Power Xpert C445 Global Motor Management Relay

User Manual

Effective September 2015
New Information

Powering Business Worldwide

Disclaimer of Warranties and Limitation of Liability

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

Support Services

The goal of Eaton is to ensure your greatest possible satisfaction with the operation of our products. We are dedicated to providing fast, friendly, and accurate assistance. That is why we offer you so many ways to get the support you need. Whether it is by phone, fax, or email, you can access Eaton's support information 24 hours a day, seven days a week.

Our wide range of services is listed below.

You should contact your local distributor for product pricing, availability, ordering, expediting, and repairs.

Website

Use the Eaton website to find product information. You can also find information on local distributors or Eaton's sales offices.

Website Address

www.eaton.com/c445

EatonCare Customer Support Center

Call the EatonCare Support Center if you need assistance with placing an order, stock availability or proof of shipment, expediting an existing order, emergency shipments, product price information, returns other than warranty returns, and information on local distributors or sales offices.

Voice: 877-ETN-CARE (386-2273) (8:00 a.m. to 6:00 p.m. EST)

After-Hours Emergency: 800-543-7038 (6:00 p.m. to 8:00 a.m. EST)

Technical Resource Center

Overload, Starter and MCC Communications Products

Voice: 877-ETN-CARE (386-2273) option 2, option 2, option 5
(8:00 a.m. to 5:00 p.m. CST [UTC -6])

email: ControlVoicemailTRC@eaton.com

Online Chat: eaton.com/chat

For Customers in Europe, contact:

Phone: +49 (0) 228 6 02-3640
Hotline: +49 (0) 180 5 223822
email: AfterSalesEGBonn@Eaton.com www.eaton.com/moeller/aftersales

Table of Contents

Table of Contents, continued

List of Figures

List of Figures, continued

List of Figures, continued

List of Figures, continued

List of Tables

List of Tables, continued

List of Tables, continued

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.

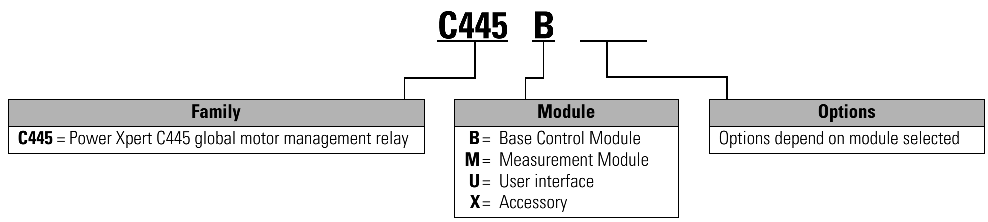
How to Use this Manual

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

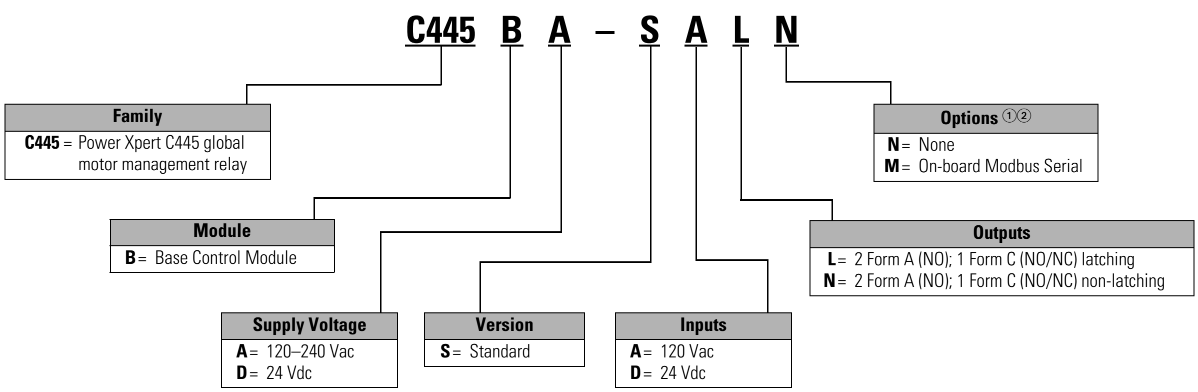
Relay

Figure 1. C445 System Catalog Numbering



Base Control Module

Figure 2. Base Control Module Catalog Numbering



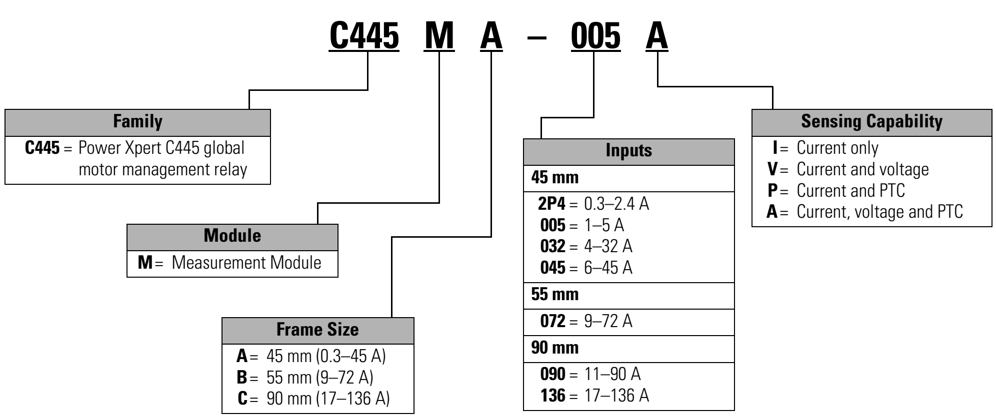
Notes

① For other communication protocol options, please see **Table 4**, Optional Communication Cards and Modules, on **Page 6**.

② If a Real-Time Clock and Memory Backup Module are required, please see **Table 4**, Optional Communication Cards and Modules, on **Page 6**.

Measurement Module

Figure 3. Measurement Module Catalog Numbering



User Interface

Figure 4. User Interface Catalog Numbering

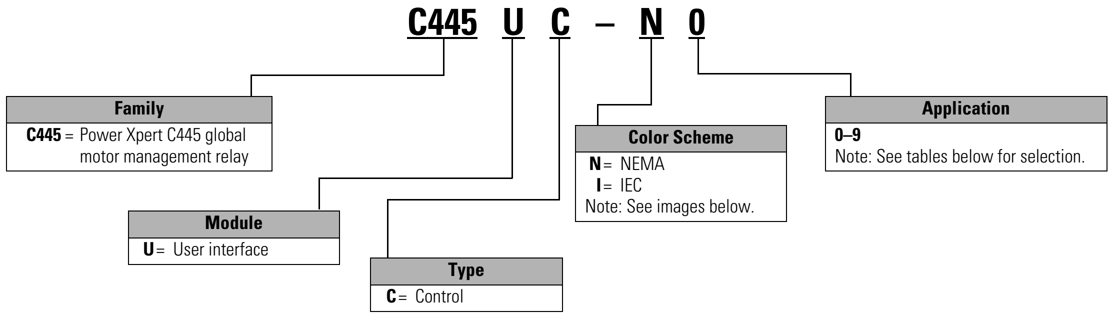


Table 1. User Interface—NEMA Color Scheme Options (English) ①②

Operation Mode	Control Type (Local = UI)	Control Button(s) Action		Control Button(s) LED Indicator Labels		Diagnostic LED Label(s)	Catalog Number
FVNR Starter	Local Only	START —	OFF —	RUN —	OFF —	FAULT, WARNING, OVERLOAD	**C445UC-N0**
FVNR Starter	Remote Only	— —	F1 ③ —	RUN —	OFF —	FAULT, WARNING, OVERLOAD	**C445UC-N1**
FVR Starter	Remote Only	— —	F1 ③ —	FWD REV	OFF —	FAULT, WARNING, OVERLOAD	**C445UC-N2**
2-Speed Starter	Remote Only	— —	F1 ③ —	SLOW FAST	OFF —	FAULT, WARNING, OVERLOAD	**C445UC-N3**
FVNR Starter	Local/Remote	— HAND	OFF AUTO	RUN HAND	OFF AUTO	FAULT, WARNING, OVERLOAD	**C445UC-N4**
FVR Starter	Local/Remote	FWD REV	OFF AUTO	FWD REV	OFF AUTO	FAULT, WARNING, OVERLOAD	**C445UC-N5**
2-Speed Starter	Local/Remote	SLOW FAST	OFF AUTO	SLOW FAST	OFF AUTO	FAULT, WARNING, OVERLOAD	**C445UC-N6**
MCCB Actuation	Local/Remote	CLOSE —	OFF AUTO	CLOSE —	OFF AUTO	FAULT, WARNING, TRIPPED	**C445UC-N7**
MCCB Actuation	Local Only	CLOSE —	OFF —	CLOSE —	OFF —	FAULT, WARNING, TRIPPED	**C445UC-N8**
Overload	Local/Remote	— TEST	F1 AUTO	RUN —	OFF AUTO	FAULT, WARNING, OVERLOAD	**C445UC-N9**

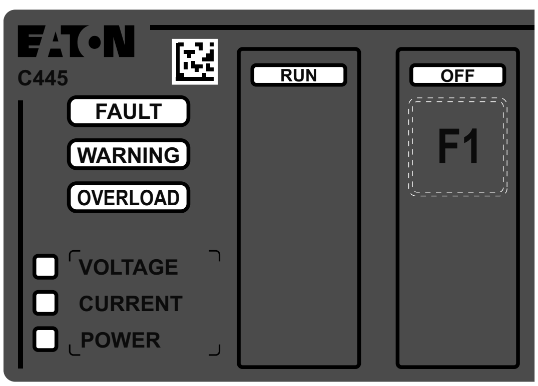
Notes

① All options include a reset button, Micro USB port and four 24 Vdc self-powered digital inputs. Please see Accessories on **Page 6** for digital inputs wiring harness options.

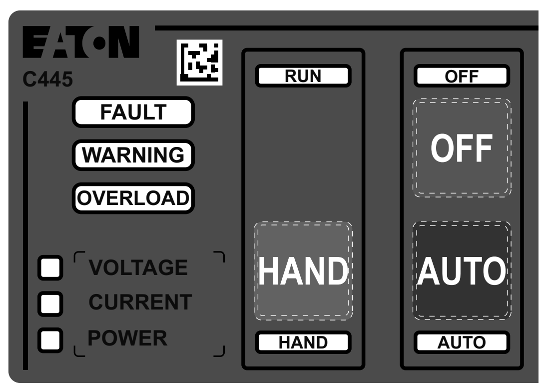
② Not all operation modes are stock items. Check with EatonCare for availability.

③ F1 function key is reserved for future functionality.

