Trip Level	UINT16 RW NV Default: 200 Range: 50 to 400 Units: % Config CRC Admin Lock USB Lock Backup Mem	The Stall protection monitors the average phase current as a percentage of FLA (Nominal Current) of the motor and will trip the motor if the current exceeds the set threshold. The stall protection is only active as the motor transitions from the starting to running states.
1008	Jam Trip Level	UINT16 RW NV Default: 400 Range: 50 to 400 Units: % Config CRC Admin Lock USB Lock Backup Mem	Jam Trip Level, when exceeded and following the Jam Trip Delay time will generate a trip.
1009	Jam Alarm Level	UINT16 RW NV Default: 400 Range: 50 to 400 Units: % Config CRC Admin Lock USB Lock Backup Mem	Jam Alarm Level, when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1010	Jam Trip Delay	UINT16 RW NV Default: 10 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Jam Trip Delay is the time delay following the trip level being exceeded until a trip occurs.
1011	Allowed Starts/hr	UINT16 RW NV Default: 4 Range: 1 to 60 Config CRC Admin Lock USB Lock Backup Mem	This protection works by limiting the number of starts per hour. Starting the motor frequently can lead to motor windings overheating resulting in a reduced life of the stator insulation. The user can choose a start limit value as well as disabling the fault. Note that the start limit is only verified when a start command is received.
1012	Instantaneous Overcurrent Trip Level	UINT16 RW NV Default: 400 Range: 50 to 400 Units: % Config CRC Admin Lock USB Lock Backup Mem	Instantaneous Overcurrent Trip Level, when exceeded and following the Instantaneous Overcurrent Trip Delay time will generate a trip.
1013	Instantaneous Overcurrent Alarm Level	UINT16 RW NV Default: 400 Range: 50 to 400 Units: % Config CRC Admin Lock USB Lock Backup Mem	Instantaneous Overcurrent Alarm Level, when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.
1014	Instantaneous Overcurrent Start Delay	UINT16 RW NV Default: 0 Range: 0 to 180 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Instantaneous Overcurrent Start Delay is a delay at power up to inhibit raising this trip condition until this time expires. If the condition is no longer present when this time expires, no trip will occur.
1015	Instantaneous Overcurrent Trip Delay	UINT16 RW NV Default: 2000 Range: 1 to 2000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	Instantaneous Overcurrent Trip Delay is the time delay following the trip level being exceeded before a trip occurs.
1016	I Phase Loss Trip Level Percent	INTERNAL UINT8 RO Default: 60 Units: %	I Phase Loss Trip Level Percent
1017	I Phase Loss Debounce	INTERNAL UINT16 RO Default: 2 Units: seconds	I Phase Loss Debounce

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1018	Current Unbalance Trip Level	UINT8 RW NV Default: 15 Range: 1 to 60 Units: % Config CRC Admin Lock USB Lock Backup Mem	Current Unbalance Trip Level Percent, when exceeded and following the Current Unbalance Trip Delay time will generate a trip.
1019	Current Unbalance Alarm Level	UINT8 RW NV Default: 15 Range: 1 to 60 Units: % Config CRC Admin Lock USB Lock Backup Mem	Current Unbalance Alarm Level Percent, when exceeded and after the Alarm Delay Time in the Protections/General category expires will cause a warning to occur.
1020	Current Unbalance Trip Delay	UINT16 RW NV Default: 15 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Current Unbalance Trip Delay is the time delay following the trip level being exceeded before a trip occurs.
1021	Undercurrent Trip Level	UINT8 RW NV Default: 50 Range: 10 to 90 Units: % Config CRC Admin Lock USB Lock Backup Mem	Undercurrent Trip Level protection monitors the three phase currents and will trip the motor if the measured current drops below the set threshold following the Undercurrent Trip Delay time.
1022	Undercurrent Alarm Level	UINT8 RW NV Default: 50 Range: 10 to 90 Units: % Config CRC Admin Lock USB Lock Backup Mem	Undercurrent Alarm Level when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.
1023	Undercurrent Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Undercurrent Trip Delay is the time delay following the trip level being exceeded until a trip occurs.

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>1024</td><td>Phase Order</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>By selecting a phase order other than “Ignore Phase Order” will result in a fault if the phase order chosen is incorrect. 0 - No Fault 1 - ABC Rotation 2 - ACB Rotation
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Ignore phase order</td></tr>
<tr><td>1</td><td>ABC (L1-L2-L3) phase order</td></tr>
<tr><td>2</td><td>ACB (L1-L3-L2) phase order</td></tr>
</table></td></tr>
<tr><td>1025</td><td>Overvoltage Trip Level</td><td>UINT16 RW NV
Default: 110
Range: 90 to 150
Units: %
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Overvoltage Trip Level, when exceeded and following the Overvoltage Trip Delay time will generate a trip.</td></tr>
<tr><td>1026</td><td>Overvoltage Alarm Level</td><td>UINT16 RW NV
Default: 110
Range: 90 to 150
Units: %
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Overvoltage Alarm Level, when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.</td></tr>
<tr><td>1027</td><td>Overvoltage Trip Delay</td><td>UINT16 RW NV
Default: 20
Range: 1 to 60
Units: seconds
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Overvoltage Trip Delay is the time delay following the trip level being exceeded until a trip occurs.</td></tr>
<tr><td>1028</td><td>Undervoltage Trip Level</td><td>UINT8 RW NV
Default: 90
Range: 10 to 100
Units: %
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Undervoltage Trip Level protection monitors the three phase voltages and will trip the motor if the measured voltage drops below the set threshold following the Undervoltage Trip Delay time.</td></tr>
<tr><td>1029</td><td>Undervoltage Alarm Level</td><td>UINT8 RW NV
Default: 90
Range: 10 to 100
Units: %
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Undervoltage Alarm Level when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1030	Undervoltage Start Delay	UINT16 RW NV Default: 20 Range: 0 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Undervoltage Start Delay is a delay to prevent this protection, if enabled, from tripping the motor at start up until this time expires. If the Undervoltage condition is still present after this time delay, then a trip would occur following the Undervoltage Trip Delay Time.
1031	Undervoltage Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Undervoltage Trip Delay is the time delay following the trip level being exceeded until a trip occurs.
1032	Voltage Loss Restart Loss Level	UINT8 RW NV Default: 70 Range: 65 to 90 Units: % Config CRC Run Lock Admin Lock USB Lock Backup Mem	Voltage Loss Restart Loss Level is the level of voltage that C445 will consider a voltage loss to start the time intervals for Voltage Loss Restart Action.
1033	Voltage Loss Restart Return Level	UINT8 RW NV Default: 90 Range: 80 to 100 Units: % Config CRC Run Lock Admin Lock USB Lock Backup Mem	Voltage Loss Restart Return Level is the voltage level that line voltage must return to for C445 to re-start motors. If the level returns to this point or above within the time intervals specified by the user (VLR Short Time and VLR Long Time), a restart sequence will be initiated according to user settable delays (VLR Short Delay and VLR Long Delay).
1034	Voltage Loss Restart Auto Time	UINT16 RW NV Default: 200 Range: 100 to 400 Units: ms Config CRC Run Lock Admin Lock USB Lock Backup Mem	Voltage Loss Restart Time Interval for The Auto Time Period. C445 will hold its output relay shut for this time period after voltage loss to automatically pull the contactor back in as soon as voltage returns. If control power is lost, C445 can remain powered for approximately 200ms at 70% control power.
1035	Voltage Loss Restart Short Delay	UINT32 RW NV Default: 1000 Range: 100 to 500000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	Voltage Loss Restart Short Delay. If voltage returns to the user specified level within the short time period C445 will send a command to re-start the motor after the Short Time Delay.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1037	Voltage Loss Restart Short Time	UINT32 RW NV Default: 400 Range: 200 to 500000 Units: ms Config CRC Run Lock Admin Lock USB Lock Backup Mem	Voltage Loss Restart Short Time Interval. If voltage returns to the user specified level within the short time period C445 will send a command to re-start the motor after the Short Time Delay.
1039	Voltage Loss Restart Long Delay	UINT16 RW NV Default: 10 Range: 1 to 3600 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Voltage Loss Restart Long Delay. If voltage returns to the user specified level within the long time period C445 will send a command to re-start the motor after the Long Time Delay.
1040	Voltage Loss Restart Long Time	UINT16 RW NV Default: 4 Range: 0 to 3600 Units: seconds Config CRC Run Lock Admin Lock USB Lock Backup Mem	Voltage Loss Restart Long Time Interval. If voltage returns to the user specified level within the long time period C445 will send a command to re-start the motor after the Long Time Delay.
1041	V Phase Loss Trip Level	INTERNAL UINT8 RO Default: 80 Units: %	V Phase Loss Trip Level
1042	V Phase Loss Debounce	INTERNAL UINT16 RO Default: 2 Units: seconds	V Phase Loss Debounce
1043	Voltage Unbalance Trip Level	UINT8 RW NV Default: 6 Range: 1 to 20 Units: % Config CRC Admin Lock USB Lock Backup Mem	Voltage Unbalance Trip Level protection monitors the three phase voltages and will trip the motor if the measured unbalance percent exceeds this threshold, following the Voltage Unbalance Trip Delay time.
1044	Voltage Unbalance Alarm Level	UINT8 RW NV Default: 6 Range: 1 to 20 Units: % Config CRC Admin Lock USB Lock Backup Mem	Voltage Unbalance Alarm Level when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1045	Voltage Unbalance Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Voltage Unbalance Trip Delay is the time delay following the trip level being exceeded until a trip occurs.
1046	High Power Trip Level	SINT16 RW NV Default: 110 Range: -200 to 200 Units: % Config CRC Admin Lock USB Lock Backup Mem	High Power Trip Level will trip the motor if the calculated KW Level exceeds this threshold, following the High Power Trip Delay time.
1047	High Power Alarm Level	SINT16 RW NV Default: 110 Range: -200 to 200 Units: % Config CRC Admin Lock USB Lock Backup Mem	High Power Alarm Level (based on KW) when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.
1048	High Power Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	High Power Trip Delay is the time delay following the trip level being exceeded until a trip occurs.
1049	Low Power Trip Level	SINT16 RW NV Default: 50 Range: -200 to 200 Units: % Config CRC Admin Lock USB Lock Backup Mem	Low Power Trip Level will trip the motor if the calculated KW Level drops below this threshold, following the Low Power Trip Delay time.
1050	Low Power Alarm Level	SINT16 RW NV Default: 50 Range: -200 to 200 Units: % Config CRC Admin Lock USB Lock Backup Mem	Low Power Alarm Level when exceeded and following the Alarm Delay Time in the Protections/General category, will generate a warning.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1051	Low Power Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Low Power Trip Delay is the time delay following the trip level being exceeded until a trip occurs.
1052	Peak Demand Warning Threshold	UINT32 RW NV Default: 0 Units: W Config CRC Admin Lock USB Lock Backup Mem	Generate an alarm if the peak demand exceeds this threshold.
1054	Demand Window Duration	UINT16 RW NV Default: 15 Range: 1 to 240 Units: minutes Config CRC Admin Lock USB Lock Backup Mem	The duration over which the Demand is measured. In North America this duration is usually chosen to be 15 minutes.
1055	Power Factor Deviation Trip Level High Scaled	SINT16 RW NV Default: 10000 Range: -10000 to 10000 Units: 0.01% Config CRC Admin Lock USB Lock Backup Mem	PF Deviation Trip Level High - The Power Factor Deviation protection monitors the PF (supply side) of the load and will trip the motor if the measured deviation from rated exceeds the set threshold. The high power factor protection is active when the motor is in the running state if enabled.
1056	Power Factor Deviation Trip Level Low Scaled	SINT16 RW NV Default: 0 Range: -10000 to 10000 Units: 0.01% Config CRC Admin Lock USB Lock Backup Mem	PF Deviation Trip Level - The Power Factor Deviation protection monitors the PF (supply side) of the load and will trip the motor if the measured deviation from rated exceeds the set threshold.
1057	Power Factor Deviation Alarm Level High Scaled	SINT16 RW NV Default: 10000 Range: -10000 to 10000 Units: 0.01% Config CRC Admin Lock USB Lock Backup Mem	Power Factor Deviation Alarm Level High - If the Power Factor rises above this level, following the Alarm Delay Time in the Protections/ General category, a warning is generated.
1058	Power Factor Deviation Alarm Level Low Scaled	SINT16 RW NV Default: 0 Range: -10000 to 10000 Units: 0.01% Config CRC Admin Lock USB Lock Backup Mem	Power Factor Deviation Alarm Level Low - If the Power Factor drops below this level, and following the Alarm Delay Time in the Protections/ General category, a warning is generated.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1059	Power Factor Deviation Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	PF Deviation Trip Delay time is the time delay from when a Power Factor trip condition exists to when the motor is tripped.
1060	GF Trip Level Scaled	UINT16 RW NV Default: 101 Range: 1 to 65535 (RW) Units: scaled A Config CRC Admin Lock USB Lock Backup Mem	Ground Fault Trip Level is the value that will generate a trip of the motor following the Residual Ground Fault Trip Delay time. Scaled by parameter "I Scale Factor".
1061	GF Alarm Level Scaled	UINT16 RW NV Default: 101 Range: 1 to 65535 (RW) Units: scaled A Config CRC Admin Lock USB Lock Backup Mem	Ground Fault Alarm Level, if exceeded, will generate a warning following the Alarm Delay Time in the Protections/General category. Scaled by parameter "I Scale Factor".
1062	GF Protection Start Delay	UINT16 RW NV Default: 0 Range: 0 to 5000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	Ground Fault Protection Start Delay is a delay at power up to inhibit raising a ground fault trip condition until this time expires. If the ground fault trip condition is no longer present when this time expires, no trip will occur.
1063	GF Trip Debounce	UINT16 RW NV Default: 1000 Range: 0 to 60000 Units: msec Config CRC Admin Lock USB Lock Backup Mem	Ground Fault Trip Delay is the time delay before a trip occurs.
1064	GF Protection Inhibit Current	BOOL RW NV Default: FALSE Config CRC Admin Lock USB Lock Backup Mem	Ground Fault Protection Inhibit Current, if selected the GF Inhibit Current will be used.
1065	GF Protection Inhibit %	UINT16 RW NV Default: 50 Range: 25 to 100 Units: % Config CRC Admin Lock USB Lock	This parameter will inhibit a Ground Fault trip if the Ground Fault current exceeds this percentage. The purpose of this is to allow an upstream control to resolve the issue. Note: The External Ground Fault Module does not use this current threshold for inhibit. Instead, the GFM monitors its CT input signal and when saturated, will inhibit the trip.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1066	Hz-Deviation Fast Trip Level Scaled	UINT16 RW NV Default: 10 Range: 2 to 200 Units: 0.01Hz Config CRC Admin Lock USB Lock Backup Mem	Frequency Deviation Fast Trip Level has a small range for the trip level selection with a large time delay to trip range. If the frequency deviation from rated exceeds the set threshold for the duration of the Frequency Deviation Fast Debounce time, it will trip the motor. The frequency deviation protection is active when the motor is in the energized state if enabled. This parameter is scaled in 0.01Hz.
1067	Frequency Deviation Fast Alarm Level Scaled	UINT16 RW NV Default: 10 Range: 2 to 200 Units: 0.01Hz Config CRC Admin Lock USB Lock Backup Mem	Frequency Deviation Fast Alarm Level has a small range for the alarm level selection and uses the Alarm Delay Time in the Protections/General category for the delay between exceeding the set threshold and generating a warning. The frequency deviation protection is always active if enabled. This parameter is scaled in 0.01Hz.
1068	Hz-Deviation Fast Trip Delay	UINT16 RW NV Default: 1000 Range: 20 to 2000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	In the motor energized state, the obtained percent deviation is compared against the set trip threshold. If the frequency deviation is higher than the Frequency Deviation Fast Trip Level for the duration of the Frequency Deviation Fast Trip Delay time, the decision to trip the motor is made. This time delay only applies to the trip level.
1069	Hz-Deviation Slow Trip Level Scaled	UINT16 RW NV Default: 10 Range: 10 to 500 Units: 0.01Hz Config CRC Admin Lock USB Lock Backup Mem	Frequency Deviation Slow Trip Level has a large range for the trip level selection with a short time delay to trip range. If the frequency deviation from rated exceeds the set threshold for the duration of the Frequency Deviation Slow Trip Delay time, it will trip the motor. The frequency deviation protection is active when the motor is in the energized state if enabled. This parameter is scaled in 0.01Hz.
1070	Hz-Deviation Slow Alarm Level Scaled	UINT16 RW NV Default: 10 Range: 10 to 500 Units: 0.01Hz Config CRC Admin Lock USB Lock Backup Mem	Frequency Deviation Slow Alarm Level has a large range for the trip level selection and uses the Alarm Delay Time in the Protections/General category for the delay between exceeding the set threshold and generating a warning. The frequency deviation protection is always active. This parameter is scaled in 0.01Hz.
1071	Hz-Deviation Slow Trip Delay	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	In the motor energized state, the obtained percent deviation is compared against the set trip threshold. If the frequency deviation is higher than the Frequency Deviation Slow Trip Level for the duration of the Frequency Deviation Slow Trip Delay time, it will trip the motor. This debounce time delay only applies to the trip level.
1072	Auto Reset Enable	BOOL RW NV Default: FALSE Config CRC Run Lock Admin Lock USB Lock Backup Mem	If disabled, no auto reset; if enabled, auto reset occurs for the trip types selected in Auto Reset Types.