Figure 5. User Interface Overlay Examples: NEMA



Example: C445UC-N1



Example: C445UC-N4

Table 2. User Interface—IEC Color Scheme (Symbols) ①②

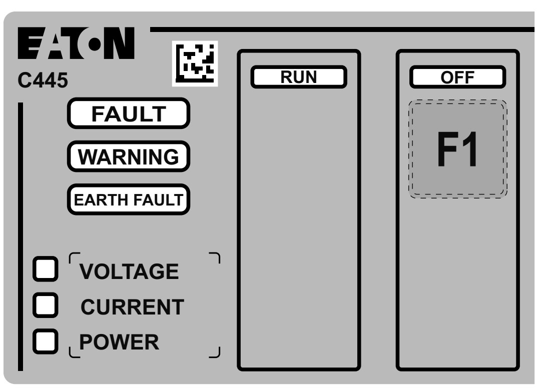
Operation Mode	Control Type (Local = UI)	Control Button(s) Action		Control Button(s) LED Indicator Labels		Diagnostic LED Label(s)	Catalog Number
FVNR Starter	Local Only	| —	○ —	— —	— —	FAULT, WARNING, EARTH FAULT	**C445UC-I0**
FVNR Starter	Remote Only	— —	F1 —	RUN —	OFF —	FAULT, WARNING, EARTH FAULT	**C445UC-I1**
FVR Starter	Remote Only	► ►►	○ —	— —	— —	FAULT, WARNING, EARTH FAULT	**C445UC-I2**
2-Speed Starter	Remote Only	► ◄	○ —	— —	— —	FAULT, WARNING, EARTH FAULT	**C445UC-I3**
FVNR Starter	Local/Remote	| —	○ AUTO	— —	— —	FAULT, WARNING, EARTH FAULT	**C445UC-I4**
FVR Starter	Local/Remote	► ◄	○ AUTO	— —	— —	FAULT, WARNING, EARTH FAULT	**C445UC-I5**
2-Speed Starter	Local/Remote	► ►►	○ AUTO	— —	— —	FAULT, WARNING, EARTH FAULT	**C445UC-I6**
MCCB Actuation	Local/Remote	| —	○ AUTO	— —	— —	FAULT, WARNING, TRIPPED	**C445UC-I7**
MCCB Actuation	Local Only	| —	○ —	— —	— —	FAULT, WARNING, TRIPPED	**C445UC-I8**
Overload	Local/Remote	— TEST	F1 AUTO	RUN —	OFF —	FAULT, WARNING, EARTH FAULT	**C445UC-I9**

Notes

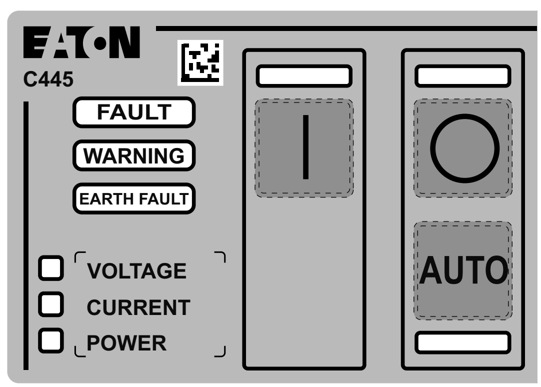
① All options include a reset button, Micro USB port and four 24 Vdc self-powered digital inputs. Please see Accessories on **Page 6** for digital inputs wiring harness options.

② Not all operation modes are stock items. Check with EatonCare for availability.

Figure 6. User Interface Overlay Examples: IEC



Example: C445UC-I1



Example: C445UC-I4

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 3. 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 Contact factory for availability. Catalog numbers are for one single-phase CT including a mounting bracket. Order quantity of 3 for a complete C445 system.

Communication and Option Modules

Table 4. 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 5. Catalog Numbers: D77E… RJ-12 Cables

Description	Catalog Number
Connection cable (Base Control Module to Measurement Module or user interface), 13 cm length, 600 V rating	**D77E-QPIP13**
Connection cable (Base Control Module to Measurement Module or user interface), 13 cm length, 1000 V rating	**D77E-QPIP13-HV**
Connection cable (Base Control Module to Measurement Module or user interface), 25 cm length, 600 V rating	**D77E-QPIP25**
Connection cable (Base Control Module to Measurement Module or user interface), 25 cm length, 1000 V rating	**D77E-QPIP25-HV**
Connection cable (Base Control Module to Measurement Module or user interface), 100 cm length, 600 V rating	**D77E-QPIP100**
Connection cable (Base Control Module to Measurement Module or user interface), 100 cm length, 1000 V rating	**D77E-QPIP100-HV**
Connection cable (Base Control Module to Measurement Module or user interface), 200 cm length, 600 V rating	**D77E-QPIP200**
Connection cable (Base Control Module to Measurement Module or user interface), 300 cm length, 600 V rating	**D77E-QPIP300**
Connection cable (Base Control Module to Measurement Module or user interface), 300 cm length, 1000 V rating	**D77E-QPIP300-HV**

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

Table 6. Catalog Numbers: C445XU… User Interface Wiring Harnesses

Description	Catalog Number
User interface digital inputs wiring harness, 50 cm, 16 AWG wires	**C445XU-050**
User interface digital inputs wiring harness, 100 cm, 16 AWG wires	**C445XU-100**
User interface digital inputs wiring harness, 200 cm, 16 AWG wires	**C445XU-200**
User interface digital inputs wiring harness, 300 cm, 16 AWG wires	**C445XU-300**
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 software tool via USB port to the Base Control Module or the User Interface.

Table 7. 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

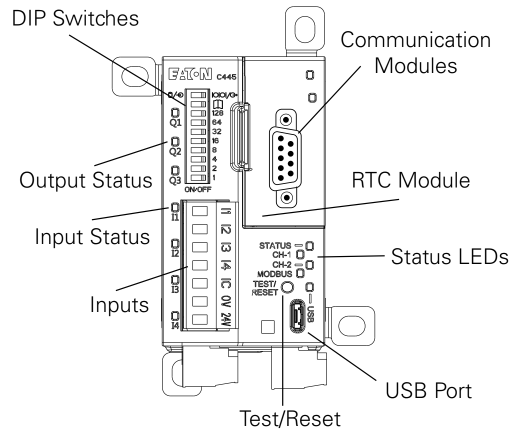
The Base Control Module is the controller of the C445 system, providing the various monitoring, protection and control algorithms. Equipped with native I/O connections, communication card options and USB connectivity, the Base Control Module provides users with real-time data on the health and status 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:

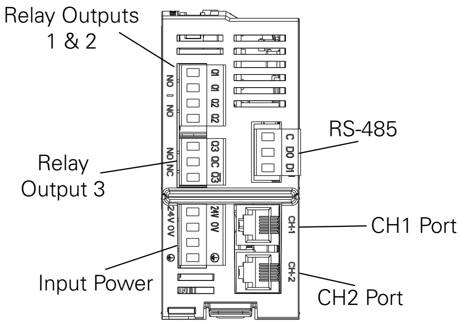
- Status: Indicates the fault and warning status of the Base Control Module
- CH1: Indicates status of modules attached to Channel 1 port on Base Control Module (Measurement Module or user interface)
- CH2: Indicates status of modules attached to Channel 2 port on Base Control Module (Measurement Module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

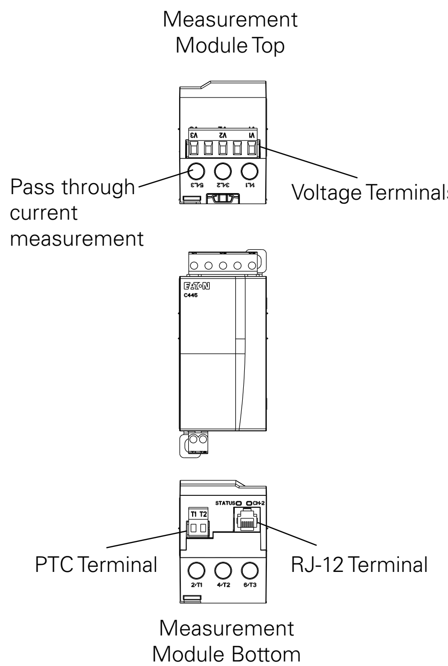
The Measurement Module is a pass-through device which samples current and voltage data consumed by the system. This data is continually transmitted back to the Base Control Module for analysis. Various frame sizes are available for applications up to 800 A, with factory orderable options for voltage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

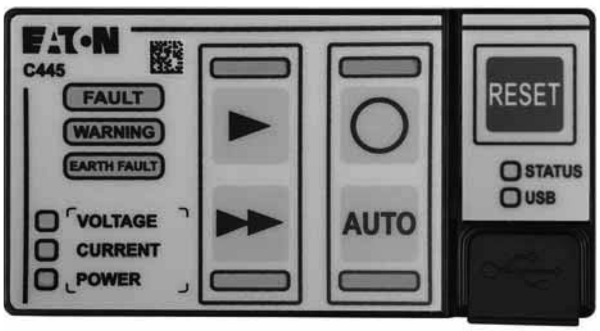
RJ-12 Terminal: Connection port to the Base Control Module.

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

User Interface Basic Overview

The user interface provides optional local motor control and status indication that can be operated from outside of the system's enclosure. An external micro USB connection allows for device commissioning, configuration, and monitoring both with and without Power Xpert *in*Control. Various overlay options are available to match the specific operation mode of the application. Two color schemes are available for NEMA (English text) or IEC (symbols) based applications.

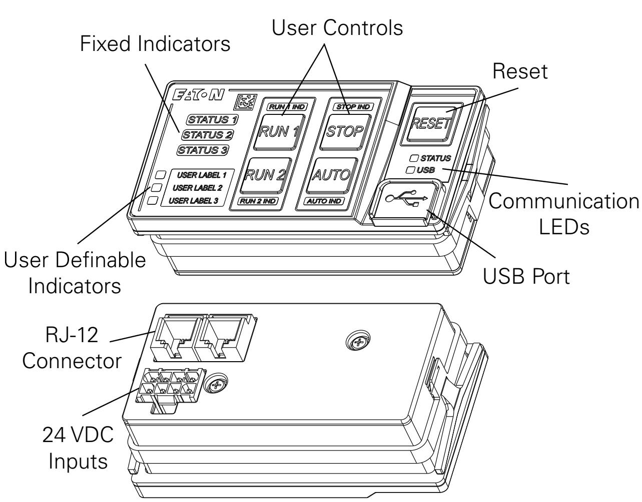
Figure 12. User Interface Image



User Interface Features

- Status and control LED indicators
- USB – local configuration
- Pushbutton control options
- (4) 24 Vdc self-powered (dry contact) inputs. (Wiring must meet SELV/PELV requirements)
- Multiple overlay options to match the operation mode
- Overload reset
- The Base Control Module provides control power and communications through the RJ-12 cable connection

Figure 13. User Interface Features and Connections



Fixed Indicators:

- Fault: Indicates a fault (tripped) condition
- Warning: Indicates an alarm threshold has been triggered
- Overload, tripped or earth fault: indicates a thermal overload (NEMA) or earth fault (IEC)

User Definable Indicators: LEDs, red/green/amber, that can be customized by the user. Standard text is; voltage, current and power. Faults will be indicated.

RJ-12 Connector: Provides a connection port to the Base Control Module.

24 Vdc Inputs: Cable assembly with mating connector is required.

USB Port: Micro AB connector, enables a connection to a computer that is running the Power Xpert *in*Control Software.

Note: Maximum cable length of 3 m.The USB ground connection is not galvanically isolated from earth. Use only an isolated laptop as PC connection to the USB connector on the device.

Communication LEDs: Indicates operating condition of the communications BUS and the USB port.

Reset: Resets a C445 overload after a trip has occurred.

User Controls: Provides motor control by using push buttons. Each button has an indicator to show status. Button designations will change depending on the overlay ordered.

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.

Each predefined operating mode can be controlled by way of 2-wire or 3-wire control wiring both with and without the User Interface option. The Pre-defined Operating modes available are:

- 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

See **System Operation** on **Page 75** 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 -40ºC – 85ºC
- 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

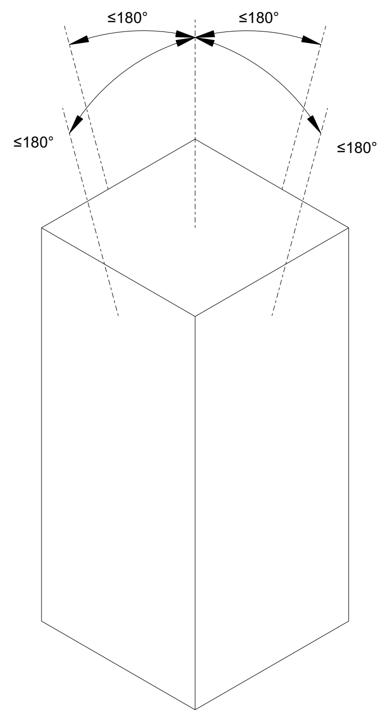
IL043003EN for C445M... Measurement Modules

IL043002EN for C445U… User Interface

Mounting Positions

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

Figure 14. Vertical Position Limits



Clearance

An installation clearance of 10 mm must be maintained in front of any C445 device. A top and bottom clearance of 10 mm each is required. A minimum of 10 mm side clearance is required between any C445 devices.

Figure 15. Clearance Dimensions

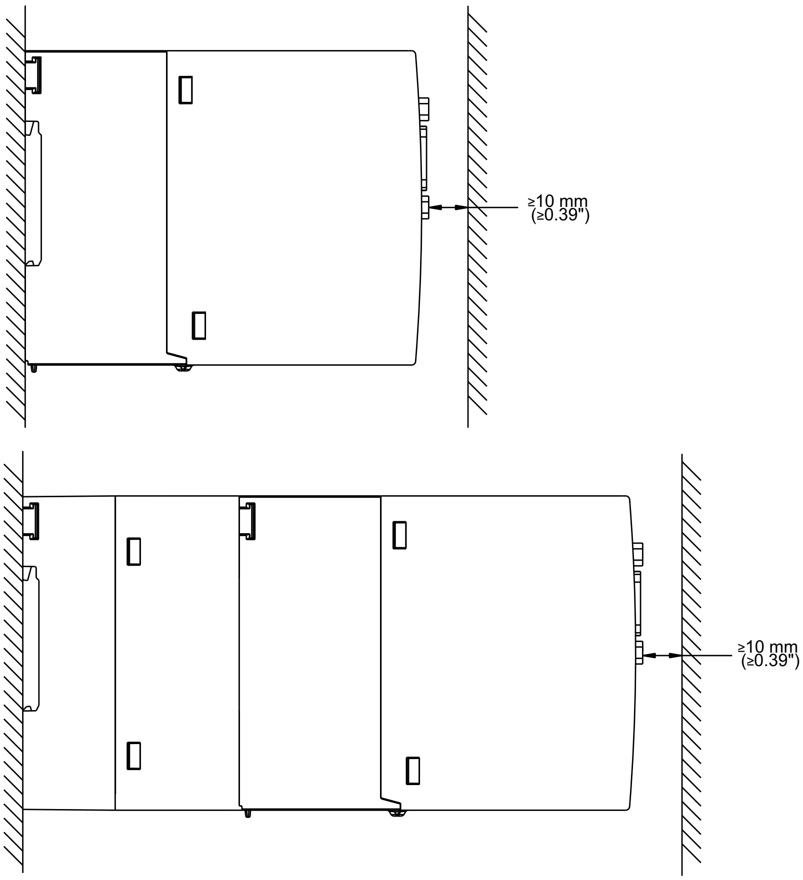
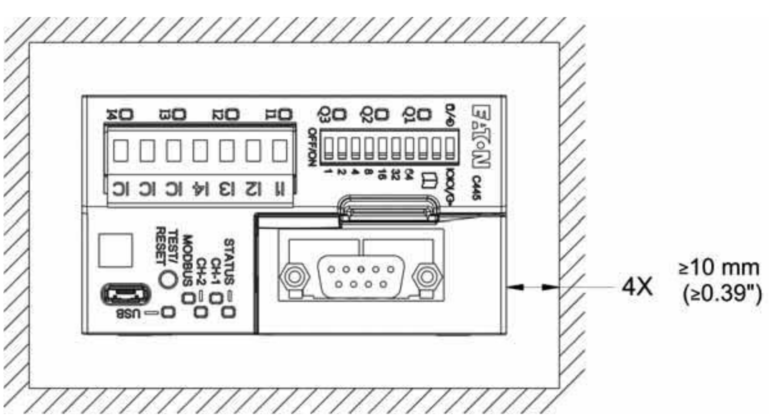


Figure 16. Clearance Dimensions (Side)



C445 Module Assembly

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

Figure 17. Component Exploded View (C445B...Base Module, C445M...Measurement Module, Accessory Cover, C445XO-TRTC Real Time Clock Module, C445C... Communications card(s))

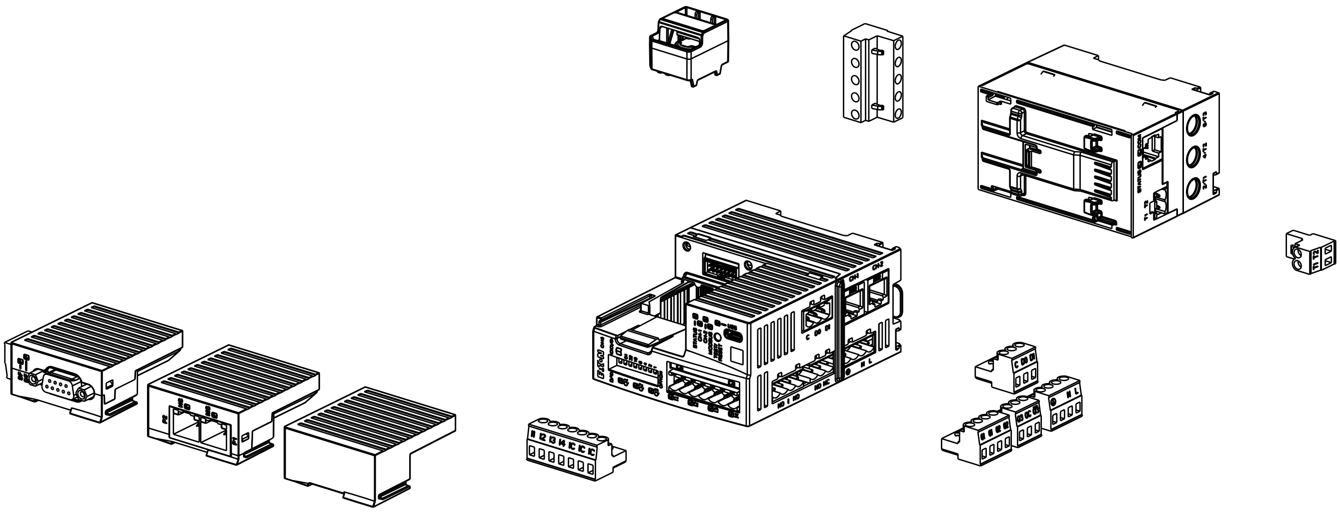


Figure 18. Option Cover Removal

Remove the C445 Option Cover to install the Real Time Clock Module (RTC), Cat # and/or Communication Cards, Cat#.

If installing only the RTC module, replace the cover on the C445 Base Module.

If installing any Communications card, the cover is no longer required and can be discarded.

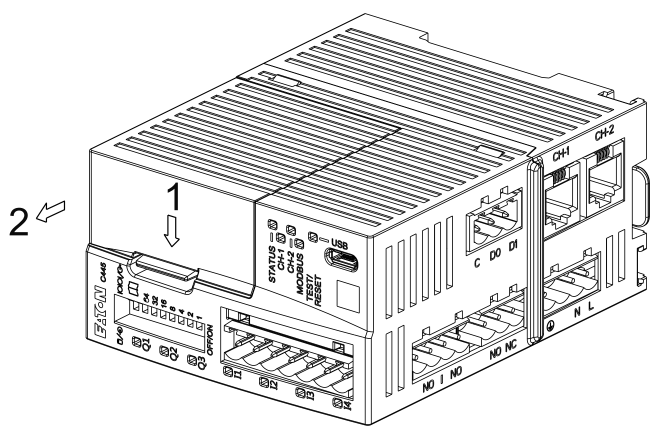


Figure 19. Real-Time Clock and Memory Backup Module Installation

Remove the C445B... Option Cover as shown in **Figure 18**.

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.

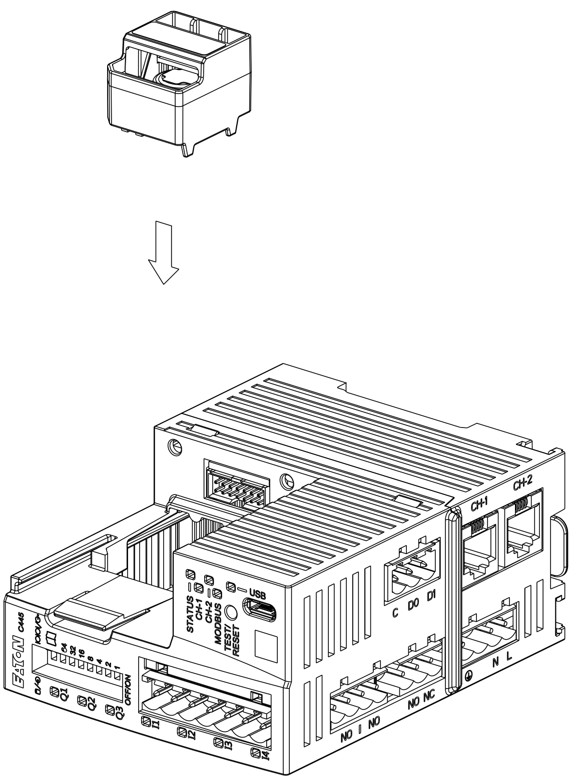


Figure 20. Communication Card Installation

Remove the C445B... Option Cover as shown in **Figure 18**.

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

The C445XC-E or C445XC-P 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.

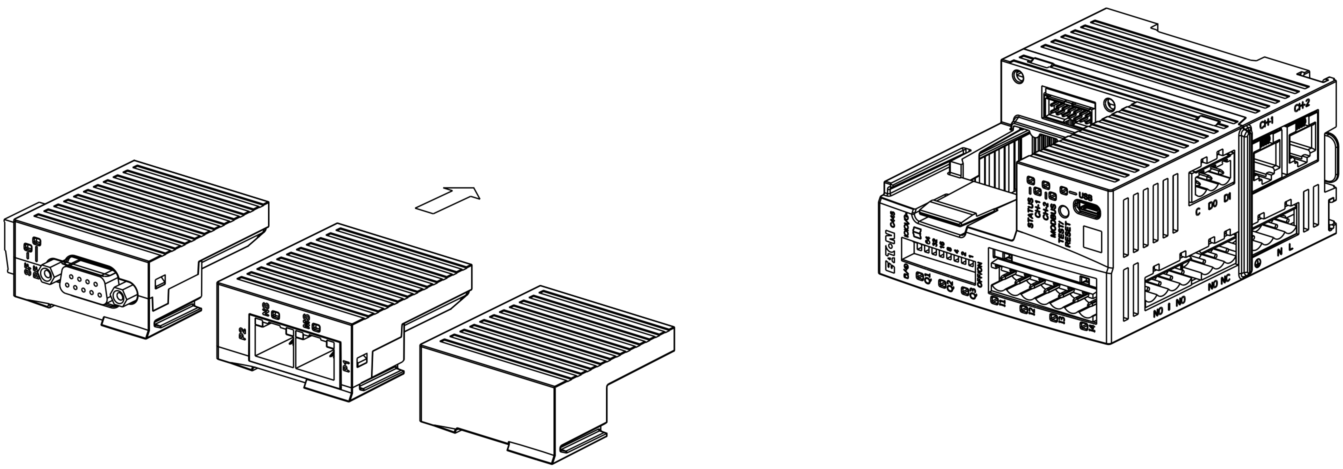


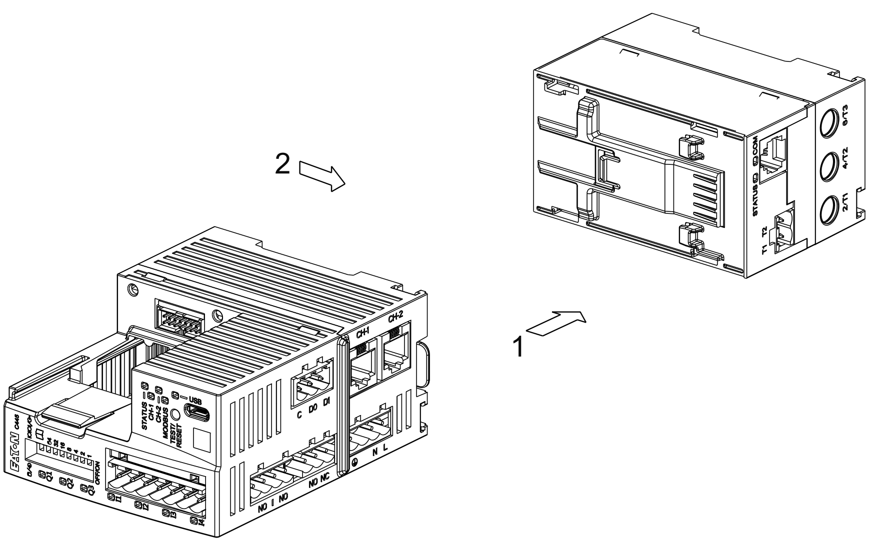
Figure 21. Component Mating

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. Provide proper clearances between devices on the rail as required by device(s) specifications.