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>1073</td><td>Auto Reset Types</td><td>BYTE RW NV
Array size: 4
Default: 0
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Select the protections that are to auto-reset if Auto Reset Enable is enabled. Each protection type is a bit.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Under voltage</td><td>17153</td></tr>
<tr><td>1</td><td>Over voltage</td><td>17154</td></tr>
<tr><td>2</td><td>Reserved</td><td>17155</td></tr>
<tr><td>3</td><td>Ground current fault</td><td>17156</td></tr>
<tr><td>4</td><td>Current phase loss</td><td>17157</td></tr>
<tr><td>5</td><td>Current unbalance</td><td>17158</td></tr>
<tr><td>6</td><td>Instantaneous over current</td><td>17159</td></tr>
<tr><td>7</td><td>Jam</td><td>17160</td></tr>
<tr><td>8</td><td>Power factor deviation</td><td>17161</td></tr>
<tr><td>9</td><td>Voltage phase loss</td><td>17162</td></tr>
<tr><td>10</td><td>Voltage unbalance</td><td>17163</td></tr>
<tr><td>11</td><td>Frequency deviation fast</td><td>17164</td></tr>
<tr><td>12</td><td>Frequency deviation slow</td><td>17165</td></tr>
<tr><td>13</td><td>Under current</td><td>17166</td></tr>
<tr><td>14</td><td>High power</td><td>17167</td></tr>
<tr><td>15</td><td>Low power</td><td>17168</td></tr>
<tr><td>16</td><td>Reserved</td><td>17169</td></tr>
<tr><td>17</td><td>Starts limit exceeded</td><td>17170</td></tr>
<tr><td>18</td><td>Overload</td><td>17171</td></tr>
<tr><td>19</td><td>Stall</td><td>17172</td></tr>
<tr><td>20</td><td>Phase rotation mismatch</td><td>17173</td></tr>
<tr><td>21</td><td>PTC</td><td>17174</td></tr>
<tr><td>22</td><td>Under voltage restart</td><td>17175</td></tr>
<tr><td>23</td><td>Peak demand</td><td>17176</td></tr>
<tr><td>24</td><td>HRGF pulse detection</td><td>17177</td></tr>
</table></td></tr>
<tr><td>1075</td><td>Auto Reset Delay</td><td>UINT16 RW NV
Default: 180
Range: 0 to 3600
Units: seconds
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>The time delay following a fault before attempting to auto-reset that fault condition.</td></tr>
<tr><td>1076</td><td>Reset on Powerup</td><td>BOOL RW NV
Default: FALSE
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>If enabled, perform a fault reset on power up.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1077	Backspin Inhibit Time	UINT16 RW NV Default: 0 Range: 0 to 3600 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Anti-backspin inhibit time before a reset is allowed.
1078	Run Transition Delay	UINT16 RW NV Default: 10 Range: 2 to 360 Units: seconds Config CRC Run Lock Admin Lock USB Lock Backup Mem	If the motor is instructed to run by the user, but the current thresholds are not reached, the C445 will not fault on Undercurrent if that protection is enabled because it has not realized a run state. If the user wants the unit to fault under these conditions on an enabled protection following the selected debounce time for that protection, a time must be selected for this parameter.
1079	Alarm Delay	UINT16 RW NV Default: 2000 Range: 200 to 5000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	Alarm Delay Time - applies to all protection function alarms that are enabled. This delay time is to avoid nuisance alarms. The fault condition must be present longer than this time setting.
1080	Inhibit Start on Voltage Fault	BOOL RW NV Default: 0 Config CRC Run Lock Admin Lock USB Lock Backup Mem	If this parameter is enabled and a voltage supply problem exists when the start command is issued, the C445 will be inhibited from starting the motor. This applies to Over Voltage, Under Voltage and Voltage Imbalance.
1081	Inhibit Start on Voltage Fault - Undervoltage Level	UINT8 RW NV Default: 90 Range: 10 to 100 Config CRC Admin Lock USB Lock Backup Mem	If Inhibit Start on Voltage Fault is enabled, this Under Voltage threshold value is used to inhibit the motor from being started.
1082	Inhibit Start on Voltage Fault - Unbalance Level	UINT8 RW NV Default: 6 Range: 1 to 20 Units: % Config CRC Admin Lock USB Lock Backup Mem	If Inhibit Start on Voltage Fault is enabled, this Voltage Unbalance threshold value is used to inhibit the motor from being started.
1083	Inhibit Start on Voltage Fault - Overvoltage Level	UINT8 RW NV Default: 110 Range: 90 to 150 Units: % Config CRC Admin Lock USB Lock Backup Mem	If Inhibit Start on Voltage Fault is enabled, this Over Voltage threshold value is used to inhibit the motor from being started.

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1084	Start Threshold Percent	UINT8 RW NV Default: 30 Range: 1 to 100 Units: % Config CRC Run Lock Admin Lock USB Lock Backup Mem	The C445 recognizes a motor Start when it measures motor current exceeding 30% of the FLA setting by default.
1085	Stop Threshold Percent	UINT8 RW NV Default: 5 Range: 1 to 50 Units: % Config CRC Run Lock Admin Lock USB Lock Backup Mem	A motor Stop is recognized when the current falls below 5% of the FLA setting by default.
1086	Transition Threshold Percent	UINT8 RW NV Default: 115 Range: 25 to 200 Units: % Config CRC Run Lock Admin Lock USB Lock Backup Mem	Motor Transition to Run Threshold Percent.
1087	Trip Indication Only Enable	BYTE RW NV Array size: 4 Default: 0x00, 0x00, 0x00, 0x00 Bitfield Config CRC Run Lock Admin Lock USB Lock Backup Mem	Enable trip indication only by selecting the box next to each protection to place a check mark in it. Each protection selected will enable those protections but will not cause the C445 control to drop out when trip occurs.

Bit	Description	Coil
0	Under voltage	17377
1	Over voltage	17378
2	Not Implemented	17379
3	Ground current fault	17380
4	Current phase loss	17381
5	Current unbalance	17382
6	Instantaneous over current	17383
7	Jam	17384
8	Power factor deviation	17385
9	Voltage phase loss	17386
10	Voltage unbalance	17387
11	Frequency deviation fast	17388
12	Frequency deviation slow	17389
13	Under current	17390
14	High power	17391
15	Low power	17392
16	Reserved	17393
17	Starts limit exceeded	17394
18	Overload	17395

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>1087</td><td>Trip Indication Only Enable</td><td>BYTE RW NV
Array size: 4
Default: 0x00, 0x00, 0x00, 0x00
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Enable trip indication only by selecting the box next to each protection to place a check mark in it. Each protection selected will enable those protections but will not cause the C445 control to drop out when trip occurs, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>19</td><td>Stall</td><td>17396</td></tr>
<tr><td>20</td><td>Phase rotation mismatch</td><td>17397</td></tr>
<tr><td>21</td><td>PTC</td><td>17398</td></tr>
<tr><td>22</td><td>Under voltage restart</td><td>17399</td></tr>
<tr><td>23</td><td>Peak demand</td><td>17400</td></tr>
<tr><td>24</td><td>HRGF pulse detection</td><td>17401</td></tr>
</table></td></tr>
<tr><td>1089</td><td>Shunt Trip Output Define</td><td>BYTE RW NV
Array size: 4
Default: 0x00, 0x00, 0x00, 0x00
Bitfield
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Enables the “Shunt Trip” output for selected protections that are configured for “trip” or “trip indication only”.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Under voltage</td><td>17409</td></tr>
<tr><td>1</td><td>Over voltage</td><td>17410</td></tr>
<tr><td>2</td><td>Not Implemented</td><td>17411</td></tr>
<tr><td>3</td><td>Ground current fault</td><td>17412</td></tr>
<tr><td>4</td><td>Current phase loss</td><td>17413</td></tr>
<tr><td>5</td><td>Current unbalance</td><td>17414</td></tr>
<tr><td>6</td><td>Instantaneous over current</td><td>17415</td></tr>
<tr><td>7</td><td>Jam</td><td>17416</td></tr>
<tr><td>8</td><td>Power factor deviation</td><td>17417</td></tr>
<tr><td>9</td><td>Voltage phase loss</td><td>17418</td></tr>
<tr><td>10</td><td>Voltage unbalance</td><td>17419</td></tr>
<tr><td>11</td><td>Frequency deviation fast</td><td>17420</td></tr>
<tr><td>12</td><td>Frequency deviation slow</td><td>17421</td></tr>
<tr><td>13</td><td>Under current</td><td>17422</td></tr>
<tr><td>14</td><td>High power</td><td>17423</td></tr>
<tr><td>15</td><td>Low power</td><td>17424</td></tr>
<tr><td>16</td><td>Reserved</td><td>17425</td></tr>
<tr><td>17</td><td>Starts limit exceeded</td><td>17426</td></tr>
<tr><td>18</td><td>Overload</td><td>17427</td></tr>
<tr><td>19</td><td>Stall</td><td>17428</td></tr>
<tr><td>20</td><td>Phase rotation mismatch</td><td>17429</td></tr>
<tr><td>21</td><td>PTC</td><td>17430</td></tr>
<tr><td>22</td><td>Under voltage restart</td><td>17431</td></tr>
<tr><td>23</td><td>Peak demand</td><td>17432</td></tr>
<tr><td>24</td><td>HRGF pulse detection</td><td>17433</td></tr>
</table></td></tr>
<tr><td>1091</td><td>Shunt trip pulse duration in ms</td><td>UINT16 RW NV
Default: 200
Range: 200 to 5000
Units: mSec
Config CRC
Run Lock
Admin Lock
USB Lock
Backup Mem</td><td>Duration of the shunt trip pulse in ms</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1092	CT Prot Response	UINT8 RW NV Default: 1 Range: 0 to 2 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	CT protection response: 0-no action; 1-warning; 2-trip
1093	Shunt trip pulse duration in ms	UINT16 RW NV Default: 3 Range: 2 to 1000 Units: 10mSec Config CRC Admin Lock USB Lock Backup Mem	Delays the ground current trip, once threshold is exceeded, the delay timer starts and when expired will trip the C445. (In 10ms) Ground Current Trip Delay
1094	Amplitude of HRG pulse current	UINT16 RW NV Default: 500 Range: 3 to 1000 Units: 10mAmps Config CRC Admin Lock USB Lock Backup Mem	Amplitude of HRG pulse current
1200	Fault Queue - Event Order	UINT16 RO Array size: 10 Enum	A List of the Last 10 Faults Shown in the Order They Occurred. Duplicates are allowed and the most recent is at the top.

Register 1092 values:

Value	Description
0	No Action
1	Warning
2	Trip

Register 1200 values:

Value	Description
0	No Faults
1	Under voltage
2	Over voltage
3	Reserved
4	Ground current fault
5	Current phase loss
6	Current unbalance
7	Instantaneous over current
8	Jam
9	PF Deviation
10	Voltage phase loss
11	Voltage unbalance
12	Frequency deviation fast
13	Frequency deviation slow
14	Under current
15	High power
16	Low power
17	Contactor failure
18	Starts limit exceeded
19	Overload
20	Stall
21	Phase rotation mismatch
22	PTC - See PTC State for details

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1200	Fault Queue - Event Order	UINT16 RO Array size: 10 Enum	A List of the Last 10 Faults Shown in the Order They Occurred. Duplicates are allowed and the most recent is at the top, continued.

Value	Description
23	Under voltage restart
24	Measurement Module fault
25	Communication loss on active fieldbus
26	Measurement Module not available or communication loss with the module
27	User Interface not available or communication loss with the module
28	Test trip was triggered
29	Option Card not available or communication loss with the module
30	RTC / Backup Memory Option Board NV memory fail
31	Currently connected User Interface does not match with what was connected before
32	Currently connected Measurement Module does not match with what was connected before
33	Currently connected Option Card does not match with what was connected before
34	Measurement Module firmware is incompatible
35	User Interface firmware is incompatible
36	Ethernet Option Card firmware is incompatible
37	Profi Option Card firmware is incompatible
38	Ground Fault Module firmware is incompatible
39	External ground fault module not available or communication loss
40	Currently connected Ground Fault Module does not match current configuration
41	GFM CT connection is open
42	GFM CT connection is shorted
43	GFM CT input has no calibration values
44	HRGF pulse detection trip
200	Logic Internal Fault
201	Logic call stack overflow
202	Logic call stack underflow
203	Logic memory read violation
204	Logic memory write violation
205	Logic invalid program
206	Logic incompatible program
207	Logic invalid instruction
220	Logic program underrun
221	Logic program overrun
222	Logic task watchdog
223	Logic instruction invalid instance number
224	Logic instruction invalid argument
225	Logic math - divide by zero
226	Logic math - underflow

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1200	Fault Queue - Event Order	UINT16 RO Array size: 10 Enum	A List of the Last 10 Faults Shown in the Order They Occurred. Duplicates are allowed and the most recent is at the top, continued.

Value	Description
227	Logic math - overflow
228	ELC IO Comm Loss
229	ELC IO is connected but unable to read/write
230	Generic Modbus Slave Comm Loss
231	Generic Modbus slave device is connected but read/write returned an error
232	Logic Program accessing ELC IO but ELC IO not configured
500	Internal - communication loss with Power Supply Board
501	Internal - Power Supply Board is not responding to SPI
502	Internal - Checksums in NV memory (FRAM) didn't match during read (neither pair)
503	Internal - Checksums in NV memory (FRAM) didn't match during write (neither pair)
504	Internal - RTC / Backup Memory Option Card is missing
505	Internal - RTC / Backup Memory Option Card does not match actual
506	Internal - RTC / Backup Memory Option Card has NV Fault.
507	Internal - serial flash memory fault (Attempt Factory Reset first. Return to manufacturer if not cleared)
508	Internal - logic mapping error (Attempt factory reset)
509	Internal - UI NV memory error
510	Internal - Option card NV memory error
511	Internal - GFM NV memory error
1000	Logic User Fault 1
1001	Logic User Fault 2
1002	Logic User Fault 3
1003	Logic User Fault 4
1004	Logic User Fault 5
1005	Logic User Fault 6
1006	Logic User Fault 7
1007	Logic User Fault 8
1008	Logic User Fault 9
1009	Logic User Fault 10
1010	Logic User Fault 11
1011	Logic User Fault 12
1012	Logic User Fault 13
1013	Logic User Fault 14
1014	Logic User Fault 15
1015	Logic User Fault 16
1016	Logic User Fault 17
1017	Logic User Fault 18
1018	Logic User Fault 19
1019	Logic User Fault 20
1020	Logic User Fault 21

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>1200</td><td>Fault Queue - Event Order</td><td>UINT16 RO
Array size: 10
Enum</td><td>A List of the Last 10 Faults Shown in the Order They Occurred. Duplicates are allowed and the most recent is at the top, continued.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>1021</td><td>Logic User Fault 22</td></tr>
<tr><td>1022</td><td>Logic User Fault 23</td></tr>
<tr><td>1023</td><td>Logic User Fault 24</td></tr>
<tr><td>1024</td><td>Logic User Fault 25</td></tr>
<tr><td>1025</td><td>Logic User Fault 26</td></tr>
<tr><td>1026</td><td>Logic User Fault 27</td></tr>
<tr><td>1027</td><td>Logic User Fault 28</td></tr>
<tr><td>1028</td><td>Logic User Fault 29</td></tr>
<tr><td>1029</td><td>Logic User Fault 30</td></tr>
<tr><td>1030</td><td>Logic User Fault 31</td></tr>
<tr><td>1031</td><td>Logic User Fault 32</td></tr>
<tr><td>1032</td><td>Logic User Fault 33</td></tr>
<tr><td>1033</td><td>Logic User Fault 34</td></tr>
<tr><td>1034</td><td>Logic User Fault 35</td></tr>
<tr><td>1035</td><td>Logic User Fault 36</td></tr>
<tr><td>1036</td><td>Logic User Fault 37</td></tr>
<tr><td>1037</td><td>Logic User Fault 38</td></tr>
<tr><td>1038</td><td>Logic User Fault 39</td></tr>
<tr><td>1039</td><td>Logic User Fault 40</td></tr>
<tr><td>1040</td><td>Logic User Fault 41</td></tr>
<tr><td>1041</td><td>Logic User Fault 42</td></tr>
<tr><td>1042</td><td>Logic User Fault 43</td></tr>
<tr><td>1043</td><td>Logic User Fault 44</td></tr>
<tr><td>1044</td><td>Logic User Fault 45</td></tr>
<tr><td>1045</td><td>Logic User Fault 46</td></tr>
<tr><td>1046</td><td>Logic User Fault 47</td></tr>
<tr><td>1047</td><td>Logic User Fault 48</td></tr>
<tr><td>1048</td><td>Logic User Fault 49</td></tr>
<tr><td>1049</td><td>Logic User Fault 50</td></tr>
</table></td></tr>
<tr><td>1300</td><td>Snap Shot Year</td><td>UINT16 RO
Default: 0
Backup Mem</td><td>Fault Snap Shot Log Year. The Year from the time stamp information when the last fault occurred.</td></tr>
<tr><td>1301</td><td>Snap Shot Month</td><td>UINT8 RO
Default: 0
Backup Mem</td><td>Fault Snap Shot Log Month. The Month from the time stamp information when the last fault occurred.</td></tr>
<tr><td>1302</td><td>Snap Shot Day</td><td>UINT8 RO
Default: 0
Backup Mem</td><td>Fault Snap Shot Log Day. The Day from the time stamp information when the last fault occurred.</td></tr>
<tr><td>1303</td><td>Snap Shot Hour</td><td>UINT8 RO
Default: 0
Backup Mem</td><td>Fault Snap Shot Log Hour. The Hour from the time stamp information when the last fault occurred.</td></tr>
<tr><td>1304</td><td>Snap Shot Minute</td><td>UINT8 RO
Default: 0
Backup Mem</td><td>Fault Snap Shot Log Minute.The Minute from the time stamp information when the last fault occurred.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1305	Snap Shot Second	UINT8 RO Default: 0 Backup Mem	Fault Snap Shot Log Second. The Seconds from the time stamp information when the last fault occurred.
1306	Snap Shot Trip Reason	UINT16 RO Default: 0 Enum Backup Mem	The fault that caused the last trip.

Value	Description
0	No Faults
1	Under voltage
2	Over voltage
3	Reserved
4	Ground current fault
5	Current phase loss
6	Current unbalance
7	Instantaneous over current
8	Jam
9	PF Deviation
10	Voltage phase loss
11	Voltage unbalance
12	Frequency deviation fast
13	Frequency deviation slow
14	Under current
15	High power
16	Low power
17	Contactor failure
18	Starts limit exceeded
19	Overload
20	Stall
21	Phase rotation mismatch
22	PTC - See PTC State for details
23	Under voltage restart
24	Measurement Module fault
25	Communication loss on active fieldbus
26	Measurement Module not available or communication loss with the module
27	User Interface not available or communication loss with the module
28	Test trip was triggered
29	Option Card not available or communication loss with the module
30	RTC / Backup Memory Option Board NV memory fail
31	Currently connected User Interface does not match with what was connected before
32	Currently connected Measurement Module does not match with what was connected before
33	Currently connected Option Card does not match with what was connected before
34	Measurement Module firmware is incompatible
35	User Interface firmware is incompatible

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1306	Snap Shot Trip Reason	UINT16 RO Default: 0 Enum Backup Mem	The fault that caused the last trip, continued.

Value	Description
36	Ethernet Option Card firmware is incompatible
37	Profi Option Card firmware is incompatible
38	Ground Fault Module firmware is incompatible
39	External ground fault module not available or communication loss
40	Currently connected Ground Fault Module does not match current configuration
41	GFM CT connection is open
42	GFM CT connection is shorted
43	GFM CT input has no calibration values
44	HRGF pulse detection trip
200	Logic Internal Fault
201	Logic call stack overflow
202	Logic call stack underflow
203	Logic memory read violation
204	Logic memory write violation
205	Logic invalid program
206	Logic incompatible program
207	Logic invalid instruction
220	Logic program underrun
221	Logic program overrun
222	Logic task watchdog
223	Logic instruction invalid instance number
224	Logic instruction invalid argument
225	Logic math - divide by zero
226	Logic math - underflow
227	Logic math - overflow
228	ELC IO Comm Loss
229	ELC IO is connected but unable to read/write
230	Generic Modbus Slave Comm Loss
231	Generic Modbus slave device is connected but read/write returned an error
232	Logic Program accessing ELC IO but ELC IO not configured
500	Internal - communication loss with Power Supply Board
501	Internal - Power Supply Board is not responding to SPI
502	Internal - Checksums in NV memory (FRAM) didn't match during read (neither pair)
503	Internal - Checksums in NV memory (FRAM) didn't match during write (neither pair)
504	Internal - RTC / Backup Memory Option Card is missing
505	Internal - RTC / Backup Memory Option Card does not match actual
506	Internal - RTC / Backup Memory Option Card has NV Fault.
507	Internal - serial flash memory fault (Attempt Factory Reset first. Return to manufacturer if not cleared)
508	Internal - logic mapping error (Attempt factory reset)

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1306	Snap Shot Trip Reason	UINT16 RO Default: 0 Enum Backup Mem	The fault that caused the last trip, continued.