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 8. 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 22. DIN-Rail Mounting Instructions

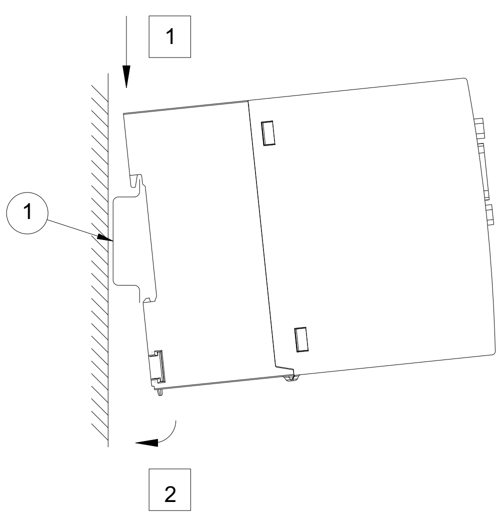
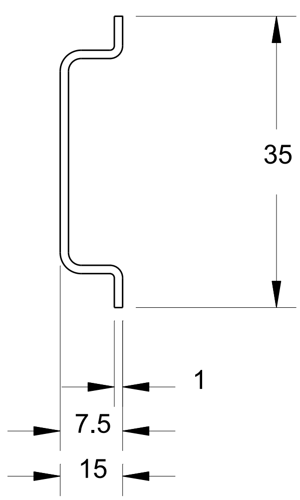


Figure 23. DIN Rail Dimensions



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 24. Base Control Module—C445B… Mounting Dimensions

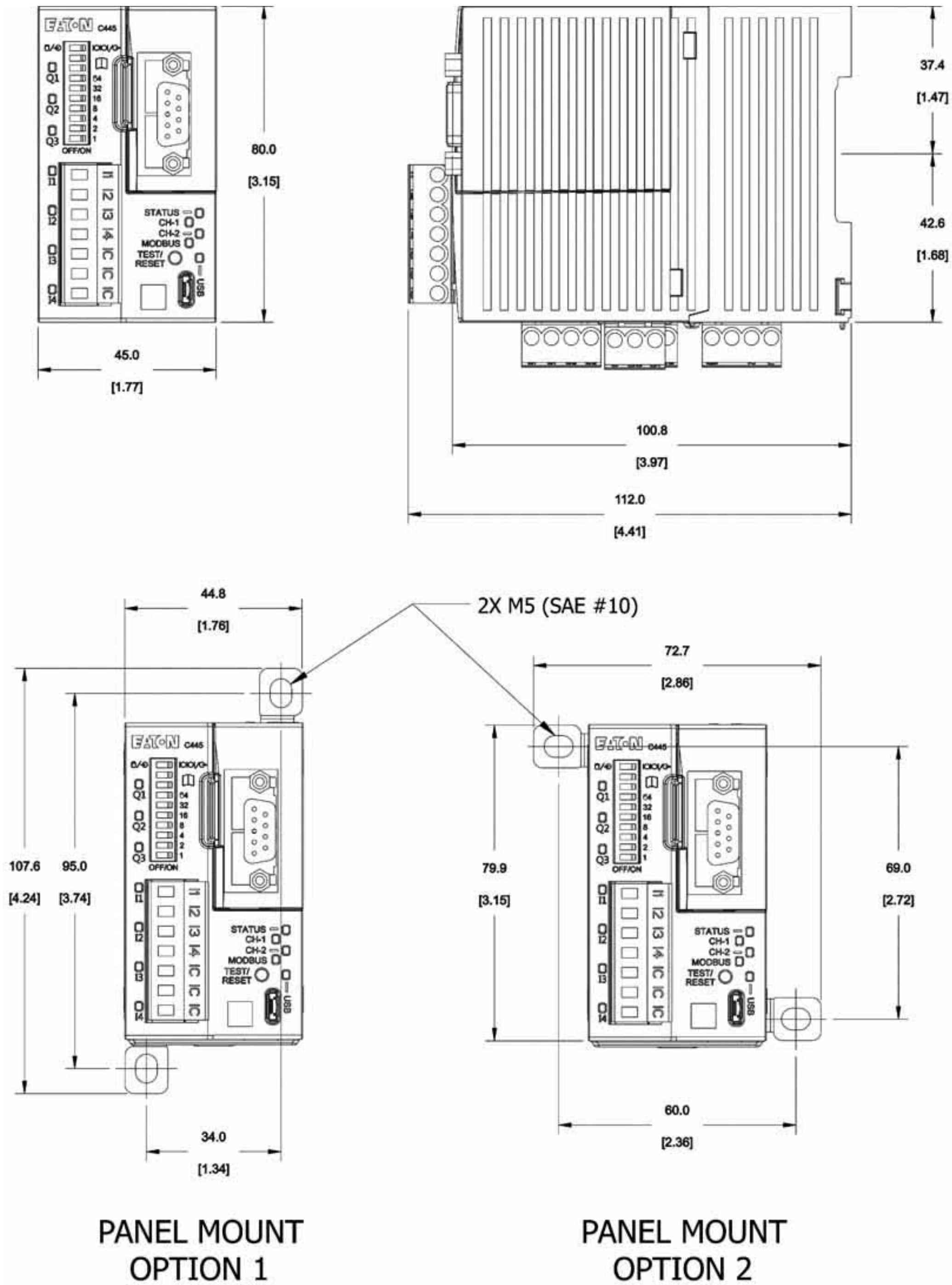


Figure 25. Measurement Module—C445MA… Mounting Dimensions

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.

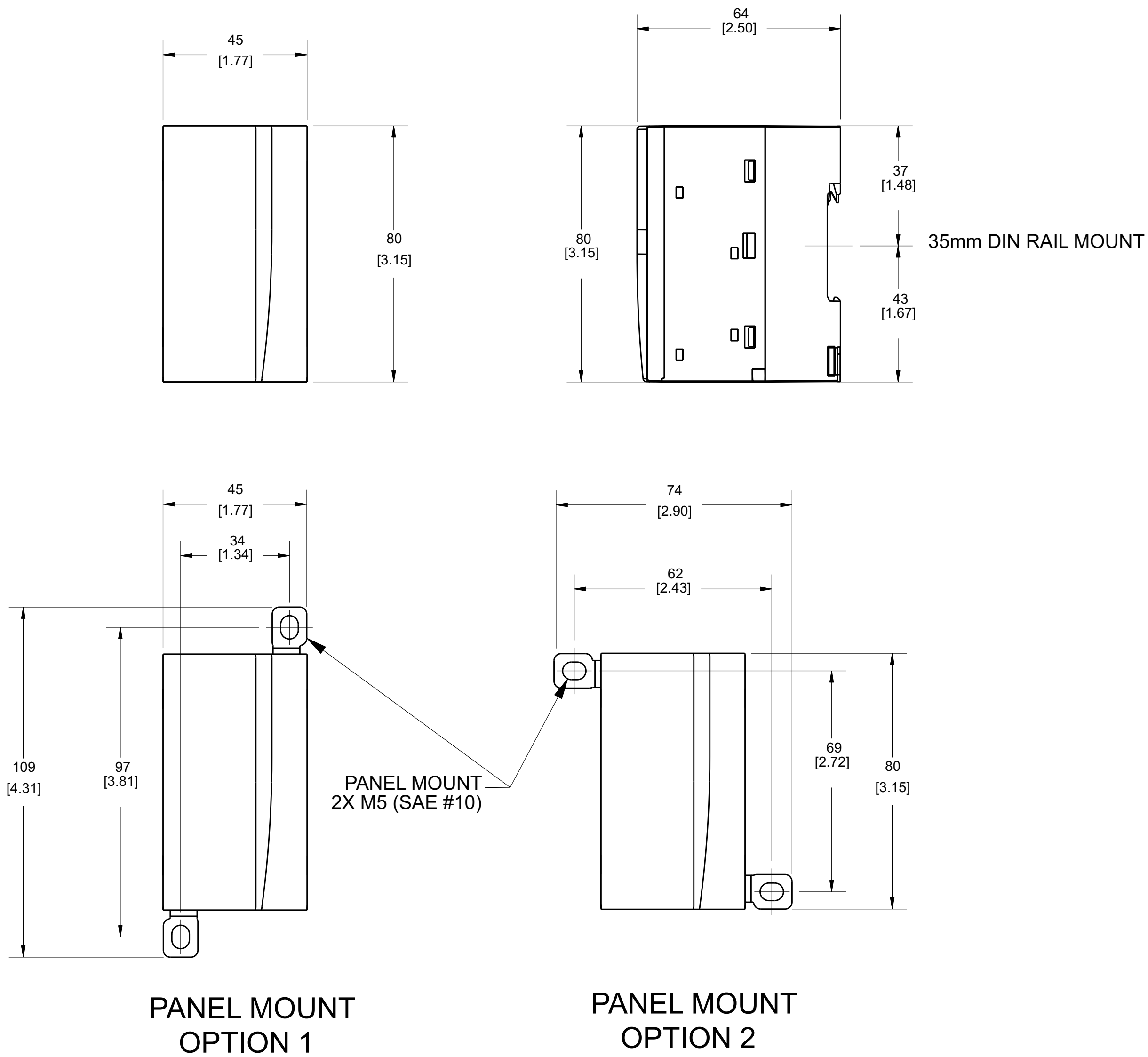
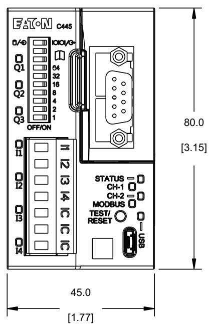
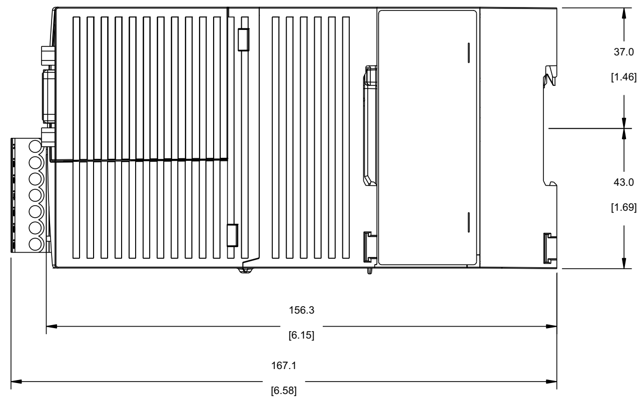
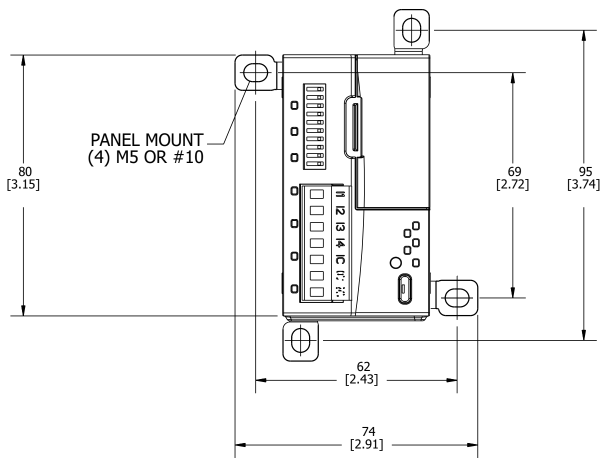


Figure 26. Base Control Module C445B… Mounting Dimensions







PANEL MOUNT
OPTION 3

Figure 27. Measurement Module C445MB… Mounting Dimensions

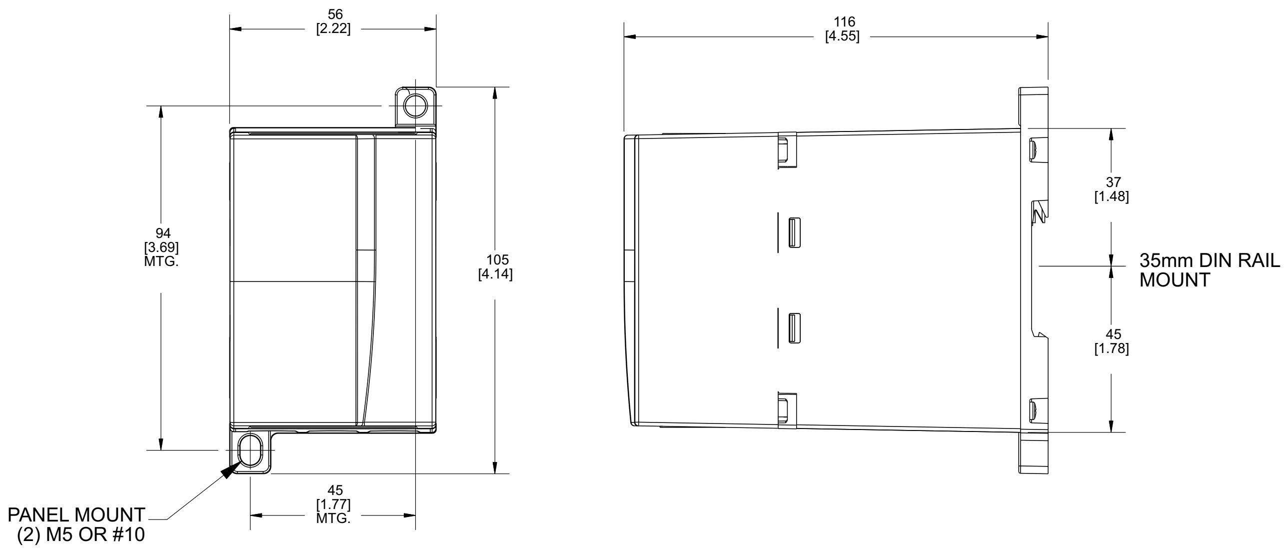


Figure 28. Measurement Module C445MC… Mounting Dimensions

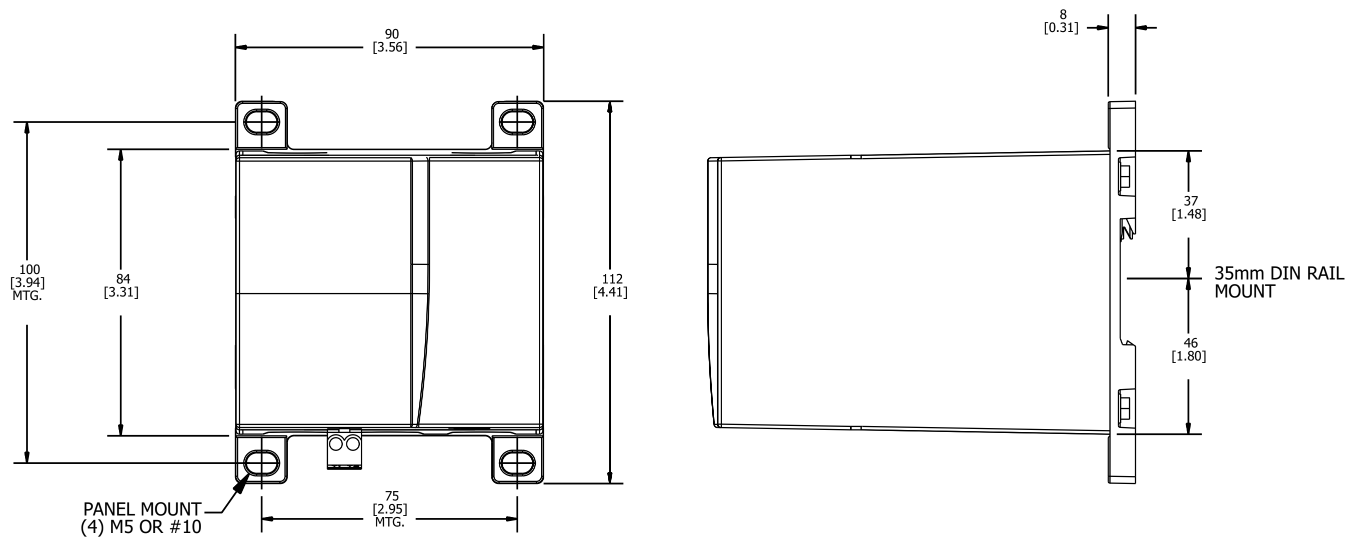
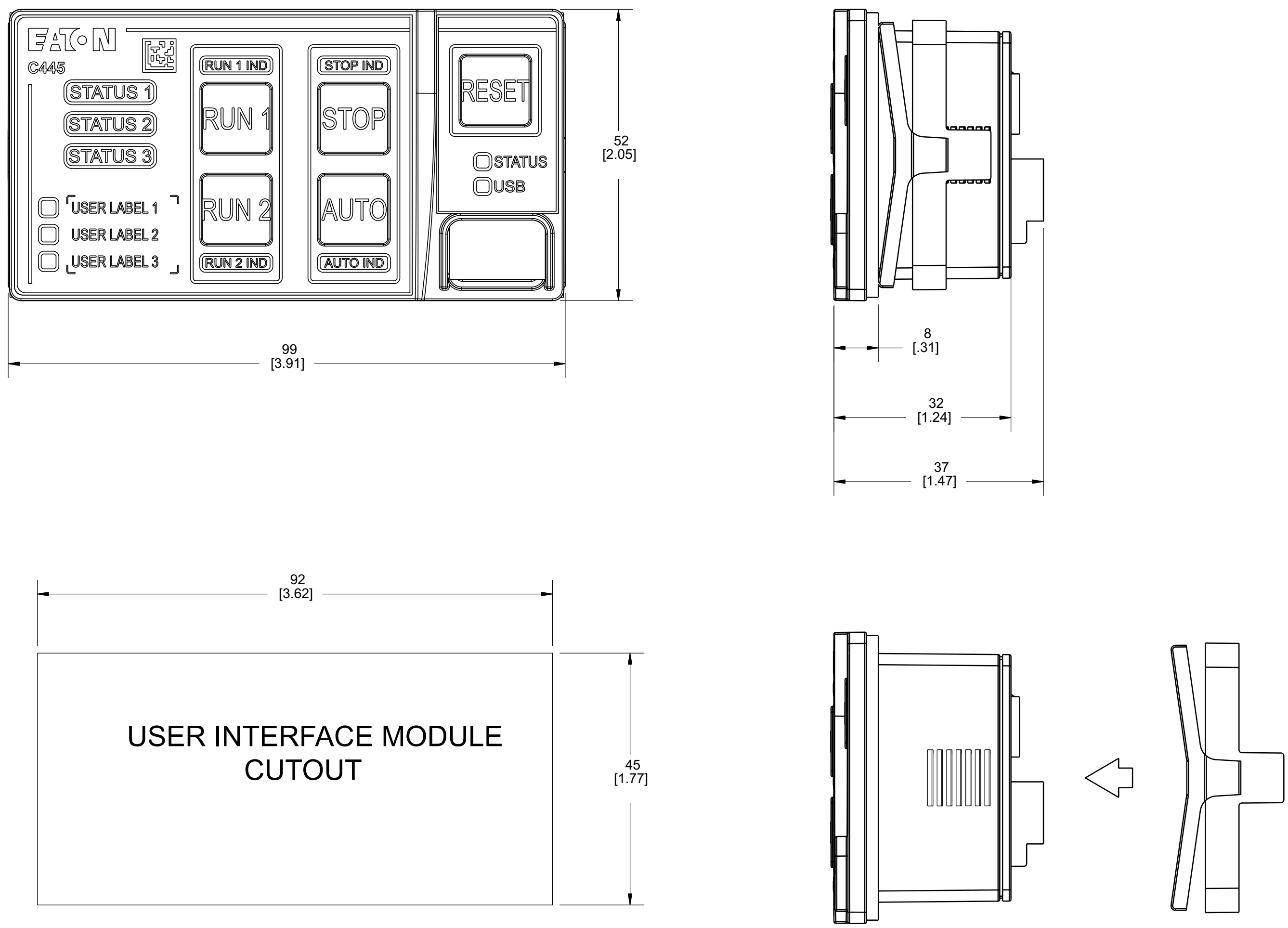


Figure 29. User Interface C445UC… Mounting Dimensions



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.

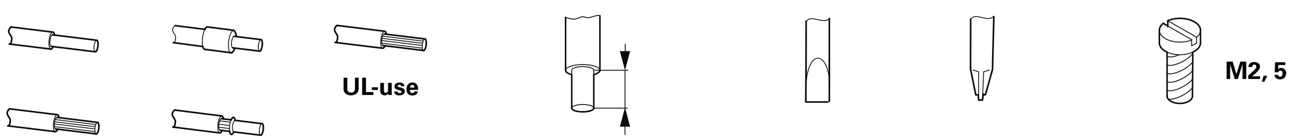
Figure 30. Terminal Fastening

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

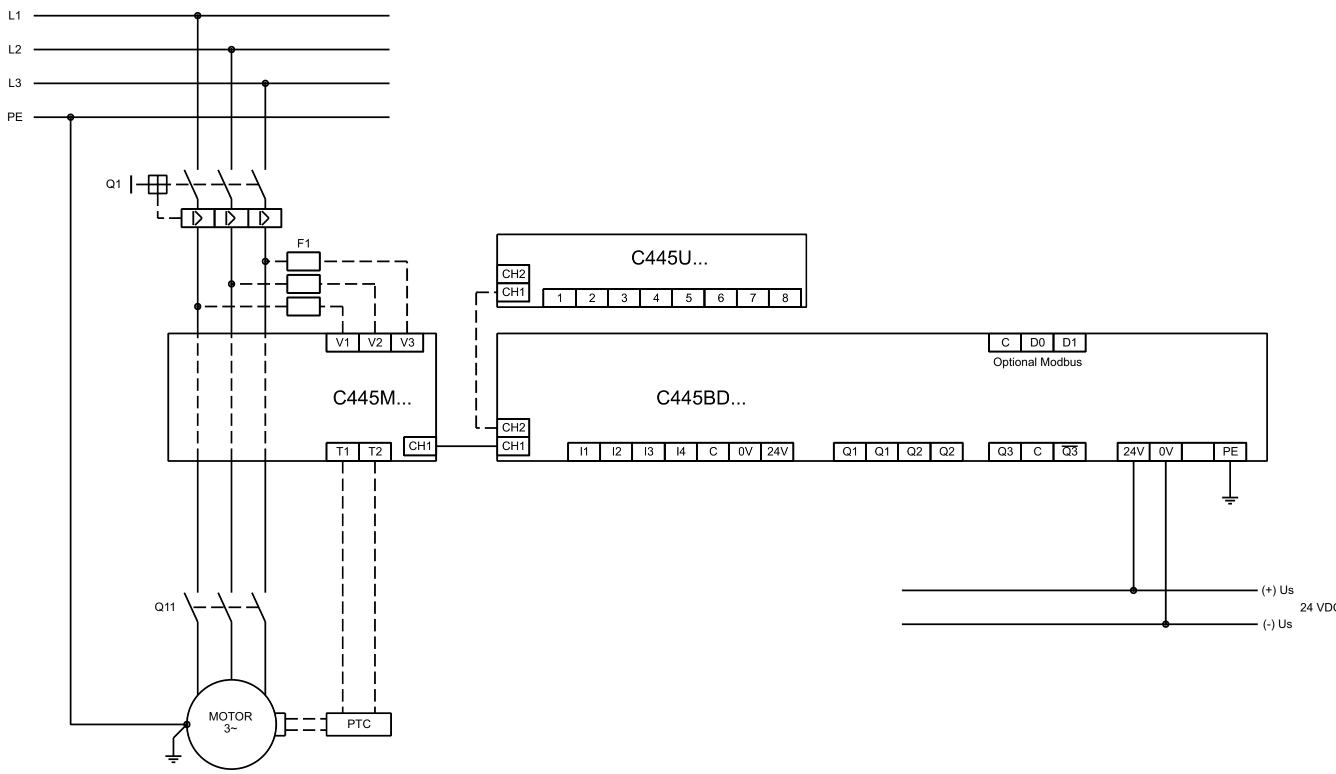


mm^2	mm^2	AWG	mm	inch	⊖	⊕	Nm	lb-in
1 x 0.2–2.5	1 x 0.2–2.5	1 x 24–12	7.0	0.275	0.6 x 3.5 mm	PH0, PZ0	0.4–0.5	3.5–4.4