Value	Description
509	Internal - UI NV memory error
510	Internal - Option card NV memory error
511	Internal - GFM NV memory error
1000	Logic User Fault 1
1001	Logic User Fault 2
1002	Logic User Fault 3
1003	Logic User Fault 4
1004	Logic User Fault 5
1005	Logic User Fault 6
1006	Logic User Fault 7
1007	Logic User Fault 8
1008	Logic User Fault 9
1009	Logic User Fault 10
1010	Logic User Fault 11
1011	Logic User Fault 12
1012	Logic User Fault 13
1013	Logic User Fault 14
1014	Logic User Fault 15
1015	Logic User Fault 16
1016	Logic User Fault 17
1017	Logic User Fault 18
1018	Logic User Fault 19
1019	Logic User Fault 20
1020	Logic User Fault 21
1021	Logic User Fault 22
1022	Logic User Fault 23
1023	Logic User Fault 24
1024	Logic User Fault 25
1025	Logic User Fault 26
1026	Logic User Fault 27
1027	Logic User Fault 28
1028	Logic User Fault 29
1029	Logic User Fault 30
1030	Logic User Fault 31
1031	Logic User Fault 32
1032	Logic User Fault 33
1033	Logic User Fault 34
1034	Logic User Fault 35
1035	Logic User Fault 36
1036	Logic User Fault 37
1037	Logic User Fault 38
1038	Logic User Fault 39
1039	Logic User Fault 40

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1306	Snap Shot Trip Reason	UINT16 RO Default: 0 Enum Backup Mem	The fault that caused the last trip, continued. Value – Description 1040 – Logic User Fault 41 1041 – Logic User Fault 42 1042 – Logic User Fault 43 1043 – Logic User Fault 44 1044 – Logic User Fault 45 1045 – Logic User Fault 46 1046 – Logic User Fault 47 1047 – Logic User Fault 48 1048 – Logic User Fault 49 1049 – Logic User Fault 50
1307	Snap Shot Thermal Capacity	UINT8 RO Default: 0 Backup Mem	Overload Thermal Capacity Percent at time of trip
1308	Snap Shot I Phase A (L1) Scaled	UINT16 RO Default: 0 Units: scaled A Backup Mem	Phase A (L1) RMS current at time of trip. Scaled by parameter “I Scale Factor”.
1309	Snap Shot I Phase B (L2) Scaled	UINT16 RO Default: 0 Units: scaled A Backup Mem	Phase B (L2) RMS current at time of trip. Scaled by parameter “I Scale Factor”.
1310	Snap Shot I Phase C (L3) Scaled	UINT16 RO Default: 0 Units: scaled A Backup Mem	Phase C (L3) RMS current at time of trip. Scaled by parameter “I Scale Factor”.
1311	Snap Shot Voltage L1-L2	UINT16 RO Default: 0 Units: V Backup Mem	Voltage AB (L1-L2) RMS volts at time of trip
1312	Snap Shot Voltage L2-L3	UINT16 RO Default: 0 Units: V Backup Mem	Voltage BC (L2-L3) RMS volts at time of trip
1313	Snap Shot Voltage L3-L1	UINT16 RO Default: 0 Units: V Backup Mem	Voltage CA (L3-L1) RMS volts at time of trip
1314	Snap Shot Frequency Scaled	UINT16 RO Default: 0 Units: 0.01Hz Backup Mem	Line Frequency at time of trip.
1315	Snap Shot Watts	SINT32 RO Default: 0 Units: W Backup Mem	Real Power at time of trip

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1317	Snap Shot VA	SINT32 RO Default: 0 Units: VA Backup Mem	Apparent Power at time of trip
1319	Snap Shot Power Factor Scaled	SINT16 RO Default: 0 Units: 0.01% Backup Mem	Power Factor at time of trip.
1320	Snap Shot Ground Fault Current RMS Scaled	UINT16 RO Default: 0 Units: scaled A Backup Mem	Ground Fault Current RMS at time of trip. Scaled by parameter "I Scale Factor".
2001	BCM 485 port mode	UINT8 RW NV Default: 0 Enum Config CRC Run Lock Admin Lock USB Lock Backup Mem	BCM 485 port mode. Value / Description: 0 – Modbus Slave 1 – ELC IO 2 – Generic master
2002	ELC IO Modbus Address	UINT8 RW NV Default: 1 Range: 1 to 247 Config CRC Admin Lock USB Lock Backup Mem	Modbus Address for the communication link between Base Control Module's RS-485 port and the ELC Modbus IO. The address is loaded at startup. A power cycle is required for change in address to take effect. ELC IO Modbus Address
2003	External IO Modbus Baud Rate	UINT8 RW NV Default: 4 Enum Config CRC Admin Lock USB Lock Backup Mem	External IO Modbus Baud Rate. Selects the Modbus Baud Rate for the Base Control Module's RS-485 Modbus port. A power cycle is required for change in baud rate to take effect. 0 = 19200 baud, 1 = 9600 baud, 2 = 38400 baud, 3 = 57600 baud, 4 = 115200 baud. Value / Description: 0 – 19200 1 – 9600 2 – 38400 3 – 57600 4 – 115200
2004	External IO Modbus Parity and Stop Bits	UINT8 RW NV Default: 0 Enum Config CRC Admin Lock USB Lock Backup Mem	External IO Modbus Parity and Stop Bits. Selects the Modbus Parity and Stop Bits for the Base Control Module - ELC IO link. A power cycle is required for change to take effect. Note: No Parity, 1 stop bit is not valid when in MODBUS_ASCII_TX_MODE mode. 0 = Even Parity - 1 stop bit, 1 = Odd Parity - 1 stop bit, 2 = No Parity - 2 stop bits, 3 = Even Parity - 2 stop bits, 4 = Odd Parity - 2 stop bits, 5 = No Parity - 1 stop bit. Value / Description: 0 – Even parity - 1 Stop bit 1 – Odd parity - 1 Stop bit 2 – No parity - 2 Stop bits 3 – Even parity - 2 Stop bits 4 – Odd parity - 2 Stop bits 5 – No parity - 1 Stop bits

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2005</td><td>ELC IO Number of digital</td><td>UINT8 RW NV
Default: 0
Range: 0 to 128
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO Number of digital inputs
ELC IO Number of digital inputs</td></tr>
<tr><td>2006</td><td>ELC IO Number of digital</td><td>UINT8 RW NV
Default: 0
Range: 0 to 128
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO Number of digital outputs
ELC IO Number of digital outputs</td></tr>
<tr><td>2007</td><td>ELC IO 1st Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 1st Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
<tr><td>2008</td><td>ELC IO 2nd Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 2nd Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
<tr><td>2009</td><td>ELC IO 3rd Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 3rd Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2010</td><td>ELC IO 4th Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 4th Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
<tr><td>2011</td><td>ELC IO 5th Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 5th Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
<tr><td>2012</td><td>ELC IO 6th Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 6th Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
<tr><td>2013</td><td>ELC IO 7th Speciality Module Model Code</td><td>UINT16 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>ELC IO 7th Speciality Module Model Code
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No Module</td></tr>
<tr><td>73</td><td>(0x49) ELC-AN02NANN</td></tr>
<tr><td>136</td><td>(0x88) ELC-AN04ANNN</td></tr>
<tr><td>137</td><td>(0x89) ELC-AN04NANN</td></tr>
<tr><td>138</td><td>(0x8A) ELC-PT04ANNN</td></tr>
<tr><td>139</td><td>(0x8B) ELC-TC04ANNN</td></tr>
<tr><td>204</td><td>(0xCC) ELC-AN06AANN</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2014	ELC IO 8th Speciality Module Model Code	UINT16 RW NV Default: 0 Enum Config CRC Admin Lock USB Lock Backup Mem	ELC IO 8th Speciality Module Model Code Value / Description: 0 – No Module 73 – (0x49) ELC-AN02NANN 136 – (0x88) ELC-AN04ANNN 137 – (0x89) ELC-AN04NANN 138 – (0x8A) ELC-PT04ANNN 139 – (0x8B) ELC-TC04ANNN 204 – (0xCC) ELC-AN06AANN
2015	ELC IO Passthrough Speciality Module 1	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 1 Array of 30 registers ELC IO Passthrough Speciality Module 1
2045	ELC IO Passthrough Speciality Module 2	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 2 Array of 30 registers ELC IO Passthrough Speciality Module 2
2075	ELC IO Passthrough Speciality Module 3	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 3 Array of 30 registers ELC IO Passthrough Speciality Module 3
2105	ELC IO Passthrough Speciality Module 4	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 4 Array of 30 registers ELC IO Passthrough Speciality Module 4
2135	ELC IO Passthrough Speciality Module 5	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 5 Array of 30 registers ELC IO Passthrough Speciality Module 5
2165	ELC IO Passthrough Speciality Module 6	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 6 Array of 30 registers ELC IO Passthrough Speciality Module 6
2195	ELC IO Passthrough Speciality Module 7	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 7 Array of 30 registers ELC IO Passthrough Speciality Module 7
2225	ELC IO Passthrough Speciality Module 8	UINT16 RW NV Array size: 30 Default: 0 Backup Mem	ELC IO Passthrough Speciality Module 8 Array of 30 registers ELC IO Passthrough Speciality Module 8
2255	ELC IO Passthrough Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Passthrough Digital In. Bit / Description / Coil: 0 – ELC Passthrough dig In x0(0) – 36065 1 – ELC Passthrough dig In x1(1) – 36066 2 – ELC Passthrough dig In x2(2) – 36067 3 – ELC Passthrough dig In x3(3) – 36068 4 – ELC Passthrough dig In x4(4) – 36069 5 – ELC Passthrough dig In x5(5) – 36070 6 – ELC Passthrough dig In x6(6) – 36071

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2255	ELC IO Passthrough Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Passthrough Digital In, continued.

Bit	Description	Coil
7	ELC Passthrough dig In x7(7)	36072
8	ELC Passthrough dig In x10(8)	36073
9	ELC Passthrough dig In x11(9)	36074
10	ELC Passthrough dig In x12(10)	36075
11	ELC Passthrough dig In x13(11)	36076
12	ELC Passthrough dig In x14(12)	36077
13	ELC Passthrough dig In x15(13)	36078
14	ELC Passthrough dig In x16(14)	36079
15	ELC Passthrough dig In x17(15)	36080
16	ELC Passthrough dig In x20(16)	36081
17	ELC Passthrough dig In x21(17)	36082
18	ELC Passthrough dig In x22(18)	36083
19	ELC Passthrough dig In x23(19)	36084
20	ELC Passthrough dig In x24(20)	36085
21	ELC Passthrough dig In x25(21)	36086
22	ELC Passthrough dig In x26(22)	36087
23	ELC Passthrough dig In x27(23)	36088
24	ELC Passthrough dig In x30(24)	36089
25	ELC Passthrough dig In x31(25)	36090
26	ELC Passthrough dig In x32(26)	36091
27	ELC Passthrough dig In x33(27)	36092
28	ELC Passthrough dig In x34(28)	36093
29	ELC Passthrough dig In x35(29)	36094
30	ELC Passthrough dig In x36(30)	36095
31	ELC Passthrough dig In x37(31)	36096
32	ELC Passthrough dig In x40(32)	36097
33	ELC Passthrough dig In x41(33)	36098
34	ELC Passthrough dig In x42(34)	36099
35	ELC Passthrough dig In x43(35)	36100
36	ELC Passthrough dig In x44(36)	36101
37	ELC Passthrough dig In x45(37)	36102
38	ELC Passthrough dig In x46(38)	36103
39	ELC Passthrough dig In x47(39)	36104
40	ELC Passthrough dig In x50(40)	36105
41	ELC Passthrough dig In x51(41)	36106
42	ELC Passthrough dig In x52(42)	36107
43	ELC Passthrough dig In x53(43)	36108
44	ELC Passthrough dig In x54(44)	36109
45	ELC Passthrough dig In x55(45)	36110
46	ELC Passthrough dig In x56(46)	36111
47	ELC Passthrough dig In x57(47)	36112
48	ELC Passthrough dig In x60(48)	36113
49	ELC Passthrough dig In x61(49)	36114

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2255	ELC IO Passthrough Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Passthrough Digital In, continued.

Bit	Description	Coil
50	ELC Passthrough dig In x62(50)	36115
51	ELC Passthrough dig In x63(51)	36116
52	ELC Passthrough dig In x64(52)	36117
53	ELC Passthrough dig In x65(53)	36118
54	ELC Passthrough dig In x66(54)	36119
55	ELC Passthrough dig In x67(55)	36120
56	ELC Passthrough dig In x70(56)	36121
57	ELC Passthrough dig In x71(57)	36122
58	ELC Passthrough dig In x72(58)	36123
59	ELC Passthrough dig In x73(59)	36124
60	ELC Passthrough dig In x74(60)	36125
61	ELC Passthrough dig In x75(61)	36126
62	ELC Passthrough dig In x76(62)	36127
63	ELC Passthrough dig In x77(63)	36128
64	ELC Passthrough dig In x100(64)	36129
65	ELC Passthrough dig In x101(65)	36130
66	ELC Passthrough dig In x102(66)	36131
67	ELC Passthrough dig In x103(67)	36132
68	ELC Passthrough dig In x104(68)	36133
69	ELC Passthrough dig In x105(69)	36134
70	ELC Passthrough dig In x106(70)	36135
71	ELC Passthrough dig In x107(71)	36136
72	ELC Passthrough dig In x110(72)	36137
73	ELC Passthrough dig In x111(73)	36138
74	ELC Passthrough dig In x112(74)	36139
75	ELC Passthrough dig In x113(75)	36140
76	ELC Passthrough dig In x114(76)	36141
77	ELC Passthrough dig In x115(77)	36142
78	ELC Passthrough dig In x116(78)	36143
79	ELC Passthrough dig In x117(79)	36144
80	ELC Passthrough dig In x120(80)	36145
81	ELC Passthrough dig In x121(81)	36146
82	ELC Passthrough dig In x122(82)	36147
83	ELC Passthrough dig In x123(83)	36148
84	ELC Passthrough dig In x124(84)	36149
85	ELC Passthrough dig In x125(85)	36150
86	ELC Passthrough dig In x126(86)	36151
87	ELC Passthrough dig In x127(87)	36152
88	ELC Passthrough dig In x130(88)	36153
89	ELC Passthrough dig In x131(89)	36154
90	ELC Passthrough dig In x132(90)	36155
91	ELC Passthrough dig In x133(91)	36156
92	ELC Passthrough dig In x134(92)	36157

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2255</td><td>ELC IO Passthrough Digital In</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Passthrough Digital In, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>93</td><td>ELC Passthrough dig In x135(93)</td><td>36158</td></tr>
<tr><td>94</td><td>ELC Passthrough dig In x136(94)</td><td>36159</td></tr>
<tr><td>95</td><td>ELC Passthrough dig In x137(95)</td><td>36160</td></tr>
<tr><td>96</td><td>ELC Passthrough dig In x140(96)</td><td>36161</td></tr>
<tr><td>97</td><td>ELC Passthrough dig In x141(97)</td><td>36162</td></tr>
<tr><td>98</td><td>ELC Passthrough dig In x142(98)</td><td>36163</td></tr>
<tr><td>99</td><td>ELC Passthrough dig In x143(99)</td><td>36164</td></tr>
<tr><td>100</td><td>ELC Passthrough dig In x144(100)</td><td>36165</td></tr>
<tr><td>101</td><td>ELC Passthrough dig In x145(101)</td><td>36166</td></tr>
<tr><td>102</td><td>ELC Passthrough dig In x146(102)</td><td>36167</td></tr>
<tr><td>103</td><td>ELC Passthrough dig In x147(103)</td><td>36168</td></tr>
<tr><td>104</td><td>ELC Passthrough dig In x150(104)</td><td>36169</td></tr>
<tr><td>105</td><td>ELC Passthrough dig In x151(105)</td><td>36170</td></tr>
<tr><td>106</td><td>ELC Passthrough dig In x152(106)</td><td>36171</td></tr>
<tr><td>107</td><td>ELC Passthrough dig In x153(107)</td><td>36172</td></tr>
<tr><td>108</td><td>ELC Passthrough dig In x154(108)</td><td>36173</td></tr>
<tr><td>109</td><td>ELC Passthrough dig In x155(109)</td><td>36174</td></tr>
<tr><td>110</td><td>ELC Passthrough dig In x156(110)</td><td>36175</td></tr>
<tr><td>111</td><td>ELC Passthrough dig In x157(111)</td><td>36176</td></tr>
<tr><td>112</td><td>ELC Passthrough dig In x160(112)</td><td>36177</td></tr>
<tr><td>113</td><td>ELC Passthrough dig In x161(113)</td><td>36178</td></tr>
<tr><td>114</td><td>ELC Passthrough dig In x162(114)</td><td>36179</td></tr>
<tr><td>115</td><td>ELC Passthrough dig In x163(115)</td><td>36180</td></tr>
<tr><td>116</td><td>ELC Passthrough dig In x164(116)</td><td>36181</td></tr>
<tr><td>117</td><td>ELC Passthrough dig In x165(117)</td><td>36182</td></tr>
<tr><td>118</td><td>ELC Passthrough dig In x166(118)</td><td>36183</td></tr>
<tr><td>119</td><td>ELC Passthrough dig In x167(119)</td><td>36184</td></tr>
<tr><td>120</td><td>ELC Passthrough dig In x170(120)</td><td>36185</td></tr>
<tr><td>121</td><td>ELC Passthrough dig In x171(121)</td><td>36186</td></tr>
<tr><td>122</td><td>ELC Passthrough dig In x172(122)</td><td>36187</td></tr>
<tr><td>123</td><td>ELC Passthrough dig In x173(123)</td><td>36188</td></tr>
<tr><td>124</td><td>ELC Passthrough dig In x174(124)</td><td>36189</td></tr>
<tr><td>125</td><td>ELC Passthrough dig In x175(125)</td><td>36190</td></tr>
<tr><td>126</td><td>ELC Passthrough dig In x176(126)</td><td>36191</td></tr>
<tr><td>127</td><td>ELC Passthrough dig In x177(127)</td><td>36192</td></tr>
</table></td></tr>
<tr><td>2263</td><td>ELC IO Passthrough Digital Out</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Passthrough Digital Out.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>ELC Passthrough dig Out x0(0)</td><td>36193</td></tr>
<tr><td>1</td><td>ELC Passthrough dig Out x1(1)</td><td>36194</td></tr>
<tr><td>2</td><td>ELC Passthrough dig Out x2(2)</td><td>36195</td></tr>
<tr><td>3</td><td>ELC Passthrough dig Out x3(3)</td><td>36196</td></tr>
<tr><td>4</td><td>ELC Passthrough dig Out x4(4)</td><td>36197</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2263	ELC IO Passthrough Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Passthrough Digital Out, continued.