Motor Connections for Standard Overload Control

Standard Overload Applications

Figure 31. Motor Connections for Standard Overload Control with C445BD…

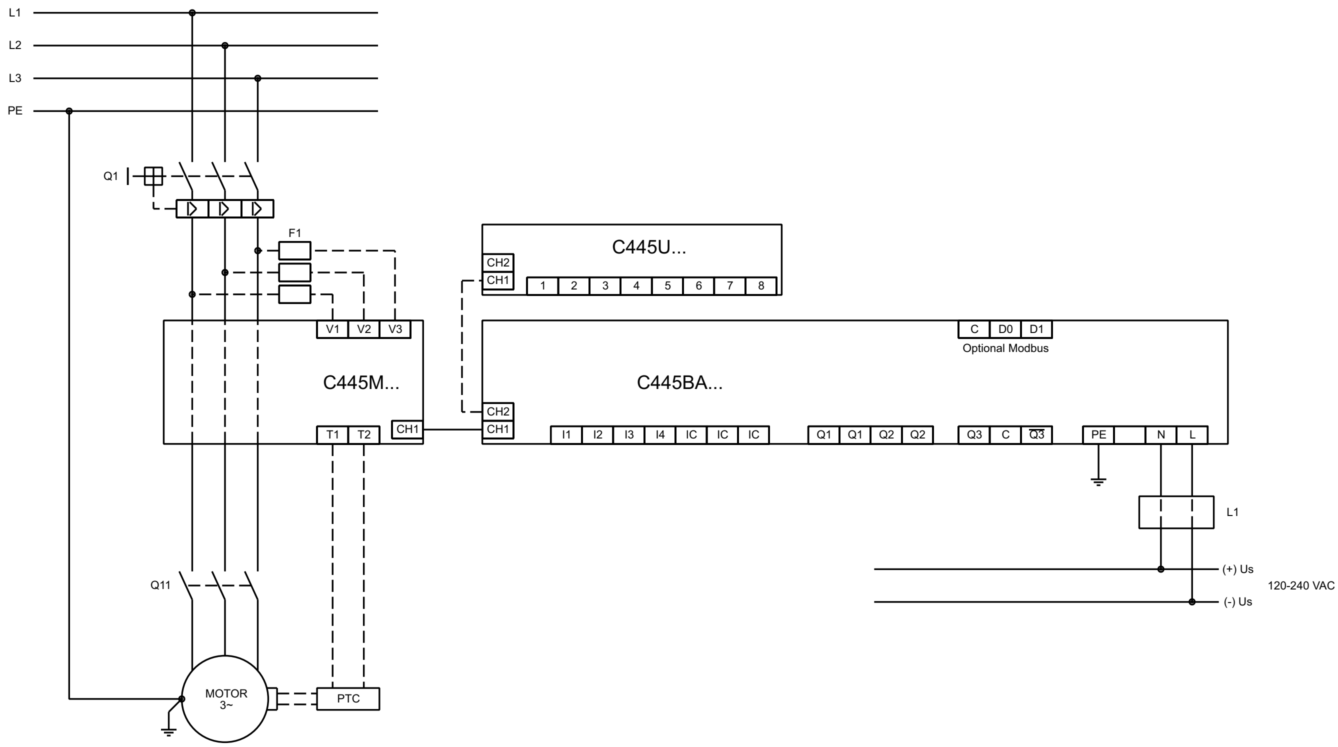


Legend

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

Fuse protection for V1, V2, V3 is recommended.

Figure 32. Motor Connections for Standard Overload Control with C445BA…



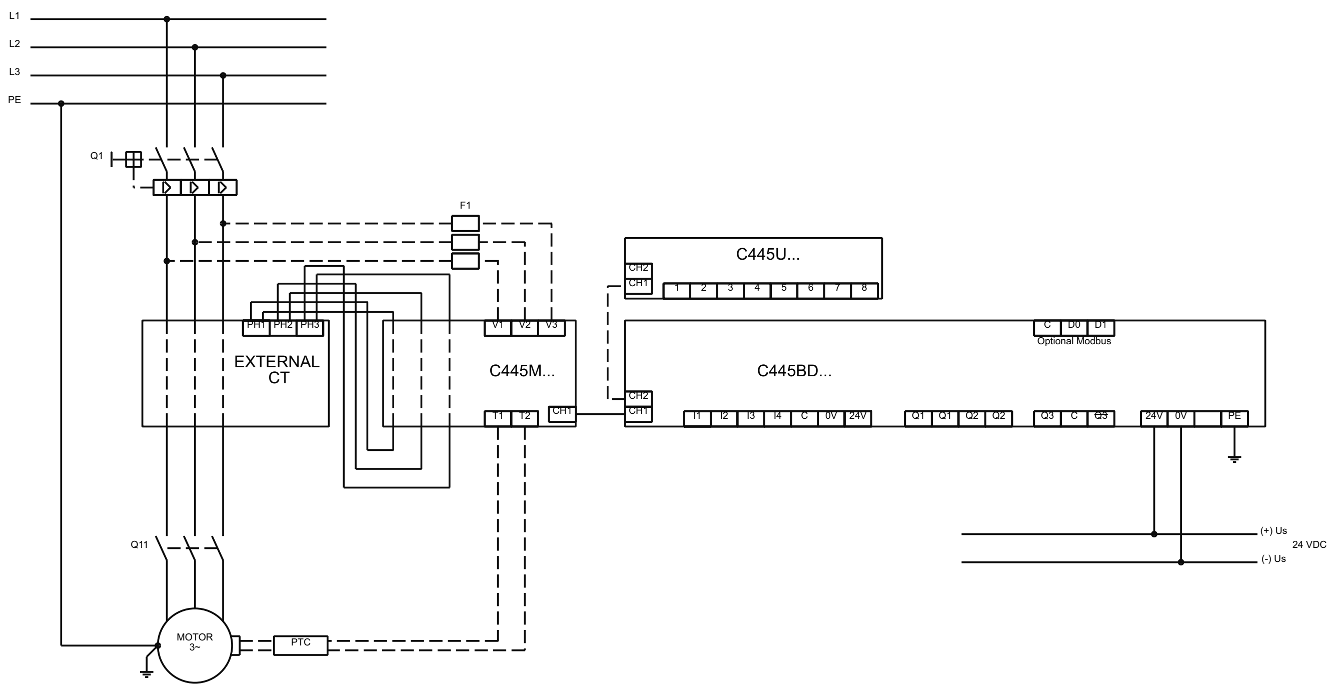
Legend

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

Fuse protection for V1, V2, V3 is recommended.

Motor Connections with External Current Transformer(s)

Figure 33. Motor Connections for Standard Overload Control Using External CTs with C445BD…

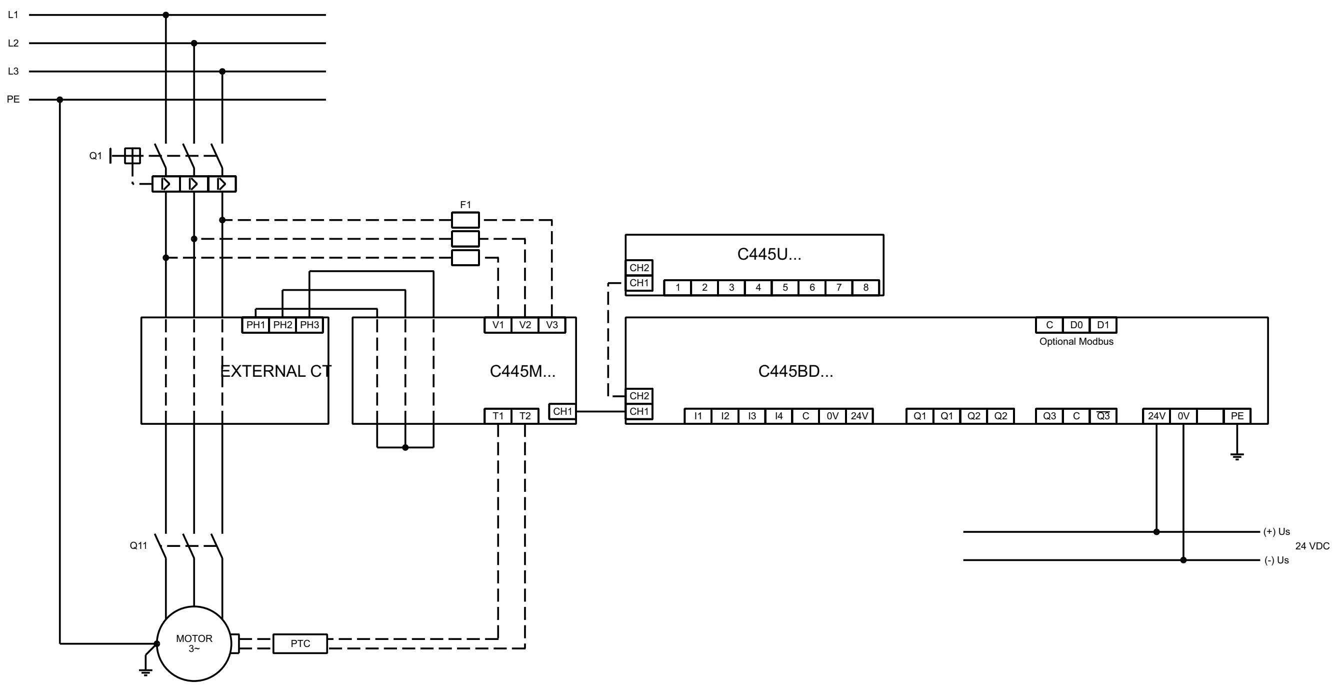


Legend

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.

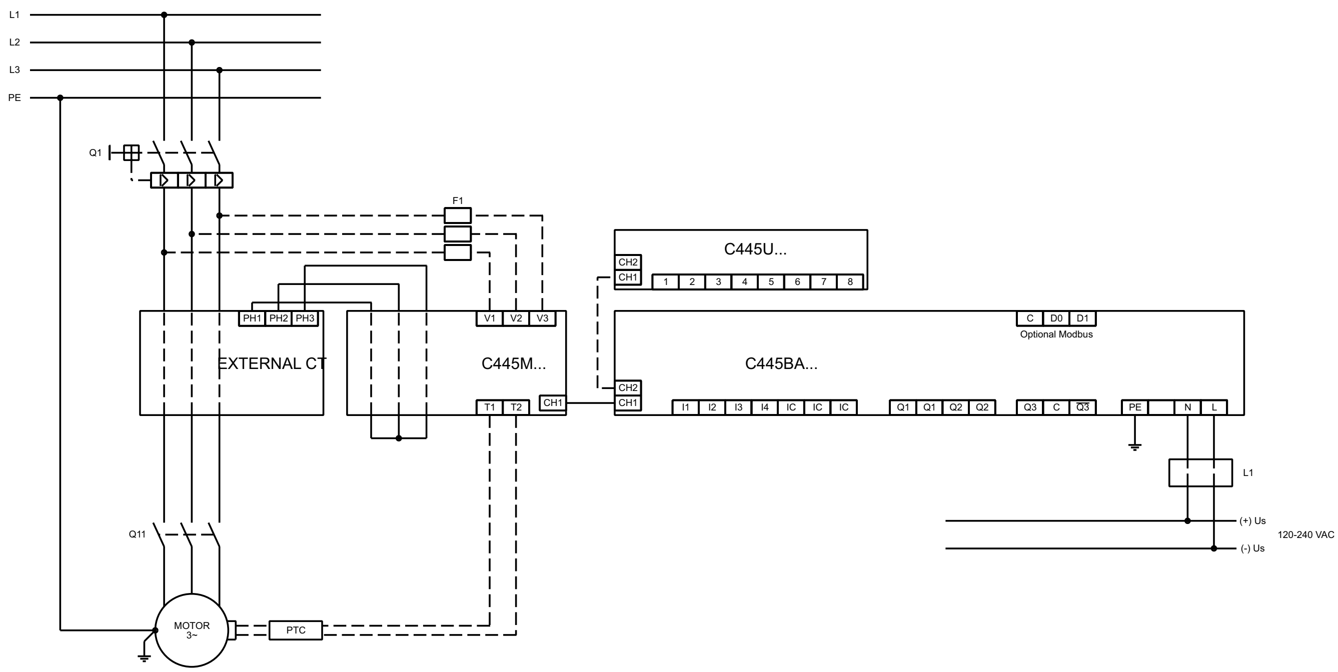
Fuse protection for V1, V2, V3 is recommended.

Figure 34. Motor Connections for Standard Overload Control Using XCT300 or XCT600 External CTs with C445BD…



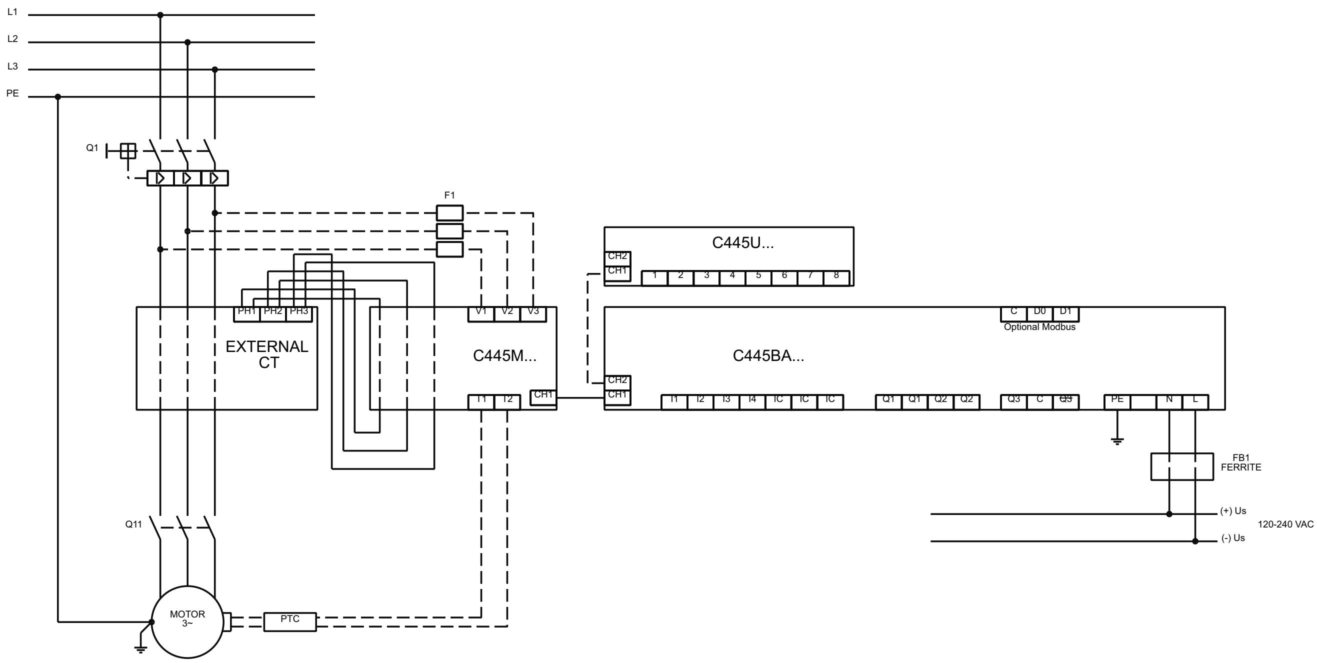
Note: Ground fault and phase imbalance is not available when the XCT300 or XCT600 external current transformers are used.

Figure 35. Motor Connections for Standard Overload Control Using XCT300 or XCT600 External CTs with C445BA…



Note: Ground fault and phase imbalance is not available when the XCT300 or XCT600 external current transformers are used.

Figure 36. Motor Connections for Standard Overload Control Using External CTs 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.

Fuse protection for V1, V2, V3 is recommended.

Figure 37. Motor Connections for Standard Overload Control Using XCT800 External CTs with C445BD…

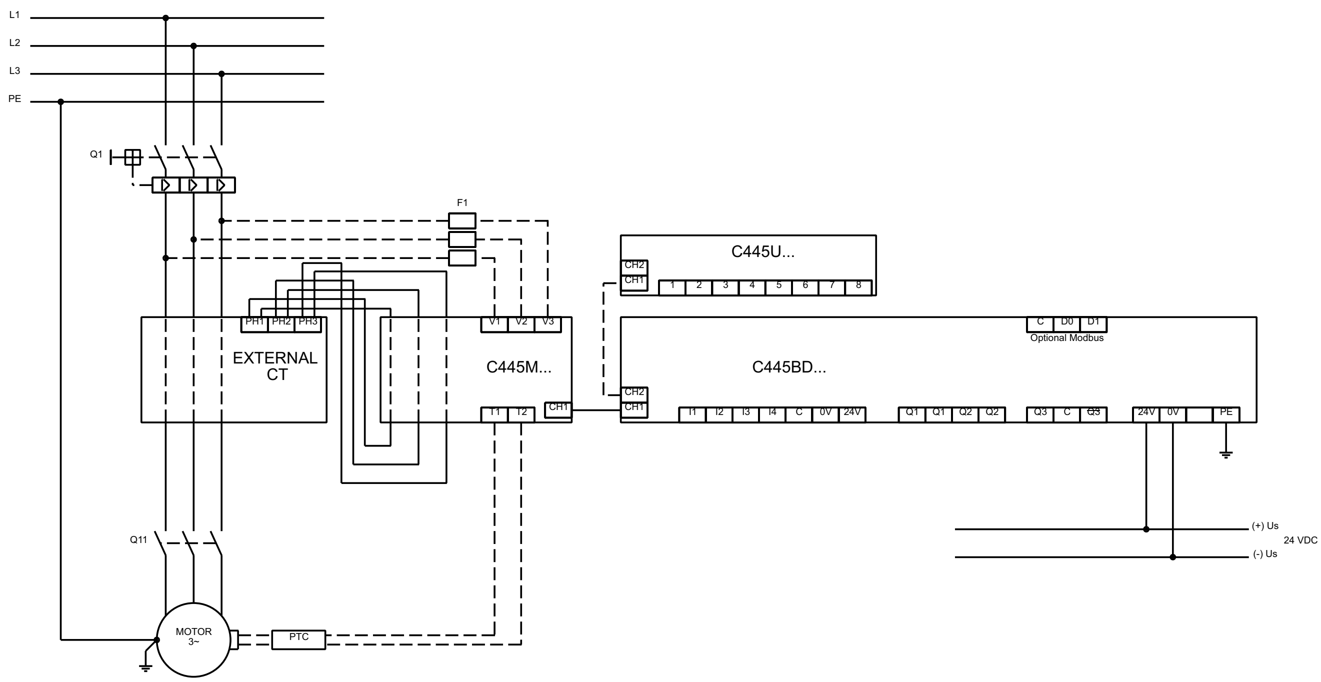


Figure 38. Motor Connections for Standard Overload Control Using XCT800 External CTs with C445BA…

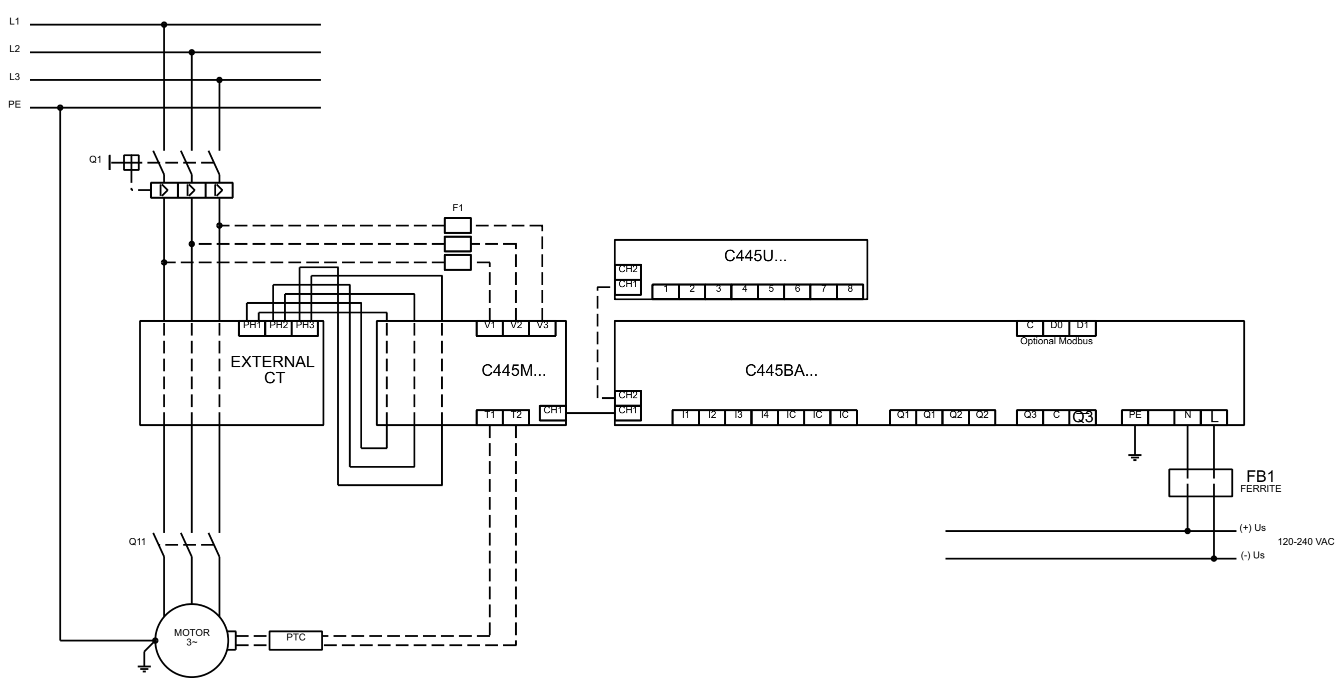
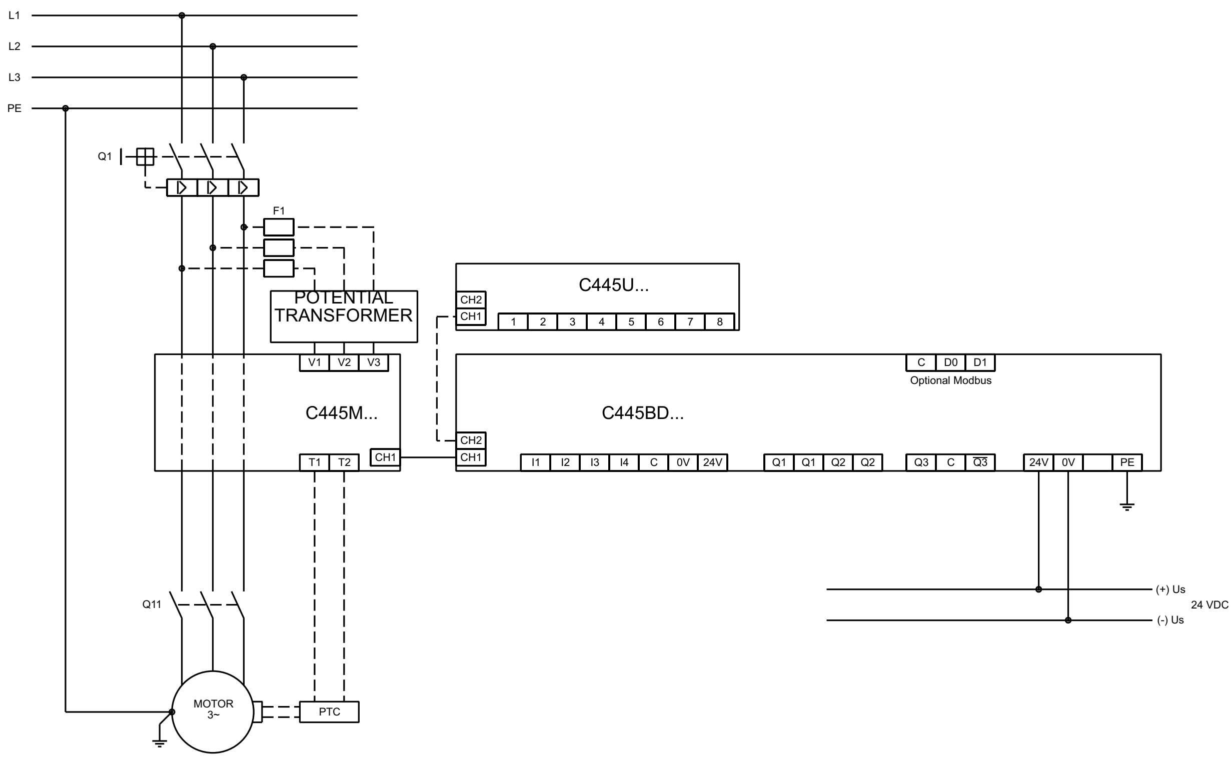