Bit	Description	Coil
5	ELC Passthrough dig Out x5(5)	36198
6	ELC Passthrough dig Out x6(6)	36199
7	ELC Passthrough dig Out x7(7)	36200
8	ELC Passthrough dig Out x10(8)	36201
9	ELC Passthrough dig Out x11(9)	36202
10	ELC Passthrough dig Out x12(10)	36203
11	ELC Passthrough dig Out x13(11)	36204
12	ELC Passthrough dig Out x14(12)	36205
13	ELC Passthrough dig Out x15(13)	36206
14	ELC Passthrough dig Out x16(14)	36207
15	ELC Passthrough dig Out x17(15)	36208
16	ELC Passthrough dig Out x20(16)	36209
17	ELC Passthrough dig Out x21(17)	36210
18	ELC Passthrough dig Out x22(18)	36211
19	ELC Passthrough dig Out x23(19)	36212
20	ELC Passthrough dig Out x24(20)	36213
21	ELC Passthrough dig Out x25(21)	36214
22	ELC Passthrough dig Out x26(22)	36215
23	ELC Passthrough dig Out x27(23)	36216
24	ELC Passthrough dig Out x30(24)	36217
25	ELC Passthrough dig Out x31(25)	36218
26	ELC Passthrough dig Out x32(26)	36219
27	ELC Passthrough dig Out x33(27)	36220
28	ELC Passthrough dig Out x34(28)	36221
29	ELC Passthrough dig Out x35(29)	36222
30	ELC Passthrough dig Out x36(30)	36223
31	ELC Passthrough dig Out x37(31)	36224
32	ELC Passthrough dig Out x40(32)	36225
33	ELC Passthrough dig Out x41(33)	36226
34	ELC Passthrough dig Out x42(34)	36227
35	ELC Passthrough dig Out x43(35)	36228
36	ELC Passthrough dig Out x44(36)	36229
37	ELC Passthrough dig Out x45(37)	36230
38	ELC Passthrough dig Out x46(38)	36231
39	ELC Passthrough dig Out x47(39)	36232
40	ELC Passthrough dig Out x50(40)	36233
41	ELC Passthrough dig Out x51(41)	36234
42	ELC Passthrough dig Out x52(42)	36235
43	ELC Passthrough dig Out x53(43)	36236
44	ELC Passthrough dig Out x54(44)	36237
45	ELC Passthrough dig Out x55(45)	36238
46	ELC Passthrough dig Out x56(46)	36239
47	ELC Passthrough dig Out x57(47)	36240

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2263	ELC IO Passthrough Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Passthrough Digital Out, continued.

Bit	Description	Coil
48	ELC Passthrough dig Out x60(48)	36241
49	ELC Passthrough dig Out x61(49)	36242
50	ELC Passthrough dig Out x62(50)	36243
51	ELC Passthrough dig Out x63(51)	36244
52	ELC Passthrough dig Out x64(52)	36245
53	ELC Passthrough dig Out x65(53)	36246
54	ELC Passthrough dig Out x66(54)	36247
55	ELC Passthrough dig Out x67(55)	36248
56	ELC Passthrough dig Out x70(56)	36249
57	ELC Passthrough dig Out x71(57)	36250
58	ELC Passthrough dig Out x72(58)	36251
59	ELC Passthrough dig Out x73(59)	36252
60	ELC Passthrough dig Out x74(60)	36253
61	ELC Passthrough dig Out x75(61)	36254
62	ELC Passthrough dig Out x76(62)	36255
63	ELC Passthrough dig Out x77(63)	36256
64	ELC Passthrough dig Out x100(64)	36257
65	ELC Passthrough dig Out x101(65)	36258
66	ELC Passthrough dig Out x102(66)	36259
67	ELC Passthrough dig Out x103(67)	36260
68	ELC Passthrough dig Out x104(68)	36261
69	ELC Passthrough dig Out x105(69)	36262
70	ELC Passthrough dig Out x106(70)	36263
71	ELC Passthrough dig Out x107(71)	36264
72	ELC Passthrough dig Out x110(72)	36265
73	ELC Passthrough dig Out x111(73)	36266
74	ELC Passthrough dig Out x112(74)	36267
75	ELC Passthrough dig Out x113(75)	36268
76	ELC Passthrough dig Out x114(76)	36269
77	ELC Passthrough dig Out x115(77)	36270
78	ELC Passthrough dig Out x116(78)	36271
79	ELC Passthrough dig Out x117(79)	36272
80	ELC Passthrough dig Out x120(80)	36273
81	ELC Passthrough dig Out x121(81)	36274
82	ELC Passthrough dig Out x122(82)	36275
83	ELC Passthrough dig Out x123(83)	36276
84	ELC Passthrough dig Out x124(84)	36277
85	ELC Passthrough dig Out x125(85)	36278
86	ELC Passthrough dig Out x126(86)	36279
87	ELC Passthrough dig Out x127(87)	36280
88	ELC Passthrough dig Out x130(88)	36281
89	ELC Passthrough dig Out x131(89)	36282
90	ELC Passthrough dig Out x132(90)	36283

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2263</td><td>ELC IO Passthrough Digital Out</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Passthrough Digital Out, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>91</td><td>ELC Passthrough dig Out x133(91)</td><td>36284</td></tr>
<tr><td>92</td><td>ELC Passthrough dig Out x134(92)</td><td>36285</td></tr>
<tr><td>93</td><td>ELC Passthrough dig Out x135(93)</td><td>36286</td></tr>
<tr><td>94</td><td>ELC Passthrough dig Out x136(94)</td><td>36287</td></tr>
<tr><td>95</td><td>ELC Passthrough dig Out x137(95)</td><td>36288</td></tr>
<tr><td>96</td><td>ELC Passthrough dig Out x140(96)</td><td>36289</td></tr>
<tr><td>97</td><td>ELC Passthrough dig Out x141(97)</td><td>36290</td></tr>
<tr><td>98</td><td>ELC Passthrough dig Out x142(98)</td><td>36291</td></tr>
<tr><td>99</td><td>ELC Passthrough dig Out x143(99)</td><td>36292</td></tr>
<tr><td>100</td><td>ELC Passthrough dig Out x144(100)</td><td>36293</td></tr>
<tr><td>101</td><td>ELC Passthrough dig Out x145(101)</td><td>36294</td></tr>
<tr><td>102</td><td>ELC Passthrough dig Out x146(102)</td><td>36295</td></tr>
<tr><td>103</td><td>ELC Passthrough dig Out x147(103)</td><td>36296</td></tr>
<tr><td>104</td><td>ELC Passthrough dig Out x150(104)</td><td>36297</td></tr>
<tr><td>105</td><td>ELC Passthrough dig Out x151(105)</td><td>36298</td></tr>
<tr><td>106</td><td>ELC Passthrough dig Out x152(106)</td><td>36299</td></tr>
<tr><td>107</td><td>ELC Passthrough dig Out x153(107)</td><td>36300</td></tr>
<tr><td>108</td><td>ELC Passthrough dig Out x154(108)</td><td>36301</td></tr>
<tr><td>109</td><td>ELC Passthrough dig Out x155(109)</td><td>36302</td></tr>
<tr><td>110</td><td>ELC Passthrough dig Out x156(110)</td><td>36303</td></tr>
<tr><td>111</td><td>ELC Passthrough dig Out x157(111)</td><td>36304</td></tr>
<tr><td>112</td><td>ELC Passthrough dig Out x160(112)</td><td>36305</td></tr>
<tr><td>113</td><td>ELC Passthrough dig Out x161(113)</td><td>36306</td></tr>
<tr><td>114</td><td>ELC Passthrough dig Out x162(114)</td><td>36307</td></tr>
<tr><td>115</td><td>ELC Passthrough dig Out x163(115)</td><td>36308</td></tr>
<tr><td>116</td><td>ELC Passthrough dig Out x164(116)</td><td>36309</td></tr>
<tr><td>117</td><td>ELC Passthrough dig Out x165(117)</td><td>36310</td></tr>
<tr><td>118</td><td>ELC Passthrough dig Out x166(118)</td><td>36311</td></tr>
<tr><td>119</td><td>ELC Passthrough dig Out x167(119)</td><td>36312</td></tr>
<tr><td>120</td><td>ELC Passthrough dig Out x170(120)</td><td>36313</td></tr>
<tr><td>121</td><td>ELC Passthrough dig Out x171(121)</td><td>36314</td></tr>
<tr><td>122</td><td>ELC Passthrough dig Out x172(122)</td><td>36315</td></tr>
<tr><td>123</td><td>ELC Passthrough dig Out x173(123)</td><td>36316</td></tr>
<tr><td>124</td><td>ELC Passthrough dig Out x174(124)</td><td>36317</td></tr>
<tr><td>125</td><td>ELC Passthrough dig Out x175(125)</td><td>36318</td></tr>
<tr><td>126</td><td>ELC Passthrough dig Out x176(126)</td><td>36319</td></tr>
<tr><td>127</td><td>ELC Passthrough dig Out x177(127)</td><td>36320</td></tr>
</table></td></tr>
<tr><td>2271</td><td>ELC IO Force Speciality Module 1</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Force Speciality Module 1
Array of 30 registers
ELC IO Force Speciality Module 1</td></tr>
<tr><td>2301</td><td>ELC IO Force Speciality Module 2</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Force Speciality Module 2
Array of 30 registers
ELC IO Force Speciality Module 2</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2331	ELC IO Force Speciality Module 3	UINT16 RW Array size: 30 Default: 0	ELC IO Force Speciality Module 3 Array of 30 registers ELC IO Force Speciality Module 3
2361	ELC IO Force Speciality Module 4	UINT16 RW Array size: 30 Default: 0	ELC IO Force Speciality Module 4 Array of 30 registers ELC IO Force Speciality Module 4
2391	ELC IO Force Speciality Module 5	UINT16 RW Array size: 30 Default: 0	ELC IO Force Speciality Module 5 Array of 30 registers ELC IO Force Speciality Module 5
2421	ELC IO Force Speciality Module 6	UINT16 RW Array size: 30 Default: 0	ELC IO Force Speciality Module 6 Array of 30 registers ELC IO Force Speciality Module 6
2451	ELC IO Force Speciality Module 7	UINT16 RW Array size: 30 Default: 0	ELC IO Force Speciality Module 7 Array of 30 registers ELC IO Force Speciality Module 7
2481	ELC IO Force Speciality Module 8	UINT16 RW Array size: 30 Default: 0	ELC IO Force Speciality Module 8 Array of 30 registers ELC IO Force Speciality Module 8
2511	ELC IO Force Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Digital In.

Bit	Description	Coil
0	ELC Force dig In x0(0)	40161
1	ELC Force dig In x1(1)	40162
2	ELC Force dig In x2(2)	40163
3	ELC Force dig In x3(3)	40164
4	ELC Force dig In x4(4)	40165
5	ELC Force dig In x5(5)	40166
6	ELC Force dig In x6(6)	40167
7	ELC Force dig In x7(7)	40168
8	ELC Force dig In x10(8)	40169
9	ELC Force dig In x11(9)	40170
10	ELC Force dig In x12(10)	40171
11	ELC Force dig In x13(11)	40172
12	ELC Force dig In x14(12)	40173
13	ELC Force dig In x15(13)	40174
14	ELC Force dig In x16(14)	40175
15	ELC Force dig In x17(15)	40176
16	ELC Force dig In x20(16)	40177
17	ELC Force dig In x21(17)	40178
18	ELC Force dig In x22(18)	40179
19	ELC Force dig In x23(19)	40180
20	ELC Force dig In x24(20)	40181
21	ELC Force dig In x25(21)	40182
22	ELC Force dig In x26(22)	40183

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2511	ELC IO Force Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Digital In.

Bit	Description	Coil
23	ELC Force dig In x27(23)	40184
24	ELC Force dig In x30(24)	40185
25	ELC Force dig In x31(25)	40186
26	ELC Force dig In x32(26)	40187
27	ELC Force dig In x33(27)	40188
28	ELC Force dig In x34(28)	40189
29	ELC Force dig In x35(29)	40190
30	ELC Force dig In x36(30)	40191
31	ELC Force dig In x37(31)	40192
32	ELC Force dig In x40(32)	40193
33	ELC Force dig In x41(33)	40194
34	ELC Force dig In x42(34)	40195
35	ELC Force dig In x43(35)	40196
36	ELC Force dig In x44(36)	40197
37	ELC Force dig In x45(37)	40198
38	ELC Force dig In x46(38)	40199
39	ELC Force dig In x47(39)	40200
40	ELC Force dig In x50(40)	40201
41	ELC Force dig In x51(41)	40202
42	ELC Force dig In x52(42)	40203
43	ELC Force dig In x53(43)	40204
44	ELC Force dig In x54(44)	40205
45	ELC Force dig In x55(45)	40206
46	ELC Force dig In x56(46)	40207
47	ELC Force dig In x57(47)	40208
48	ELC Force dig In x60(48)	40209
49	ELC Force dig In x61(49)	40210
50	ELC Force dig In x62(50)	40211
51	ELC Force dig In x63(51)	40212
52	ELC Force dig In x64(52)	40213
53	ELC Force dig In x65(53)	40214
54	ELC Force dig In x66(54)	40215
55	ELC Force dig In x67(55)	40216
56	ELC Force dig In x70(56)	40217
57	ELC Force dig In x71(57)	40218
58	ELC Force dig In x72(58)	40219
59	ELC Force dig In x73(59)	40220
60	ELC Force dig In x74(60)	40221
61	ELC Force dig In x75(61)	40222
62	ELC Force dig In x76(62)	40223
63	ELC Force dig In x77(63)	40224
64	ELC Force dig In x100(64)	40225
65	ELC Force dig In x101(65)	40226

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2511	ELC IO Force Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Digital In.

Bit	Description	Coil
66	ELC Force dig In x102(66)	40227
67	ELC Force dig In x103(67)	40228
68	ELC Force dig In x104(68)	40229
69	ELC Force dig In x105(69)	40230
70	ELC Force dig In x106(70)	40231
71	ELC Force dig In x107(71)	40232
72	ELC Force dig In x110(72)	40233
73	ELC Force dig In x111(73)	40234
74	ELC Force dig In x112(74)	40235
75	ELC Force dig In x113(75)	40236
76	ELC Force dig In x114(76)	40237
77	ELC Force dig In x115(77)	40238
78	ELC Force dig In x116(78)	40239
79	ELC Force dig In x117(79)	40240
80	ELC Force dig In x120(80)	40241
81	ELC Force dig In x121(81)	40242
82	ELC Force dig In x122(82)	40243
83	ELC Force dig In x123(83)	40244
84	ELC Force dig In x124(84)	40245
85	ELC Force dig In x125(85)	40246
86	ELC Force dig In x126(86)	40247
87	ELC Force dig In x127(87)	40248
88	ELC Force dig In x130(88)	40249
89	ELC Force dig In x131(89)	40250
90	ELC Force dig In x132(90)	40251
91	ELC Force dig In x133(91)	40252
92	ELC Force dig In x134(92)	40253
93	ELC Force dig In x135(93)	40254
94	ELC Force dig In x136(94)	40255
95	ELC Force dig In x137(95)	40256
96	ELC Force dig In x140(96)	40257
97	ELC Force dig In x141(97)	40258
98	ELC Force dig In x142(98)	40259
99	ELC Force dig In x143(99)	40260
100	ELC Force dig In x144(100)	40261
101	ELC Force dig In x145(101)	40262
102	ELC Force dig In x146(102)	40263
103	ELC Force dig In x147(103)	40264
104	ELC Force dig In x150(104)	40265
105	ELC Force dig In x151(105)	40266
106	ELC Force dig In x152(106)	40267
107	ELC Force dig In x153(107)	40268
108	ELC Force dig In x154(108)	40269

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2511</td><td>ELC IO Force Digital In</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Force Digital In.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>109</td><td>ELC Force dig In x155(109)</td><td>40270</td></tr>
<tr><td>110</td><td>ELC Force dig In x156(110)</td><td>40271</td></tr>
<tr><td>111</td><td>ELC Force dig In x157(111)</td><td>40272</td></tr>
<tr><td>112</td><td>ELC Force dig In x160(112)</td><td>40273</td></tr>
<tr><td>113</td><td>ELC Force dig In x161(113)</td><td>40274</td></tr>
<tr><td>114</td><td>ELC Force dig In x162(114)</td><td>40275</td></tr>
<tr><td>115</td><td>ELC Force dig In x163(115)</td><td>40276</td></tr>
<tr><td>116</td><td>ELC Force dig In x164(116)</td><td>40277</td></tr>
<tr><td>117</td><td>ELC Force dig In x165(117)</td><td>40278</td></tr>
<tr><td>118</td><td>ELC Force dig In x166(118)</td><td>40279</td></tr>
<tr><td>119</td><td>ELC Force dig In x167(119)</td><td>40280</td></tr>
<tr><td>120</td><td>ELC Force dig In x170(120)</td><td>40281</td></tr>
<tr><td>121</td><td>ELC Force dig In x171(121)</td><td>40282</td></tr>
<tr><td>122</td><td>ELC Force dig In x172(122)</td><td>40283</td></tr>
<tr><td>123</td><td>ELC Force dig In x173(123)</td><td>40284</td></tr>
<tr><td>124</td><td>ELC Force dig In x174(124)</td><td>40285</td></tr>
<tr><td>125</td><td>ELC Force dig In x175(125)</td><td>40286</td></tr>
<tr><td>126</td><td>ELC Force dig In x176(126)</td><td>40287</td></tr>
<tr><td>127</td><td>ELC Force dig In x177(127)</td><td>40288</td></tr>
</table></td></tr>
<tr><td>2519</td><td>ELC IO Force Digital Out</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Force Digital Out.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>ELC Force dig Out x0(0)</td><td>40289</td></tr>
<tr><td>1</td><td>ELC Force dig Out x1(1)</td><td>40290</td></tr>
<tr><td>2</td><td>ELC Force dig Out x2(2)</td><td>40291</td></tr>
<tr><td>3</td><td>ELC Force dig Out x3(3)</td><td>40292</td></tr>
<tr><td>4</td><td>ELC Force dig Out x4(4)</td><td>40293</td></tr>
<tr><td>5</td><td>ELC Force dig Out x5(5)</td><td>40294</td></tr>
<tr><td>6</td><td>ELC Force dig Out x6(6)</td><td>40295</td></tr>
<tr><td>7</td><td>ELC Force dig Out x7(7)</td><td>40296</td></tr>
<tr><td>8</td><td>ELC Force dig Out x10(8)</td><td>40297</td></tr>
<tr><td>9</td><td>ELC Force dig Out x11(9)</td><td>40298</td></tr>
<tr><td>10</td><td>ELC Force dig Out x12(10)</td><td>40299</td></tr>
<tr><td>11</td><td>ELC Force dig Out x13(11)</td><td>40300</td></tr>
<tr><td>12</td><td>ELC Force dig Out x14(12)</td><td>40301</td></tr>
<tr><td>13</td><td>ELC Force dig Out x15(13)</td><td>40302</td></tr>
<tr><td>14</td><td>ELC Force dig Out x16(14)</td><td>40303</td></tr>
<tr><td>15</td><td>ELC Force dig Out x17(15)</td><td>40304</td></tr>
<tr><td>16</td><td>ELC Force dig Out x20(16)</td><td>40305</td></tr>
<tr><td>17</td><td>ELC Force dig Out x21(17)</td><td>40306</td></tr>
<tr><td>18</td><td>ELC Force dig Out x22(18)</td><td>40307</td></tr>
<tr><td>19</td><td>ELC Force dig Out x23(19)</td><td>40308</td></tr>
<tr><td>20</td><td>ELC Force dig Out x24(20)</td><td>40309</td></tr>
<tr><td>21</td><td>ELC Force dig Out x25(21)</td><td>40310</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2519	ELC IO Force Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Digital Out, continued.

Bit	Description	Coil
22	ELC Force dig Out x26(22)	40311
23	ELC Force dig Out x27(23)	40312
24	ELC Force dig Out x30(24)	40313
25	ELC Force dig Out x31(25)	40314
26	ELC Force dig Out x32(26)	40315
27	ELC Force dig Out x33(27)	40316
28	ELC Force dig Out x34(28)	40317
29	ELC Force dig Out x35(29)	40318
30	ELC Force dig Out x36(30)	40319
31	ELC Force dig Out x37(31)	40320
32	ELC Force dig Out x40(32)	40321
33	ELC Force dig Out x41(33)	40322
34	ELC Force dig Out x42(34)	40323
35	ELC Force dig Out x43(35)	40324
36	ELC Force dig Out x44(36)	40325
37	ELC Force dig Out x45(37)	40326
38	ELC Force dig Out x46(38)	40327
39	ELC Force dig Out x47(39)	40328
40	ELC Force dig Out x50(40)	40329
41	ELC Force dig Out x51(41)	40330
42	ELC Force dig Out x52(42)	40331
43	ELC Force dig Out x53(43)	40332
44	ELC Force dig Out x54(44)	40333
45	ELC Force dig Out x55(45)	40334
46	ELC Force dig Out x56(46)	40335
47	ELC Force dig Out x57(47)	40336
48	ELC Force dig Out x60(48)	40337
49	ELC Force dig Out x61(49)	40338
50	ELC Force dig Out x62(50)	40339
51	ELC Force dig Out x63(51)	40340
52	ELC Force dig Out x64(52)	40341
53	ELC Force dig Out x65(53)	40342
54	ELC Force dig Out x66(54)	40343
55	ELC Force dig Out x67(55)	40344
56	ELC Force dig Out x70(56)	40345
57	ELC Force dig Out x71(57)	40346
58	ELC Force dig Out x72(58)	40347
59	ELC Force dig Out x73(59)	40348
60	ELC Force dig Out x74(60)	40349
61	ELC Force dig Out x75(61)	40350
62	ELC Force dig Out x76(62)	40351
63	ELC Force dig Out x77(63)	40352
64	ELC Force dig Out x100(64)	40353

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2519	ELC IO Force Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Digital Out, continued.

Bit	Description	Coil
65	ELC Force dig Out x101(65)	40354
66	ELC Force dig Out x102(66)	40355
67	ELC Force dig Out x103(67)	40356
68	ELC Force dig Out x104(68)	40357
69	ELC Force dig Out x105(69)	40358
70	ELC Force dig Out x106(70)	40359
71	ELC Force dig Out x107(71)	40360
72	ELC Force dig Out x110(72)	40361
73	ELC Force dig Out x111(73)	40362
74	ELC Force dig Out x112(74)	40363
75	ELC Force dig Out x113(75)	40364
76	ELC Force dig Out x114(76)	40365
77	ELC Force dig Out x115(77)	40366
78	ELC Force dig Out x116(78)	40367
79	ELC Force dig Out x117(79)	40368
80	ELC Force dig Out x120(80)	40369
81	ELC Force dig Out x121(81)	40370
82	ELC Force dig Out x122(82)	40371
83	ELC Force dig Out x123(83)	40372
84	ELC Force dig Out x124(84)	40373
85	ELC Force dig Out x125(85)	40374
86	ELC Force dig Out x126(86)	40375
87	ELC Force dig Out x127(87)	40376
88	ELC Force dig Out x130(88)	40377
89	ELC Force dig Out x131(89)	40378
90	ELC Force dig Out x132(90)	40379
91	ELC Force dig Out x133(91)	40380
92	ELC Force dig Out x134(92)	40381
93	ELC Force dig Out x135(93)	40382
94	ELC Force dig Out x136(94)	40383
95	ELC Force dig Out x137(95)	40384
96	ELC Force dig Out x140(96)	40385
97	ELC Force dig Out x141(97)	40386
98	ELC Force dig Out x142(98)	40387
99	ELC Force dig Out x143(99)	40388
100	ELC Force dig Out x144(100)	40389
101	ELC Force dig Out x145(101)	40390
102	ELC Force dig Out x146(102)	40391
103	ELC Force dig Out x147(103)	40392
104	ELC Force dig Out x150(104)	40393
105	ELC Force dig Out x151(105)	40394
106	ELC Force dig Out x152(106)	40395
107	ELC Force dig Out x153(107)	40396

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2519</td><td>ELC IO Force Digital Out</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Force Digital Out, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>108</td><td>ELC Force dig Out x154(108)</td><td>40397</td></tr>
<tr><td>109</td><td>ELC Force dig Out x155(109)</td><td>40398</td></tr>
<tr><td>110</td><td>ELC Force dig Out x156(110)</td><td>40399</td></tr>
<tr><td>111</td><td>ELC Force dig Out x157(111)</td><td>40400</td></tr>
<tr><td>112</td><td>ELC Force dig Out x160(112)</td><td>40401</td></tr>
<tr><td>113</td><td>ELC Force dig Out x161(113)</td><td>40402</td></tr>
<tr><td>114</td><td>ELC Force dig Out x162(114)</td><td>40403</td></tr>
<tr><td>115</td><td>ELC Force dig Out x163(115)</td><td>40404</td></tr>
<tr><td>116</td><td>ELC Force dig Out x164(116)</td><td>40405</td></tr>
<tr><td>117</td><td>ELC Force dig Out x165(117)</td><td>40406</td></tr>
<tr><td>118</td><td>ELC Force dig Out x166(118)</td><td>40407</td></tr>
<tr><td>119</td><td>ELC Force dig Out x167(119)</td><td>40408</td></tr>
<tr><td>120</td><td>ELC Force dig Out x170(120)</td><td>40409</td></tr>
<tr><td>121</td><td>ELC Force dig Out x171(121)</td><td>40410</td></tr>
<tr><td>122</td><td>ELC Force dig Out x172(122)</td><td>40411</td></tr>
<tr><td>123</td><td>ELC Force dig Out x173(123)</td><td>40412</td></tr>
<tr><td>124</td><td>ELC Force dig Out x174(124)</td><td>40413</td></tr>
<tr><td>125</td><td>ELC Force dig Out x175(125)</td><td>40414</td></tr>
<tr><td>126</td><td>ELC Force dig Out x176(126)</td><td>40415</td></tr>
<tr><td>127</td><td>ELC Force dig Out x177(127)</td><td>40416</td></tr>
</table></td></tr>
<tr><td>2527</td><td>ELC IO Force Enable Speciality Module 1</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 1
Array of 2 registers
ELC IO Force Enable Speciality Module 1</td></tr>
<tr><td>2529</td><td>ELC IO Force Enable Speciality Module 2</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 2
Array of 2 registers
ELC IO Force Enable Speciality Module 2</td></tr>
<tr><td>2531</td><td>ELC IO Force Enable Speciality Module 3</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 3
Array of 2 registers
ELC IO Force Enable Speciality Module 3</td></tr>
<tr><td>2533</td><td>ELC IO Force Enable Speciality Module 4</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 4
Array of 2 registers
ELC IO Force Enable Speciality Module 4</td></tr>
<tr><td>2535</td><td>ELC IO Force Enable Speciality Module 5</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 5
Array of 2 registers
ELC IO Force Enable Speciality Module 5</td></tr>
<tr><td>2537</td><td>ELC IO Force Enable Speciality Module 6</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 6
Array of 2 registers
ELC IO Force Enable Speciality Module 6</td></tr>
<tr><td>2539</td><td>ELC IO Force Enable Speciality Module 7</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 7
Array of 2 registers
ELC IO Force Enable Speciality Module 7</td></tr>
<tr><td>2541</td><td>ELC IO Force Enable Speciality Module 8</td><td>UINT16 RW
Array size: 2
Default: 0</td><td>ELC IO Force Enable Speciality Module 8
Array of 2 registers
ELC IO Force Enable Speciality Module 8</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2543	ELC IO Force Enable Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Enable Digital In.

Bit	Description	Coil
0	ELC Force Enable dig In x0(0)	40673
1	ELC Force Enable dig In x1(1)	40674
2	ELC Force Enable dig In x2(2)	40675
3	ELC Force Enable dig In x3(3)	40676
4	ELC Force Enable dig In x4(4)	40677
5	ELC Force Enable dig In x5(5)	40678
6	ELC Force Enable dig In x6(6)	40679
7	ELC Force Enable dig In x7(7)	40680
8	ELC Force Enable dig In x10(8)	40681
9	ELC Force Enable dig In x11(9)	40682
10	ELC Force Enable dig In x12(10)	40683
11	ELC Force Enable dig In x13(11)	40684
12	ELC Force Enable dig In x14(12)	40685
13	ELC Force Enable dig In x15(13)	40686
14	ELC Force Enable dig In x16(14)	40687
15	ELC Force Enable dig In x17(15)	40688
16	ELC Force Enable dig In x20(16)	40689
17	ELC Force Enable dig In x21(17)	40690
18	ELC Force Enable dig In x22(18)	40691
19	ELC Force Enable dig In x23(19)	40692
20	ELC Force Enable dig In x24(20)	40693
21	ELC Force Enable dig In x25(21)	40694
22	ELC Force Enable dig In x26(22)	40695
23	ELC Force Enable dig In x27(23)	40696
24	ELC Force Enable dig In x30(24)	40697
25	ELC Force Enable dig In x31(25)	40698
26	ELC Force Enable dig In x32(26)	40699
27	ELC Force Enable dig In x33(27)	40700
28	ELC Force Enable dig In x34(28)	40701
29	ELC Force Enable dig In x35(29)	40702
30	ELC Force Enable dig In x36(30)	40703
31	ELC Force Enable dig In x37(31)	40704
32	ELC Force Enable dig In x40(32)	40705
33	ELC Force Enable dig In x41(33)	40706
34	ELC Force Enable dig In x42(34)	40707
35	ELC Force Enable dig In x43(35)	40708
36	ELC Force Enable dig In x44(36)	40709
37	ELC Force Enable dig In x45(37)	40710
38	ELC Force Enable dig In x46(38)	40711
39	ELC Force Enable dig In x47(39)	40712

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2543	ELC IO Force Enable Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Enable Digital In, continued.

Bit	Description	Coil
40	ELC Force Enable dig In x50(40)	40713
41	ELC Force Enable dig In x51(41)	40714
42	ELC Force Enable dig In x52(42)	40715
43	ELC Force Enable dig In x53(43)	40716
44	ELC Force Enable dig In x54(44)	40717
45	ELC Force Enable dig In x55(45)	40718
46	ELC Force Enable dig In x56(46)	40719
47	ELC Force Enable dig In x57(47)	40720
48	ELC Force Enable dig In x60(48)	40721
49	ELC Force Enable dig In x61(49)	40722
50	ELC Force Enable dig In x62(50)	40723
51	ELC Force Enable dig In x63(51)	40724
52	ELC Force Enable dig In x64(52)	40725
53	ELC Force Enable dig In x65(53)	40726
54	ELC Force Enable dig In x66(54)	40727
55	ELC Force Enable dig In x67(55)	40728
56	ELC Force Enable dig In x70(56)	40729
57	ELC Force Enable dig In x71(57)	40730
58	ELC Force Enable dig In x72(58)	40731
59	ELC Force Enable dig In x73(59)	40732
60	ELC Force Enable dig In x74(60)	40733
61	ELC Force Enable dig In x75(61)	40734
62	ELC Force Enable dig In x76(62)	40735
63	ELC Force Enable dig In x77(63)	40736
64	ELC Force Enable dig In x100(64)	40737
65	ELC Force Enable dig In x101(65)	40738
66	ELC Force Enable dig In x102(66)	40739
67	ELC Force Enable dig In x103(67)	40740
68	ELC Force Enable dig In x104(68)	40741
69	ELC Force Enable dig In x105(69)	40742
70	ELC Force Enable dig In x106(70)	40743
71	ELC Force Enable dig In x107(71)	40744
72	ELC Force Enable dig In x110(72)	40745
73	ELC Force Enable dig In x111(73)	40746
74	ELC Force Enable dig In x112(74)	40747
75	ELC Force Enable dig In x113(75)	40748
76	ELC Force Enable dig In x114(76)	40749
77	ELC Force Enable dig In x115(77)	40750
78	ELC Force Enable dig In x116(78)	40751
79	ELC Force Enable dig In x117(79)	40752
80	ELC Force Enable dig In x120(80)	40753
81	ELC Force Enable dig In x121(81)	40754
82	ELC Force Enable dig In x122(82)	40755
83	ELC Force Enable dig In x123(83)	40756

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2543	ELC IO Force Enable Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Enable Digital In, continued.

Bit	Description	Coil
84	ELC Force Enable dig In x124(84)	40757
85	ELC Force Enable dig In x125(85)	40758
86	ELC Force Enable dig In x126(86)	40759
87	ELC Force Enable dig In x127(87)	40760
88	ELC Force Enable dig In x130(88)	40761
89	ELC Force Enable dig In x131(89)	40762
90	ELC Force Enable dig In x132(90)	40763
91	ELC Force Enable dig In x133(91)	40764
92	ELC Force Enable dig In x134(92)	40765
93	ELC Force Enable dig In x135(93)	40766
94	ELC Force Enable dig In x136(94)	40767
95	ELC Force Enable dig In x137(95)	40768
96	ELC Force Enable dig In x140(96)	40769
97	ELC Force Enable dig In x141(97)	40770
98	ELC Force Enable dig In x142(98)	40771
99	ELC Force Enable dig In x143(99)	40772
100	ELC Force Enable dig In x144(100)	40773
101	ELC Force Enable dig In x145(101)	40774
102	ELC Force Enable dig In x146(102)	40775
103	ELC Force Enable dig In x147(103)	40776
104	ELC Force Enable dig In x150(104)	40777
105	ELC Force Enable dig In x151(105)	40778
106	ELC Force Enable dig In x152(106)	40779
107	ELC Force Enable dig In x153(107)	40780
108	ELC Force Enable dig In x154(108)	40781
109	ELC Force Enable dig In x155(109)	40782
110	ELC Force Enable dig In x156(110)	40783
111	ELC Force Enable dig In x157(111)	40784
112	ELC Force Enable dig In x160(112)	40785
113	ELC Force Enable dig In x161(113)	40786
114	ELC Force Enable dig In x162(114)	40787
115	ELC Force Enable dig In x163(115)	40788
116	ELC Force Enable dig In x164(116)	40789
117	ELC Force Enable dig In x165(117)	40790
118	ELC Force Enable dig In x166(118)	40791
119	ELC Force Enable dig In x167(119)	40792
120	ELC Force Enable dig In x170(120)	40793
121	ELC Force Enable dig In x171(121)	40794
122	ELC Force Enable dig In x172(122)	40795
123	ELC Force Enable dig In x173(123)	40796
124	ELC Force Enable dig In x174(124)	40797
125	ELC Force Enable dig In x175(125)	40798
126	ELC Force Enable dig In x176(126)	40799
127	ELC Force Enable dig In x177(127)	40800

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2551	ELC IO Force Enable Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Enable Digital Out.

Bit	Description	Coil
0	ELC Force Enable dig Out x0(0)	40801
1	ELC Force Enable dig Out x1(1)	40802
2	ELC Force Enable dig Out x2(2)	40803
3	ELC Force Enable dig Out x3(3)	40804
4	ELC Force Enable dig Out x4(4)	40805
5	ELC Force Enable dig Out x5(5)	40806
6	ELC Force Enable dig Out x6(6)	40807
7	ELC Force Enable dig Out x7(7)	40808
8	ELC Force Enable dig Out x10(8)	40809
9	ELC Force Enable dig Out x11(9)	40810
10	ELC Force Enable dig Out x12(10)	40811
11	ELC Force Enable dig Out x13(11)	40812
12	ELC Force Enable dig Out x14(12)	40813
13	ELC Force Enable dig Out x15(13)	40814
14	ELC Force Enable dig Out x16(14)	40815
15	ELC Force Enable dig Out x17(15)	40816
16	ELC Force Enable dig Out x20(16)	40817
17	ELC Force Enable dig Out x21(17)	40818
18	ELC Force Enable dig Out x22(18)	40819
19	ELC Force Enable dig Out x23(19)	40820
20	ELC Force Enable dig Out x24(20)	40821
21	ELC Force Enable dig Out x25(21)	40822
22	ELC Force Enable dig Out x26(22)	40823
23	ELC Force Enable dig Out x27(23)	40824
24	ELC Force Enable dig Out x30(24)	40825
25	ELC Force Enable dig Out x31(25)	40826
26	ELC Force Enable dig Out x32(26)	40827
27	ELC Force Enable dig Out x33(27)	40828
28	ELC Force Enable dig Out x34(28)	40829
29	ELC Force Enable dig Out x35(29)	40830
30	ELC Force Enable dig Out x36(30)	40831
31	ELC Force Enable dig Out x37(31)	40832
32	ELC Force Enable dig Out x40(32)	40833
33	ELC Force Enable dig Out x41(33)	40834
34	ELC Force Enable dig Out x42(34)	40835
35	ELC Force Enable dig Out x43(35)	40836
36	ELC Force Enable dig Out x44(36)	40837
37	ELC Force Enable dig Out x45(37)	40838
38	ELC Force Enable dig Out x46(38)	40839
39	ELC Force Enable dig Out x47(39)	40840
40	ELC Force Enable dig Out x50(40)	40841
41	ELC Force Enable dig Out x51(41)	40842
42	ELC Force Enable dig Out x52(42)	40843
43	ELC Force Enable dig Out x53(43)	40844

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2551	ELC IO Force Enable Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Enable Digital Out, continued.

Bit	Description	Coil
44	ELC Force Enable dig Out x54(44)	40845
45	ELC Force Enable dig Out x55(45)	40846
46	ELC Force Enable dig Out x56(46)	40847
47	ELC Force Enable dig Out x57(47)	40848
48	ELC Force Enable dig Out x60(48)	40849
49	ELC Force Enable dig Out x61(49)	40850
50	ELC Force Enable dig Out x62(50)	40851
51	ELC Force Enable dig Out x63(51)	40852
52	ELC Force Enable dig Out x64(52)	40853
53	ELC Force Enable dig Out x65(53)	40854
54	ELC Force Enable dig Out x66(54)	40855
55	ELC Force Enable dig Out x67(55)	40856
56	ELC Force Enable dig Out x70(56)	40857
57	ELC Force Enable dig Out x71(57)	40858
58	ELC Force Enable dig Out x72(58)	40859
59	ELC Force Enable dig Out x73(59)	40860
60	ELC Force Enable dig Out x74(60)	40861
61	ELC Force Enable dig Out x75(61)	40862
62	ELC Force Enable dig Out x76(62)	40863
63	ELC Force Enable dig Out x77(63)	40864
64	ELC Force Enable dig Out x100(64)	40865
65	ELC Force Enable dig Out x101(65)	40866
66	ELC Force Enable dig Out x102(66)	40867
67	ELC Force Enable dig Out x103(67)	40868
68	ELC Force Enable dig Out x104(68)	40869
69	ELC Force Enable dig Out x105(69)	40870
70	ELC Force Enable dig Out x106(70)	40871
71	ELC Force Enable dig Out x107(71)	40872
72	ELC Force Enable dig Out x110(72)	40873
73	ELC Force Enable dig Out x111(73)	40874
74	ELC Force Enable dig Out x112(74)	40875
75	ELC Force Enable dig Out x113(75)	40876
76	ELC Force Enable dig Out x114(76)	40877
77	ELC Force Enable dig Out x115(77)	40878
78	ELC Force Enable dig Out x116(78)	40879
79	ELC Force Enable dig Out x117(79)	40880
80	ELC Force Enable dig Out x120(80)	40881
81	ELC Force Enable dig Out x121(81)	40882
82	ELC Force Enable dig Out x122(82)	40883
83	ELC Force Enable dig Out x123(83)	40884
84	ELC Force Enable dig Out x124(84)	40885
85	ELC Force Enable dig Out x125(85)	40886
86	ELC Force Enable dig Out x126(86)	40887
87	ELC Force Enable dig Out x127(87)	40888

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2551	ELC IO Force Enable Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Force Enable Digital Out, continued.

Bit	Description	Coil
88	ELC Force Enable dig Out x130(88)	40889
89	ELC Force Enable dig Out x131(89)	40890
90	ELC Force Enable dig Out x132(90)	40891
91	ELC Force Enable dig Out x133(91)	40892
92	ELC Force Enable dig Out x134(92)	40893
93	ELC Force Enable dig Out x135(93)	40894
94	ELC Force Enable dig Out x136(94)	40895
95	ELC Force Enable dig Out x137(95)	40896
96	ELC Force Enable dig Out x140(96)	40897
97	ELC Force Enable dig Out x141(97)	40898
98	ELC Force Enable dig Out x142(98)	40899
99	ELC Force Enable dig Out x143(99)	40900
100	ELC Force Enable dig Out x144(100)	40901
101	ELC Force Enable dig Out x145(101)	40902
102	ELC Force Enable dig Out x146(102)	40903
103	ELC Force Enable dig Out x147(103)	40904
104	ELC Force Enable dig Out x150(104)	40905
105	ELC Force Enable dig Out x151(105)	40906
106	ELC Force Enable dig Out x152(106)	40907
107	ELC Force Enable dig Out x153(107)	40908
108	ELC Force Enable dig Out x154(108)	40909
109	ELC Force Enable dig Out x155(109)	40910
110	ELC Force Enable dig Out x156(110)	40911
111	ELC Force Enable dig Out x157(111)	40912
112	ELC Force Enable dig Out x160(112)	40913
113	ELC Force Enable dig Out x161(113)	40914
114	ELC Force Enable dig Out x162(114)	40915
115	ELC Force Enable dig Out x163(115)	40916
116	ELC Force Enable dig Out x164(116)	40917
117	ELC Force Enable dig Out x165(117)	40918
118	ELC Force Enable dig Out x166(118)	40919
119	ELC Force Enable dig Out x167(119)	40920
120	ELC Force Enable dig Out x170(120)	40921
121	ELC Force Enable dig Out x171(121)	40922
122	ELC Force Enable dig Out x172(122)	40923
123	ELC Force Enable dig Out x173(123)	40924
124	ELC Force Enable dig Out x174(124)	40925
125	ELC Force Enable dig Out x175(125)	40926
126	ELC Force Enable dig Out x176(126)	40927
127	ELC Force Enable dig Out x177(127)	40928

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2559</td><td>Fault/Warning configuration</td><td>BYTE RW NV
Array size: 4
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Fault/Warning configuration - When a bit is set to 0, a fault is thrown, when set to 1, a warning is thrown.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Logic program underrun</td><td>40929</td></tr>
<tr><td>1</td><td>Logic program overrun</td><td>40930</td></tr>
<tr><td>2</td><td>Logic task watchdog</td><td>40931</td></tr>
<tr><td>3</td><td>Logic instruction invalid instance number</td><td>40932</td></tr>
<tr><td>4</td><td>Logic instruction invalid argument</td><td>40933</td></tr>
<tr><td>5</td><td>Logic math - divide by zero</td><td>40934</td></tr>
<tr><td>6</td><td>Logic math - underflow</td><td>40935</td></tr>
<tr><td>7</td><td>Logic math - overflow</td><td>40936</td></tr>
<tr><td>8</td><td>ELC IO Comm loss</td><td>40937</td></tr>
<tr><td>9</td><td>ELC IO Comm error</td><td>40938</td></tr>
<tr><td>10</td><td>Generic Modbus slave comm loss</td><td>40939</td></tr>
<tr><td>11</td><td>Generic Modbus slave comm error</td><td>40940</td></tr>
<tr><td>12</td><td>Logic Program accessing ELC IO but ELC IO not configured</td><td>40941</td></tr>
</table></td></tr>
<tr><td>2561</td><td>Logic error info - Program Id</td><td>UINT16 RO
Default: 0</td><td>Logic error info - Program Id
Logic error info - Program Id</td></tr>
<tr><td>2562</td><td>Logic error info - Program Counter</td><td>UINT32 RO
Default: 0</td><td>Logic error info - Program Counter
Logic error info - Program Counter</td></tr>
<tr><td>2564</td><td>Logic error info - Error Data</td><td>UINT32 RO
Default: 0</td><td>Logic error info - Error Data
Logic error info - Error Data</td></tr>
<tr><td>2566</td><td>Logic Run Control</td><td>BYTE RW NV
Default: 0
Bitfield
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Logic Run Control
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Run</td><td>41041</td></tr>
</table></td></tr>
<tr><td>2567</td><td>Logic Run Status</td><td>BYTE RO
Default: 0
Bitfield</td><td>Logic Run Status
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Logic Running</td><td>41057</td></tr>
</table></td></tr>
<tr><td>2568</td><td>ELC IO Speciality Module config location</td><td>UINT8 RW NV
Default: 0
Enum
Admin Lock
Backup Mem</td><td>ELC IO Speciality Module config location
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>C445</td><td>ELC10</td></tr>
</table></td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2569</td><td>ELC IO Status</td><td>BYTE RO
Array size: 4
Bitfield</td><td>ELC IO Status.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>485 port not configured for ELC IO</td><td>41089</td></tr>
<tr><td>1</td><td>Syncing configuration</td><td>41090</td></tr>
<tr><td>2</td><td>Running</td><td>41091</td></tr>
<tr><td>3</td><td>Comm Loss</td><td>41092</td></tr>
<tr><td>4</td><td>Comm Error</td><td>41093</td></tr>
<tr><td>5</td><td>Invalid number of digital inputs</td><td>41094</td></tr>
<tr><td>6</td><td>Invalid number of digital outputs</td><td>41095</td></tr>
<tr><td>7</td><td>Invalid specialty module 1 code</td><td>41096</td></tr>
<tr><td>8</td><td>Invalid specialty module 2 code</td><td>41097</td></tr>
<tr><td>9</td><td>Invalid specialty module 3 code</td><td>41098</td></tr>
<tr><td>10</td><td>Invalid specialty module 4 code</td><td>41099</td></tr>
<tr><td>11</td><td>Invalid specialty module 5 code</td><td>41100</td></tr>
<tr><td>12</td><td>Invalid specialty module 6 code</td><td>41101</td></tr>
<tr><td>13</td><td>Invalid specialty module 7 code</td><td>41102</td></tr>
<tr><td>14</td><td>Invalid specialty module 8 code</td><td>41103</td></tr>
</table></td></tr>
<tr><td>2571</td><td>ELC IO Analog Update interval</td><td>UINT16 RO
Units: mSec</td><td>ELC IO Analog Update interval
ELC IO Analog Update interval</td></tr>
<tr><td>2572</td><td>ELC IO Digital Update interval</td><td>UINT16 RO
Units: mSec</td><td>ELC IO Digital Update interval
ELC IO Digital Update interval</td></tr>
<tr><td>2573</td><td>ELC IO Actual Speciality Module 1</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 1
Array of 30 registers
ELC IO Actual Speciality Module 1</td></tr>
<tr><td>2603</td><td>ELC IO Actual Speciality Module 2</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 2
Array of 30 registers
ELC IO Actual Speciality Module 2</td></tr>
<tr><td>2633</td><td>ELC IO Actual Speciality Module 3</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 3
Array of 30 registers
ELC IO Actual Speciality Module 3</td></tr>
<tr><td>2663</td><td>ELC IO Actual Speciality Module 4</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 4
Array of 30 registers
ELC IO Actual Speciality Module 4</td></tr>
<tr><td>2693</td><td>ELC IO Actual Speciality Module 5</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 5
Array of 30 registers
ELC IO Actual Speciality Module 5</td></tr>
<tr><td>2723</td><td>ELC IO Actual Speciality Module 6</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 6
Array of 30 registers
ELC IO Actual Speciality Module 6</td></tr>
<tr><td>2753</td><td>ELC IO Actual Speciality Module 7</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 7
Array of 30 registers
ELC IO Actual Speciality Module 7</td></tr>
<tr><td>2783</td><td>ELC IO Actual Speciality Module 8</td><td>UINT16 RW
Array size: 30
Default: 0</td><td>ELC IO Actual Speciality Module 8
Array of 30 registers
ELC IO Actual Speciality Module 8</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2813	ELC IO Actual Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Actual Digital In

Bit	Description	Coil
0	ELC Force dig In x0(0)	44993
1	ELC Force dig In x1(1)	44994
2	ELC Force dig In x2(2)	44995
3	ELC Force dig In x3(3)	44996
4	ELC Force dig In x4(4)	44997
5	ELC Force dig In x5(5)	44998
6	ELC Force dig In x6(6)	44999
7	ELC Force dig In x7(7)	45000
8	ELC Force dig In x10(8)	45001
9	ELC Force dig In x11(9)	45002
10	ELC Force dig In x12(10)	45003
11	ELC Force dig In x13(11)	45004
12	ELC Force dig In x14(12)	45005
13	ELC Force dig In x15(13)	45006
14	ELC Force dig In x16(14)	45007
15	ELC Force dig In x17(15)	45008
16	ELC Force dig In x20(16)	45009
17	ELC Force dig In x21(17)	45010
18	ELC Force dig In x22(18)	45011
19	ELC Force dig In x23(19)	45012
20	ELC Force dig In x24(20)	45013
21	ELC Force dig In x25(21)	45014
22	ELC Force dig In x26(22)	45015
23	ELC Force dig In x27(23)	45016
24	ELC Force dig In x30(24)	45017
25	ELC Force dig In x31(25)	45018
26	ELC Force dig In x32(26)	45019
27	ELC Force dig In x33(27)	45020
28	ELC Force dig In x34(28)	45021
29	ELC Force dig In x35(29)	45022
30	ELC Force dig In x36(30)	45023
31	ELC Force dig In x37(31)	45024
32	ELC Force dig In x40(32)	45025
33	ELC Force dig In x41(33)	45026
34	ELC Force dig In x42(34)	45027
35	ELC Force dig In x43(35)	45028
36	ELC Force dig In x44(36)	45029
37	ELC Force dig In x45(37)	45030
38	ELC Force dig In x46(38)	45031
39	ELC Force dig In x47(39)	45032
40	ELC Force dig In x50(40)	45033

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2813	ELC IO Actual Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Actual Digital In, continued

Bit	Description	Coil
41	ELC Force dig In x51(41)	45034
42	ELC Force dig In x52(42)	45035
43	ELC Force dig In x53(43)	45036
44	ELC Force dig In x54(44)	45037
45	ELC Force dig In x55(45)	45038
46	ELC Force dig In x56(46)	45039
47	ELC Force dig In x57(47)	45040
48	ELC Force dig In x60(48)	45041
49	ELC Force dig In x61(49)	45042
50	ELC Force dig In x62(50)	45043
51	ELC Force dig In x63(51)	45044
52	ELC Force dig In x64(52)	45045
53	ELC Force dig In x65(53)	45046
54	ELC Force dig In x66(54)	45047
55	ELC Force dig In x67(55)	45048
56	ELC Force dig In x70(56)	45049
57	ELC Force dig In x71(57)	45050
58	ELC Force dig In x72(58)	45051
59	ELC Force dig In x73(59)	45052
60	ELC Force dig In x74(60)	45053
61	ELC Force dig In x75(61)	45054
62	ELC Force dig In x76(62)	45055
63	ELC Force dig In x77(63)	45056
64	ELC Force dig In x100(64)	45057
65	ELC Force dig In x101(65)	45058
66	ELC Force dig In x102(66)	45059
67	ELC Force dig In x103(67)	45060
68	ELC Force dig In x104(68)	45061
69	ELC Force dig In x105(69)	45062
70	ELC Force dig In x106(70)	45063
71	ELC Force dig In x107(71)	45064
72	ELC Force dig In x110(72)	45065
73	ELC Force dig In x111(73)	45066
74	ELC Force dig In x112(74)	45067
75	ELC Force dig In x113(75)	45068
76	ELC Force dig In x114(76)	45069
77	ELC Force dig In x115(77)	45070
78	ELC Force dig In x116(78)	45071
79	ELC Force dig In x117(79)	45072
80	ELC Force dig In x120(80)	45073
81	ELC Force dig In x121(81)	45074
82	ELC Force dig In x122(82)	45075
83	ELC Force dig In x123(83)	45076
84	ELC Force dig In x124(84)	45077

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2813	ELC IO Actual Digital In	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Actual Digital In, continued

Bit	Description	Coil
85	ELC Force dig In x125(85)	45078
86	ELC Force dig In x126(86)	45079
87	ELC Force dig In x127(87)	45080
88	ELC Force dig In x130(88)	45081
89	ELC Force dig In x131(89)	45082
90	ELC Force dig In x132(90)	45083
91	ELC Force dig In x133(91)	45084
92	ELC Force dig In x134(92)	45085
93	ELC Force dig In x135(93)	45086
94	ELC Force dig In x136(94)	45087
95	ELC Force dig In x137(95)	45088
96	ELC Force dig In x140(96)	45089
97	ELC Force dig In x141(97)	45090
98	ELC Force dig In x142(98)	45091
99	ELC Force dig In x143(99)	45092
100	ELC Force dig In x144(100)	45093
101	ELC Force dig In x145(101)	45094
102	ELC Force dig In x146(102)	45095
103	ELC Force dig In x147(103)	45096
104	ELC Force dig In x150(104)	45097
105	ELC Force dig In x151(105)	45098
106	ELC Force dig In x152(106)	45099
107	ELC Force dig In x153(107)	45100
108	ELC Force dig In x154(108)	45101
109	ELC Force dig In x155(109)	45102
110	ELC Force dig In x156(110)	45103
111	ELC Force dig In x157(111)	45104
112	ELC Force dig In x160(112)	45105
113	ELC Force dig In x161(113)	45106
114	ELC Force dig In x162(114)	45107
115	ELC Force dig In x163(115)	45108
116	ELC Force dig In x164(116)	45109
117	ELC Force dig In x165(117)	45110
118	ELC Force dig In x166(118)	45111
119	ELC Force dig In x167(119)	45112
120	ELC Force dig In x170(120)	45113
121	ELC Force dig In x171(121)	45114
122	ELC Force dig In x172(122)	45115
123	ELC Force dig In x173(123)	45116
124	ELC Force dig In x174(124)	45117
125	ELC Force dig In x175(125)	45118
126	ELC Force dig In x176(126)	45119
127	ELC Force dig In x177(127)	45120

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2821	ELC IO Actual Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Actual Digital Out.

Bit	Description	Coil
0	ELC Force dig In x0(0)	45121
1	ELC Force dig In x1(1)	45122
2	ELC Force dig In x2(2)	45123
3	ELC Force dig In x3(3)	45124
4	ELC Force dig In x4(4)	45125
5	ELC Force dig In x5(5)	45126
6	ELC Force dig In x6(6)	45127
7	ELC Force dig In x7(7)	45128
8	ELC Force dig In x10(8)	45129
9	ELC Force dig In x11(9)	45130
10	ELC Force dig In x12(10)	45131
11	ELC Force dig In x13(11)	45132
12	ELC Force dig In x14(12)	45133
13	ELC Force dig In x15(13)	45134
14	ELC Force dig In x16(14)	45135
15	ELC Force dig In x17(15)	45136
16	ELC Force dig In x20(16)	45137
17	ELC Force dig In x21(17)	45138
18	ELC Force dig In x22(18)	45139
19	ELC Force dig In x23(19)	45140
20	ELC Force dig In x24(20)	45141
21	ELC Force dig In x25(21)	45142
22	ELC Force dig In x26(22)	45143
23	ELC Force dig In x27(23)	45144
24	ELC Force dig In x30(24)	45145
25	ELC Force dig In x31(25)	45146
26	ELC Force dig In x32(26)	45147
27	ELC Force dig In x33(27)	45148
28	ELC Force dig In x34(28)	45149
29	ELC Force dig In x35(29)	45150
30	ELC Force dig In x36(30)	45151
31	ELC Force dig In x37(31)	45152
32	ELC Force dig In x40(32)	45153
33	ELC Force dig In x41(33)	45154
34	ELC Force dig In x42(34)	45155
35	ELC Force dig In x43(35)	45156
36	ELC Force dig In x44(36)	45157
37	ELC Force dig In x45(37)	45158
38	ELC Force dig In x46(38)	45159
39	ELC Force dig In x47(39)	45160
40	ELC Force dig In x50(40)	45161
41	ELC Force dig In x51(41)	45162
42	ELC Force dig In x52(42)	45163
43	ELC Force dig In x53(43)	45164

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
2821	ELC IO Actual Digital Out	BYTE RW Array size: 16 Default: 0 Bitfield	ELC IO Actual Digital Out, continued.

Bit	Description	Coil
44	ELC Force dig In x54(44)	45165
45	ELC Force dig In x55(45)	45166
46	ELC Force dig In x56(46)	45167
47	ELC Force dig In x57(47)	45168
48	ELC Force dig In x60(48)	45169
49	ELC Force dig In x61(49)	45170
50	ELC Force dig In x62(50)	45171
51	ELC Force dig In x63(51)	45172
52	ELC Force dig In x64(52)	45173
53	ELC Force dig In x65(53)	45174
54	ELC Force dig In x66(54)	45175
55	ELC Force dig In x67(55)	45176
56	ELC Force dig In x70(56)	45177
57	ELC Force dig In x71(57)	45178
58	ELC Force dig In x72(58)	45179
59	ELC Force dig In x73(59)	45180
60	ELC Force dig In x74(60)	45181
61	ELC Force dig In x75(61)	45182
62	ELC Force dig In x76(62)	45183
63	ELC Force dig In x77(63)	45184
64	ELC Force dig In x100(64)	45185
65	ELC Force dig In x101(65)	45186
66	ELC Force dig In x102(66)	45187
67	ELC Force dig In x103(67)	45188
68	ELC Force dig In x104(68)	45189
69	ELC Force dig In x105(69)	45190
70	ELC Force dig In x106(70)	45191
71	ELC Force dig In x107(71)	45192
72	ELC Force dig In x110(72)	45193
73	ELC Force dig In x111(73)	45194
74	ELC Force dig In x112(74)	45195
75	ELC Force dig In x113(75)	45196
76	ELC Force dig In x114(76)	45197
77	ELC Force dig In x115(77)	45198
78	ELC Force dig In x116(78)	45199
79	ELC Force dig In x117(79)	45200
80	ELC Force dig In x120(80)	45201
81	ELC Force dig In x121(81)	45202
82	ELC Force dig In x122(82)	45203
83	ELC Force dig In x123(83)	45204
84	ELC Force dig In x124(84)	45205
85	ELC Force dig In x125(85)	45206
86	ELC Force dig In x126(86)	45207
87	ELC Force dig In x127(87)	45208

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>2821</td><td>ELC IO Actual Digital Out</td><td>BYTE RW
Array size: 16
Default: 0
Bitfield</td><td>ELC IO Actual Digital Out, continued.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>88</td><td>ELC Force dig In x130(88)</td><td>45209</td></tr>
<tr><td>89</td><td>ELC Force dig In x131(89)</td><td>45210</td></tr>
<tr><td>90</td><td>ELC Force dig In x132(90)</td><td>45211</td></tr>
<tr><td>91</td><td>ELC Force dig In x133(91)</td><td>45212</td></tr>
<tr><td>92</td><td>ELC Force dig In x134(92)</td><td>45213</td></tr>
<tr><td>93</td><td>ELC Force dig In x135(93)</td><td>45214</td></tr>
<tr><td>94</td><td>ELC Force dig In x136(94)</td><td>45215</td></tr>
<tr><td>95</td><td>ELC Force dig In x137(95)</td><td>45216</td></tr>
<tr><td>96</td><td>ELC Force dig In x140(96)</td><td>45217</td></tr>
<tr><td>97</td><td>ELC Force dig In x141(97)</td><td>45218</td></tr>
<tr><td>98</td><td>ELC Force dig In x142(98)</td><td>45219</td></tr>
<tr><td>99</td><td>ELC Force dig In x143(99)</td><td>45220</td></tr>
<tr><td>100</td><td>ELC Force dig In x144(100)</td><td>45221</td></tr>
<tr><td>101</td><td>ELC Force dig In x145(101)</td><td>45222</td></tr>
<tr><td>102</td><td>ELC Force dig In x146(102)</td><td>45223</td></tr>
<tr><td>103</td><td>ELC Force dig In x147(103)</td><td>45224</td></tr>
<tr><td>104</td><td>ELC Force dig In x150(104)</td><td>45225</td></tr>
<tr><td>105</td><td>ELC Force dig In x151(105)</td><td>45226</td></tr>
<tr><td>106</td><td>ELC Force dig In x152(106)</td><td>45227</td></tr>
<tr><td>107</td><td>ELC Force dig In x153(107)</td><td>45228</td></tr>
<tr><td>108</td><td>ELC Force dig In x154(108)</td><td>45229</td></tr>
<tr><td>109</td><td>ELC Force dig In x155(109)</td><td>45230</td></tr>
<tr><td>110</td><td>ELC Force dig In x156(110)</td><td>45231</td></tr>
<tr><td>111</td><td>ELC Force dig In x157(111)</td><td>45232</td></tr>
<tr><td>112</td><td>ELC Force dig In x160(112)</td><td>45233</td></tr>
<tr><td>113</td><td>ELC Force dig In x161(113)</td><td>45234</td></tr>
<tr><td>114</td><td>ELC Force dig In x162(114)</td><td>45235</td></tr>
<tr><td>115</td><td>ELC Force dig In x163(115)</td><td>45236</td></tr>
<tr><td>116</td><td>ELC Force dig In x164(116)</td><td>45237</td></tr>
<tr><td>117</td><td>ELC Force dig In x165(117)</td><td>45238</td></tr>
<tr><td>118</td><td>ELC Force dig In x166(118)</td><td>45239</td></tr>
<tr><td>119</td><td>ELC Force dig In x167(119)</td><td>45240</td></tr>
<tr><td>120</td><td>ELC Force dig In x170(120)</td><td>45241</td></tr>
<tr><td>121</td><td>ELC Force dig In x171(121)</td><td>45242</td></tr>
<tr><td>122</td><td>ELC Force dig In x172(122)</td><td>45243</td></tr>
<tr><td>123</td><td>ELC Force dig In x173(123)</td><td>45244</td></tr>
<tr><td>124</td><td>ELC Force dig In x174(124)</td><td>45245</td></tr>
<tr><td>125</td><td>ELC Force dig In x175(125)</td><td>45246</td></tr>
<tr><td>126</td><td>ELC Force dig In x176(126)</td><td>45247</td></tr>
<tr><td>127</td><td>ELC Force dig In x177(127)</td><td>45248</td></tr>
</table></td></tr>
<tr><td>3000</td><td>Modbus Scan Data</td><td>UINT16 RW
Array size: 32</td><td>Data used for Modbus Scan List. The actual data for each register selected with the Modbus Scan List parameter will be displayed in this parameter for Modbus read data and data can be entered into this parameter for Modbus writes.
Array of 32 registers</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>3032</td><td>Modbus Scan List</td><td>UINT16 RW NV
Array size: 32
Default: 0
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>The Modbus scan registers can be used to create a custom Modbus data block. This allows various non-contiguous Register Numbers to be entered in this list and be read or written with a single modbus command. The Modbus addresses for this block of data are entered here and the actual data for each register will be displayed in the Modbus Scan Data parameter for Modbus read data and data can be entered into the Modbus Scan Data parameter for Modbus writes. The Modbus register numbers for all parameters can be found in the C445 User Manual, Appendix D. The starting Modbus address to read or write this custom data block is register 3000.
Array of 32 registers</td></tr>
<tr><td>4000</td><td>RTC Time</td><td>UINT8 RO
Array size: 3</td><td>Real Time Clock Time in hh:mm:ss format (24 hour format)
Array of 2 registers</td></tr>
<tr><td>4002</td><td>RTC Year</td><td>UINT16 RW
Range: 2000 to 2099</td><td>Real Time Clock - year</td></tr>
<tr><td>4003</td><td>RTC Month</td><td>UINT8 RW
Enum</td><td>Real Time Clock Month
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>1</td><td>January</td></tr>
<tr><td>2</td><td>February</td></tr>
<tr><td>3</td><td>March</td></tr>
<tr><td>4</td><td>April</td></tr>
<tr><td>5</td><td>May</td></tr>
<tr><td>6</td><td>June</td></tr>
<tr><td>7</td><td>July</td></tr>
<tr><td>8</td><td>August</td></tr>
<tr><td>9</td><td>September</td></tr>
<tr><td>10</td><td>October</td></tr>
<tr><td>11</td><td>November</td></tr>
<tr><td>12</td><td>December</td></tr>
</table></td></tr>
<tr><td>4004</td><td>RTC Day of Month</td><td>UINT8 RW</td><td>Real Time Clock Day of Month</td></tr>
<tr><td>4005</td><td>RTC Time Hours</td><td>UINT8 RW</td><td>Real Time Clock Time hours</td></tr>
<tr><td>4006</td><td>RTC Time Minutes</td><td>UINT8 RW</td><td>Real Time Clock Time minutes</td></tr>
<tr><td>4007</td><td>RTC Time Seconds</td><td>UINT8 RW</td><td>Real Time Clock Time seconds</td></tr>
<tr><td>4008</td><td>RTC Time (milliseconds)</td><td>UINT16 RO</td><td>Real Time Clock Time milliseconds</td></tr>
<tr><td>4009</td><td>RTC Power Interrupted</td><td>UINT8 RO
Default: 0
Enum
Backup Mem</td><td>Real Time Clock backup power has been interrupted: 0 = Power Not Interrupted, 1 = Power Interrupted.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Power not interrupted</td></tr>
<tr><td>1</td><td>Power interrupted</td></tr>
</table></td></tr>
<tr><td>4010</td><td>RTC Time In UNIX format</td><td>UINT32 RO
Units: seconds</td><td>Real Time Clock time in seconds from UNIX epoch</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>4012</td><td>RTC Status</td><td>UINT8 RO
Enum</td><td>Real Time Clock Status: 0 = Running, 1 = Initializing, 2 = Real Time Clock not present, 3 = internal error.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Running</td></tr>
<tr><td>1</td><td>Initializing</td></tr>
<tr><td>2</td><td>Real time clock not present</td></tr>
<tr><td>3</td><td>Internal error</td></tr>
</table></td></tr>
<tr><td>4013</td><td>RTC Time Set Status</td><td>UINT8 RO
Enum</td><td>Real Time Clock Time Set Status: 0 = Initial Value, 1 = Successful, 2 = In Progress, 3 = Wrong Input, 4 = Conversion out of range, 5 = Internal Error
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Initial value</td></tr>
<tr><td>1</td><td>Successful</td></tr>
<tr><td>2</td><td>Set in progress</td></tr>
<tr><td>3</td><td>Wrong data</td></tr>
<tr><td>4</td><td>Conversion out of range</td></tr>
<tr><td>5</td><td>Internal error</td></tr>
</table></td></tr>
<tr><td>4014</td><td>RTC Time Zone DST Setting Status</td><td>UINT8 RO
Enum
Config CRC
Admin Lock
USB Lock</td><td>Real Time Clock Time Zone DST Setting Status: 0 = Okay, 1 = Manual Rule error, 2 = Time Zone error, 3 = Conversion out of range, 4 = Internal error.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Okay</td></tr>
<tr><td>1</td><td>Manual rule error</td></tr>
<tr><td>2</td><td>Time zone error</td></tr>
<tr><td>3</td><td>Conversion out of range</td></tr>
<tr><td>4</td><td>Internal error</td></tr>
</table></td></tr>
<tr><td>4015</td><td>RTC DST Rule</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Real Time Clock DST Rule Selection: 0 = No daylight savings time, 1 = Manually set DST start and end, 2 = Europe, 3 = United States of America, 4 = Australia, 5 = Brazil, 6 = New Zealand, 7 = United States before 2007.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No daylight savings time</td></tr>
<tr><td>1</td><td>Manually set DST start and end</td></tr>
<tr><td>2</td><td>Europe</td></tr>
<tr><td>3</td><td>United States of America</td></tr>
<tr><td>4</td><td>Australia</td></tr>
<tr><td>5</td><td>Brazil</td></tr>
<tr><td>6</td><td>New Zealand</td></tr>
<tr><td>7</td><td>United States before 2007</td></tr>
</table></td></tr>
<tr><td>4016</td><td>RTC DST End</td><td>UINT8 RW NV
Array size: 5
Default: 11, 1, 7, 2, 0
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Real Time Clock Manual Daylight Savings Time Rule End date/time (Element 0 = month, Element 1 = week, Element 2 = weekday, Element 3 = hour, Element 4 = minute).
Array of 3 registers</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
4019	RTC DST Start	UINT8 RW NV Array size: 5 Default: 3, 2, 7, 2, 0 Config CRC Admin Lock USB Lock Backup Mem	Real Time Clock Manual Daylight Savings Time Rule Start date/time (Element 0 = month, Element 1 = week, Element 2 = weekday, Element 3 = hour, Element 4 = minute). Array of 3 registers
4022	RTC Month and Date	UINT8 RO Array size: 2	Real Time Clock Month and Date Array of 1 registers
4023	RTC Time Zone Ahead of UTC	UINT8 RW NV Default: 0 Enum Config CRC Admin Lock USB Lock Backup Mem	Real Time Clock calculation for Time Zone ahead of UTC. If true, UTC+hh:mm; otherwise UTC-hh:mm Value / Description: 0 — UTC - hh: mm 1 — UTC + hh: mm
4024	RTC Time Zone hh mm	UINT8 RW NV Array size: 2 Default: 0 Config CRC Admin Lock USB Lock Backup Mem	Time zone assignment (UTC+/-hh:mm). Where 0xhhmm. Element [0] = Minutes Element [1] = Hours Array of 1 register
5000	Admin Password	UINT32 RW Default: 0x00000000 Config CRC Admin Lock USB Lock Backup Mem	Set administrator password (0x00000000 means no password)
5002	Admin Login	UINT32 RW	Log in with administrator password
5004	USB Password	UINT32 RW Default: 0x00000000 Config CRC Admin Lock USB Lock Backup Mem	Set USB port password (0x00000000 means no password)
5006	USB Login	UINT32 RW	Log in with USB Port administrator password
5008	Run Lock Override	BOOL RW NV Default: 0 Config CRC Admin Lock USB Lock Backup Mem	When the motor is either running or is being commanded to run, certain protection and control parameters are locked. To disable this lock and allow parameters to be adjusted during motor run time, check this box. To restrict access during run time, uncheck this box. It is not recommended to change configuration parameters while running.
5009	Motor Running Parameter Access Lock	INTERNAL UINT8 RO	Indicates whether the Motor Running Parameter Access Lock is currently locked. If this parameter is high then the lock is active and the run lock parameters will be in a read only state.
5010	Param Lock	INTERNAL UINT8 RO	Indicates whether the Admin Password Parameter Access Lock is currently locked. If this parameter is high then the lock is active and the admin lock parameters will be in a read only state.
5011	USB Param Lock State	INTERNAL UINT8 RO	When this bit is high the USB Parameter Access lock is enabled. Parameters covered by the USB Param lock will be read only during this time.

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>6000</td><td>Modbus Address</td><td>UINT8 RW NV
Default: 1
Range: 1 to 247
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Modbus Address for the Base Control Module's RS-485 port. The address is loaded at startup. A power cycle is required for change in address to take effect.</td></tr>
<tr><td>6001</td><td>Modbus Baud Rate</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Selects the Modbus Baud Rate for the Base Control Module's RS-485 Modbus port. A power cycle is required for change in baud rate to take effect. 0 = 19200 baud, 1 = 9600 baud, 2 = 38400 baud, 3 = 57600 baud, 4 = 115200 baud.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>19200</td></tr>
<tr><td>1</td><td>9600</td></tr>
<tr><td>2</td><td>38400</td></tr>
<tr><td>3</td><td>57600</td></tr>
<tr><td>4</td><td>115200</td></tr>
</table></td></tr>
<tr><td>6002</td><td>Modbus Parity and Stop Bits</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Selects the Modbus Parity and Stop Bits for the Base Control Module's Modbus port. A power cycle is required for change to take effect. Note: No Parity, 1 stop bit is not valid when in MODBUS_ASCII_TX_MODE mode. 0 = Even Parity - 1 stop bit, 1 = Odd Parity - 1 stop bit, 2 = No Parity - 2 stop bits, 3 = Even Parity - 2 stop bits, 4 = Odd Parity - 2 stop bits, 5 = No Parity - 1 stop bit.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Even parity - 1 Stop bit</td></tr>
<tr><td>1</td><td>Odd parity - 1 Stop bit</td></tr>
<tr><td>2</td><td>No parity - 2 Stop bits</td></tr>
<tr><td>3</td><td>Even parity - 2 Stop bits</td></tr>
<tr><td>4</td><td>Odd parity - 2 Stop bits</td></tr>
<tr><td>5</td><td>No parity - 1 Stop bits</td></tr>
</table></td></tr>
<tr><td>6003</td><td>Modbus Port TX More</td><td>UINT8 RW NV
Default: 0
Enum
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Selects the RTU/ASCII Modbus Mode for the Base Control Module's Modbus port. 0 = RTU Tx Mode (8 Data Bits), 1 = ASCII Tx Mode (7 Data Bits).
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>RTU Tx Mode (8 data bits)</td></tr>
<tr><td>1</td><td>ASCII Tx Mode (7 data bits)</td></tr>
</table></td></tr>
<tr><td>6004</td><td>Modbus Timeout</td><td>UINT16 RW NV
Default: 2000
Units: ms
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>The time before Modbus communications are considered lost. Every valid message received will reset this timer. The timeout is in milliseconds. When this timer expires, communication loss behavior will be triggered. A value of zero (0) will disable the communication timeout.</td></tr>
<tr><td>6005</td><td>Base Control Module USB Modbus Timeout</td><td>UINT16 RW NV
Default: 10000
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>The time before Modbus communications are considered lost. Every valid message received will reset this timer. The timeout is in milliseconds. When this timer expires, communication loss behavior will be triggered. A value of zero (0) will disable the communication timeout.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
6006	User Interface USB Modbus Timeout	UINT16 RW NV Default: 0 Units: ms Backup Mem	The time before Modbus communications are considered lost. Every valid message received will reset this timer. The timeout is in milliseconds. When this timer expires, communication loss behavior will be triggered. A value of zero (0) will disable the communication timeout.
6007	Modbus TCP Timeout	UINT16 RW NV Default: 2000 Units: ms Config CRC Admin Lock USB Lock	The time before Modbus TCP communications are considered lost. Every valid message received will reset this timer. The timeout is in milliseconds. When this timer expires, communication loss behavior will be triggered. A value of zero (0) will disable the communication timeout.
6008	Webservices Communication Timeout	UINT16 RW NV Default: 0 Units: ms Config CRC Admin Lock USB Lock	The time before HTTP REST communications are considered lost. Every valid poll assembly message received will reset this timer. The timeout is in milliseconds. When this timer expires, communication loss behavior will be triggered. A value of zero (0) will disable the communication timeout.
6010	Present IP Address	UINT8 RO Array size: 4	The Active IP Address being used on the Network. Array of 2 registers
6012	Present Subnet Mask	UINT8 RO Array size: 4	The Active Subnet Mask IP Address being used on the Network. Array of 2 registers
6014	Present Gateway	UINT8 RO Array size: 4	The Active Default Gateway IP Address being used on the Network. Array of 2 registers
6016	Stored IP Address	UINT8 RW NV Array size: 4 Default: 0xFE, 0x01, 0xA8, 0xC0 Config CRC Admin Lock USB Lock	The IP address used in the NV address select configuration. The DIP switch settings on the Base Control Module determine if a static IP address of 192.168.1.x, where x= the value on the DIP switch settings is used, or if DHCP is used or if the IP address stored at this parameter is used. To use this IP address, enter an IP address for this parameter, power down the C445, set the DIP switches for the NVMEM selection and when the unit is powered again, the C445 Ethernet module will be using this IP address. Array of 2 registers
6018	Stored Subnet Mask	UINT8 RW NV Array size: 4 Default: 0x00, 0xFF, 0xFF, 0xFF Config CRC Admin Lock USB Lock	The IP subnet mask used in the NV address select configuration. If the DIP switches on the Base Control Module are set for NVMEM, this IP subnet mask will take effect following a power cycle. Array of 2 registers
6020	Stored Gateway	UINT8 RW NV Array size: 4 Default: 0x01, 0x01, 0xA8, 0xC0 Config CRC Admin Lock USB Lock	The IP default gateway used in the NV address select configuration. Array of 2 registers
6022	Ethernet Port 1 Speed Select	UINT16 RW NV Default: 100 Enum Units: Mbs Config CRC Admin Lock USB Lock	Select the Ethernet link speed. Only used when Auto-Negotiate is disabled. **Value** – **Description** 10 – 10 Mbps 100 – 100 Mbps

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>6023</td><td>Ethernet Port 1 Speed Actual</td><td>UINT16 RO
Enum
Units: Mbs</td><td>Actual Ethernet link speed. This parameter is used to verify the data rate being used on the Ethernet network. It is read only.<table><tr><th>Value</th><th>Description</th></tr><tr><td>10</td><td>10 Mbps</td></tr><tr><td>100</td><td>100 Mbps</td></tr></table></td></tr>
<tr><td>6024</td><td>Ethernet Port 1 Full Duplex Enable</td><td>BOOL RW NV
Default: 1
Config CRC
Admin Lock
USB Lock</td><td>Selects the duplex mode. Only used when Auto-Negotiate is disabled. True = Full Duplex False = Half Duplex</td></tr>
<tr><td>6025</td><td>Ethernet Port 1 Full Duplex Enabled</td><td>BOOL RO</td><td>Actual duplex mode. This is a read only parameter, indicating the actual duplex mode on the Ethernet network. True = Full Duplex False = Half Duplex</td></tr>
<tr><td>6026</td><td>Ethernet Port 1 Autonegotiate Enable</td><td>BOOL RW NV
Default: 1
Config CRC
Admin Lock
USB Lock</td><td>Selects Auto-Negotiation of link speed and duplex. False = Disabled True = Enabled</td></tr>
<tr><td>6027</td><td>Ethernet Port 1 Autonegotiate State</td><td>UINT8 RO
Enum</td><td>Active state of the Auto-Negotiation behavior. This parameter indicates the status of auto negotiate on the Ethernet network. This is read only.<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Link inactive</td></tr><tr><td>1</td><td>Auto negotiation in progress</td></tr><tr><td>2</td><td>Auto negotiation failed</td></tr><tr><td>3</td><td>Auto negotiation of duplex failed (speed ok)</td></tr><tr><td>4</td><td>Auto negotiation success</td></tr><tr><td>5</td><td>Auto negotiation disabled</td></tr><tr><td>6</td><td>Port disabled</td></tr></table></td></tr>
<tr><td>6028</td><td>Ethernet Port 1 Enable</td><td>BOOL RW NV
Default: 1
Config CRC
Admin Lock
USB Lock</td><td>This parameter is used to disable the Ethernet port. True = Enable Port False = Disable Port</td></tr>
<tr><td>6029</td><td>Ethernet Port 2 Speed Select</td><td>UINT16 RW NV
Default: 100
Enum
Units: Mbs
Config CRC
Admin Lock
USB Lock</td><td>Select the Ethernet link speed. Only used when Auto-Negotiate is disabled.<table><tr><th>Value</th><th>Description</th></tr><tr><td>10</td><td>10 Mbps</td></tr><tr><td>100</td><td>100 Mbps</td></tr></table></td></tr>
<tr><td>6030</td><td>Ethernet Port 2 Speed Actual</td><td>UINT16 RO
Enum
Units: Mbs</td><td>Actual Ethernet link speed. This is a read only parameter.<table><tr><th>Value</th><th>Description</th></tr><tr><td>10</td><td>10 Mbps</td></tr><tr><td>100</td><td>100 Mbps</td></tr></table></td></tr>
<tr><td>6031</td><td>Ethernet Port 2 Full Duplex Enable</td><td>BOOL RW NV
Default: 1
Config CRC
Admin Lock
USB Lock</td><td>Selects the duplex mode. Only used when Auto-Negotiate is disabled. True = Full Duplex False = Half Duplex</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
6032	Ethernet Port 2 Full Duplex Enabled	BOOL RO	Actual duplex mode. This is a read only parameter. True = Full Duplex False = Half Duplex
6033	Ethernet Port 2 Autonegotiate Enabled	BOOL RW NV Default: 1 Config CRC Admin Lock USB Lock	Selects Auto-Negotiation of link speed and duplex. False = Disabled True = Enabled (default)
6034	Ethernet Port 2 Autonegotiate State	UINT8 RO Enum	Active state of the Auto-Negotiation behavior. This is read only. Value – Description 0 – Link inactive 1 – Auto negotiation in progress 2 – Auto negotiation failed 3 – Auto negotiation of duplex failed (speed ok) 4 – Auto negotiation success 5 – Auto negotiation disabled 6 – Port disabled
6035	Ethernet Port 2 Enable	BOOL RW NV Default: 1 Config CRC Admin Lock USB Lock	This parameter is used to disable the Ethernet port. True = Enable Port False = Disable Port
6036	IP Conflict Detection Enable	BOOL RW NV Default: 1 Config CRC Admin Lock USB Lock	Address Conflict Detection enable. ACD provides protection from duplicate IP addresses on the network. 0 = Disable ACD, 1 = Enable ACD.
6037	IP Conflict Detection Status	UINT8 RO Enum	Address Conflict Detection State. This is read only. 0 = no conflict detected, 1 = conflict detected - defending, 2 = conflict detected - retreated. Value – Description 0 – No conflict detected 1 – Conflict detected - defending 2 – Conflict detected - retreated
6038	IP Conflict Detection Conflicted Status	UINT8 RW NV Default: 0 Range: 0 to 0	Address Conflict Detection Status. The state of ACD activity when the last conflict was detected.
6039	IP Conflict Detection Conflicted MAC	UINT8 RW NV Array size: 6 Default: 0 Range: 0 to 0	Address Conflict Detection conflicted device MAC address. The source MAC address from the header of the received Ethernet packet which was sent by a device reporting a conflict. All Ethernet devices have a unique MAC address so by reporting the MAC address of the device containing the duplicate IP address allows the issue to be resolved in a timely manner. Array of 3 registers
6048	Ethernet MAC Address	UINT8 RO Array size: 6	Unique MAC Address assigned to this device. Array of 3 registers
6052	Profibus Modbus Timeout	UINT16 RW NV Default: 2000 Units: ms Backup Mem	The time before Modbus communications are considered lost. Every valid message received will reset this timer. The timeout is based on milliseconds. When this timer expires, communication loss behavior will be triggered. A value of zero (0) will disable the communication timeout.

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>6053</td><td>Set UI Local Password</td><td>UINT32 RW
Default: 0x00000000
Range: 0 to 9999
Admin Lock
USB Lock
Backup Mem</td><td>Set UI local password (0x00000000 means no password)</td></tr>
<tr><td>6055</td><td>UI Local Login</td><td>UINT32 RW
Range: 0 to 9999</td><td>Log in with UI local password</td></tr>
<tr><td>6058</td><td>TCP socket timeout</td><td>INTERNALUINT32 RW NV
Default: 300000
Range: 10 to 600000
Units: mSec
Backup Mem</td><td>TCP socket inactivity timeout; if no activity for set time, socket is closed
TCP Socket Timeout</td></tr>
<tr><td>7000</td><td>Minimum FLA (Nominal Current) Scaled</td><td>UINT16 RO
Default: 1
Units: scaled A</td><td>Minimum Setting allowed for Full Load Amperes, Scaled (Nominal Current). The minimum range is based on the measurement module used. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>7001</td><td>Maximum FLA (Nominal Current) Scaled</td><td>UINT16 RO
Default: 65535
Units: scaled A</td><td>Maximum Setting allowed for Full Load Amperes, Scaled (Nominal Current). The max range is based on the Measurement Module used. Scaled by parameter “I Scale Factor”.</td></tr>
<tr><td>7002</td><td>Overlay type</td><td>UINT8 RO
Default: 255
Enum</td><td>The Overlay type for the User Interface - Applies to C445UC… models only.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>No predefined User Interface overlay selected</td></tr>
<tr><td>1</td><td>30-46625-101 IEC User Interface Overlay</td></tr>
<tr><td>2</td><td>30-46625-102 IEC User Interface Overlay</td></tr>
<tr><td>3</td><td>30-46625-103 IEC User Interface Overlay</td></tr>
<tr><td>4</td><td>30-46625-104 IEC User Interface Overlay</td></tr>
<tr><td>5</td><td>30-46625-105 IEC User Interface Overlay</td></tr>
<tr><td>6</td><td>30-46625-106 IEC User Interface Overlay</td></tr>
<tr><td>7</td><td>30-46625-107 IEC User Interface Overlay</td></tr>
<tr><td>8</td><td>30-46625-108 IEC User Interface Overlay</td></tr>
<tr><td>9</td><td>30-46625-109 IEC User Interface Overlay</td></tr>
<tr><td>10</td><td>30-46625-110 IEC User Interface Overlay</td></tr>
<tr><td>11</td><td>30-46625-201 NEMA User Interface Overlay</td></tr>
<tr><td>12</td><td>30-46625-202 NEMA User Interface Overlay</td></tr>
<tr><td>13</td><td>30-46625-203 NEMA User Interface Overlay</td></tr>
<tr><td>14</td><td>30-46625-204 NEMA User Interface Overlay</td></tr>
<tr><td>15</td><td>30-46625-205 NEMA User Interface Overlay</td></tr>
<tr><td>16</td><td>30-46625-206 NEMA User Interface Overlay</td></tr>
<tr><td>17</td><td>30-46625-207 NEMA User Interface Overlay</td></tr>
<tr><td>18</td><td>30-46625-208 NEMA User Interface Overlay</td></tr>
<tr><td>19</td><td>30-46625-209 NEMA User Interface Overlay</td></tr>
<tr><td>20</td><td>30-46625-210 NEMA User Interface Overlay</td></tr>
<tr><td>21</td><td>MUI connected</td></tr>
<tr><td>255</td><td>Out of box or factory reset state. No User Interface was ever connected</td></tr>
</table>
Write-protected by manufacturing lock service. Preserved on WipeNV.</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>7003</td><td>Base Control Module Product Name</td><td>STRING8 RO
Array size: 32</td><td>Base Control Module Product Name, short description of the Product Code
Array of 16 registers</td></tr>
<tr><td>7025</td><td>Base Control Module Assigned Name</td><td>STRING8 RW NV
Array size: 32
Default: “Power Xpert C445”
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Base Control Module User Assigned Name. The default is “Power Xpert C445”, but optionally may be changed.
Array of 16 registers</td></tr>
<tr><td>7041</td><td>Base Control Module Serial Number</td><td>UINT32 RO</td><td>Base Control Module Serial Number (32 bit format).
Write-protected by manufacturing lock service. Preserved on WipeNV.</td></tr>
<tr><td>7043</td><td>Base Control Module Product Code</td><td>UINT16 RO</td><td>Base Control Module Product Code (numerical format)</td></tr>
<tr><td>7044</td><td>Base Control Module Product Sub Code</td><td>UINT16 RO</td><td>Base Control Module Product Sub Code
Write-protected by manufacturing lock service. Preserved on WipeNV.</td></tr>
<tr><td>7045</td><td>Base Control Module Firmware Version</td><td>UINT16 RO
Array size: 2</td><td>Base Control Module Firmware Version
Array of 2 registers</td></tr>
<tr><td>7048</td><td>Base Control Module Hardware Version</td><td>UINT16 RO</td><td>Base Control Module Product Hardware Version (numerical format).
Write-protected by manufacturing lock service. Preserved on WipeNV.</td></tr>
<tr><td>7049</td><td>Base Control Module Config CRC</td><td>UINT16 RO</td><td>The configuration CRC is a calculated hash of configuration parameters (see appendix for list of covered parameters). After a configuration parameter is changed the configuration CRC is recalculated. While the CRC is being calculated the returned value will be 65535 (0xFFFF).</td></tr>
<tr><td>7050</td><td>Base Control Module Bootloader Version</td><td>UINT16 RO
Array size: 2</td><td>Base Control Module Bootloader Version
Array of 2 registers</td></tr>
<tr><td>7053</td><td>Measurement Module Serial Number</td><td>UINT32 RO</td><td>Measurement Module Product Serial Number</td></tr>
<tr><td>7055</td><td>Measurement Module Product Code</td><td>UINT16 RO</td><td>Measurement Module Product Code</td></tr>
<tr><td>7056</td><td>Measurement Module Product Sub Code</td><td>UINT16 RO
Default: 65535</td><td>Measurement Module Product Sub Code</td></tr>
<tr><td>7057</td><td>Measurement Module Firmware Version</td><td>UINT16 RO
Array size: 2</td><td>Measurement Module Product Firmware Version
Array of 2 registers</td></tr>
<tr><td>7060</td><td>Measurement Module Hardware Version</td><td>UINT16 RO</td><td>Measurement Module Product Hardware Version</td></tr>
<tr><td>7061</td><td>Measurement Module Option Board Type</td><td>BYTE RO
Bitfield</td><td>Measurement Module board type. 0: Voltage option board present, 1: PTC option board present.
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Voltage option board present in Measurement Module</td><td>n/a</td></tr>
<tr><td>1</td><td>PTC option board present in Measurement Module</td><td>n/a</td></tr>
</table></td></tr>
<tr><td>7062</td><td>Measurement Module Bootloader Version</td><td>UINT16 RO
Array size: 2</td><td>Measurement Module Bootloader Version
Array of 2 registers</td></tr>
<tr><td>7065</td><td>User Interface Serial Number</td><td>UINT32 RO</td><td>User Interface Module Device Serial Number (32 bit format).</td></tr>
</table>

Table 128. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
7067	User Interface Product Code	UINT16 RO	User Interface Module Product code (numerical format).
7068	User Interface Product Sub Code	UINT16 RO	User Interface Product Sub Code
7069	User Interface Firmware Version	UINT16 RO Array size: 2	User Interface Module Firmware version (numerical format). Array of 2 registers
7072	User Interface Hardware Version	UINT16 RO	User Interface Module Product hardware version (numerical format).
7073	User Interface Bootloader Version	UINT16 RO Array size: 2	User Interface Bootloader Version Array of 2 registers
7076	Option Card Serial Number	UINT32 RO	Option Card Serial Number (32 bit format).
7078	Option Card Product Code	UINT16 RO Default: 0	Option Card Product Code
7079	Option Card Product Sub Code	UINT16 RO	Option Card Product Sub Code
7080	Option Card Product Firmware Version	UINT16 RO Array size: 2	Option Card Product Firmware Version Array of 2 registers
7083	Option Card Hardware Version	UINT16 RO	Option Card Product Hardware Version
7084	Option Card Bootloader Version	UINT16 RO Array size: 2	Option Card Bootloader Version Array of 2 registers
7087	Power Board Serial Number	UINT32 RO	Power Board Serial Number (32 bit format).
7089	Power Board Firmware Version	UINT16 RO Array size: 2	The Firmware version of the power board processor. Array of 2 registers
7092	Power Board Hardware Version	UINT16 RO	Power Board Product hardware version (numerical format).
7093	GFM Serial Number	UINT32 RO	Ground Fault Module Product Serial Number Write-protected by manufacturing lock service. Preserved on WipeNV.
7095	GFM Product Code	UINT16 RO	Ground Fault Module Product Code Numerical
7096	GFM Product Sub Code	UINT16 RO Default: 0	GFM Product Sub Code Write-protected by manufacturing lock service. Preserved on WipeNV.
7097	GFM Firmware Version	UINT16 RO Array size: 2	Ground Fault Module Firmware Version Array of 2 registers
7099	GFM Firmware CRC	UINT16 RO	Ground Fault Module Firmware CRC
7100	GFM Bootloader Version	UINT16 RO Array size: 2	GFM Bootloader Firmware Version Array of 2 registers
7102	GFM Bootloader CRC	UINT16 RO	GFM Bootloader Firmware CRC
7103	GFM Hardware Version	UINT16 RO	Configuration register used to flag functional hardware version Write-protected by manufacturing lock service. Preserved on WipeNV.
7104	GFM PCB Configuration	UINT8 RO	PCBA Configuration

Table 128. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>8004</td><td>Control User Interface Input Debounce</td><td>UINT16 RW NV
Array size: 4
Default: 20
Range: 5 to 5000
Units: ms
Config CRC
Admin Lock
USB Lock
Backup Mem</td><td>Array of debounce values for the Control User Interface digital inputs (C445UC… versions only). A debounce value exists for each input. The debounce applies to both rising and falling edge.
Array of 4 registers</td></tr>
<tr><td>8027</td><td>Measurement Module Board Ambient Temp</td><td>SINT16 RO
Units: °C</td><td>Measurement Module Ambient temperature measured on the PCB.</td></tr>
<tr><td>8028</td><td>Measurement Module Max Board Ambient Temp</td><td>SINT16 RW NV
Default: –40
Units: °C</td><td>Measurement Module Maximum ambient temperature measured on the PCB. This value can be set (typically to -40).</td></tr>
<tr><td>8145</td><td>Supply Voltage Low Flag</td><td>BOOL RO</td><td>Flag indicates the power supply voltage is too low to pull in the output relays</td></tr>
<tr><td>8502</td><td>Control Word with NetCtrl bit</td><td>BYTE RW
Bitfield</td><td>Network Control Word with NetCtrl bit Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: NetCtrl Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved
<table>
<tr><th>Bit</th><th>Description</th><th>Coil</th></tr>
<tr><td>0</td><td>Run1 command</td><td>n/a</td></tr>
<tr><td>1</td><td>Run2 command</td><td>n/a</td></tr>
<tr><td>2</td><td>Reserved</td><td>n/a</td></tr>
<tr><td>3</td><td>Reset fault</td><td>n/a</td></tr>
<tr><td>4</td><td>Remote control enable (Allow control commands from this control word)</td><td>n/a</td></tr>
<tr><td>5</td><td>Test trip the device</td><td>n/a</td></tr>
</table>
</td></tr>
</table>

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