Figure 39. Motor Connections for Standard Overload Control Using Potential Transformers with C445BD…



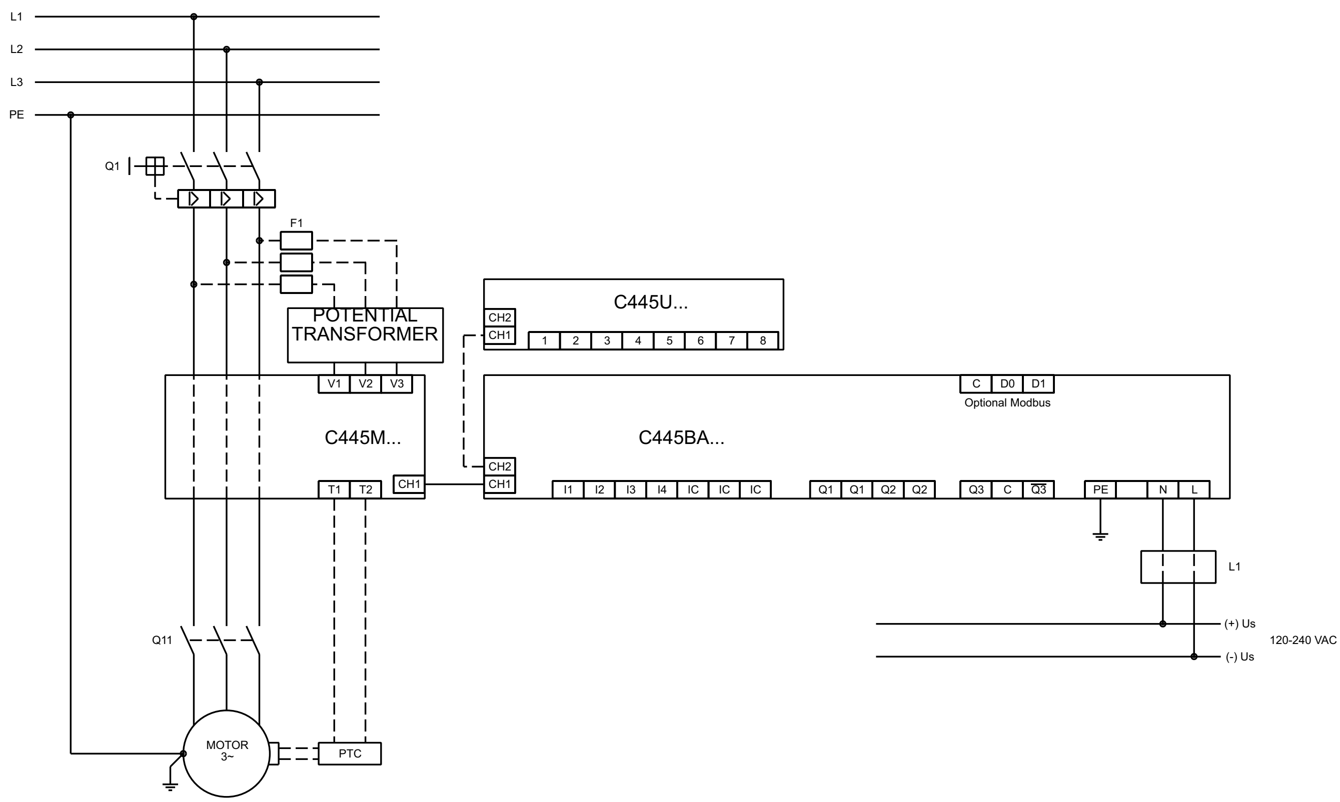
Legend

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.

Fuse protection for V1, V2, V3 is recommended.

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.

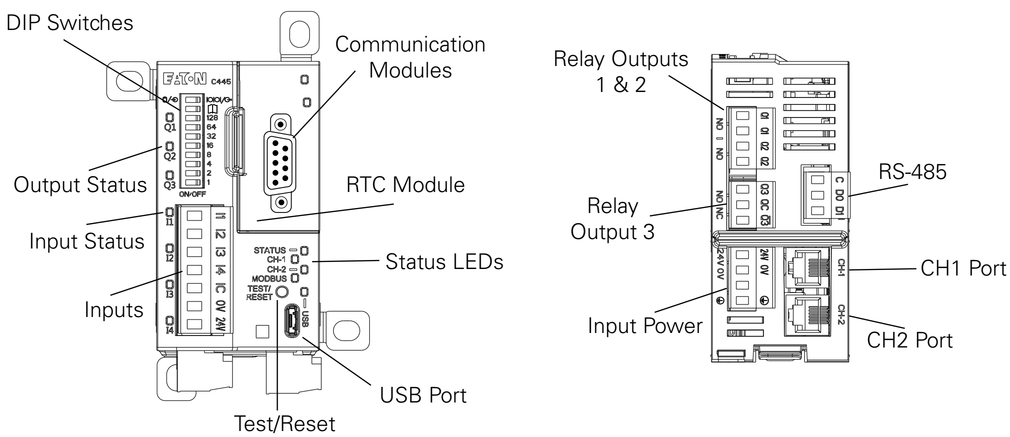
Fuse protection for V1, V2, V3 is recommended.

Power and I/O Wiring

Base Control Module

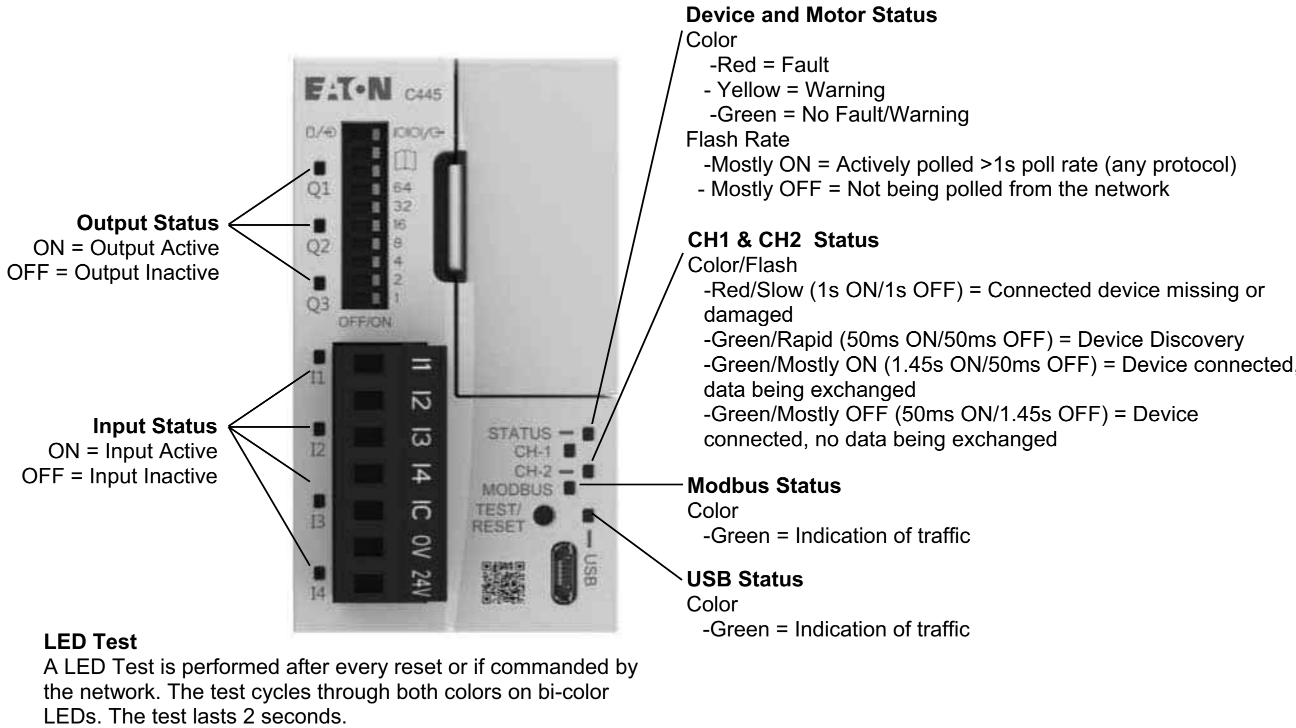
The Base Control Module is the controller of the C445 Motor Management Relay system. It provides motor protection and control algorithms and various motor data for monitoring. This module is equipped with native digital inputs for field wire control and outputs for motor control and protection. It also 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



Base Control Module Features

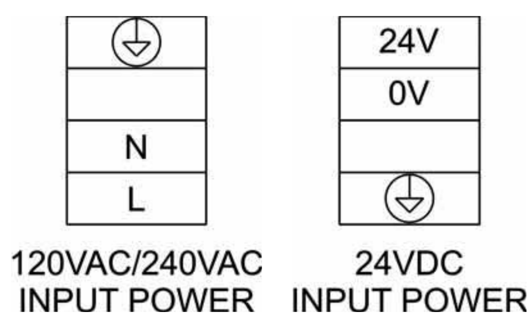
- Motor protection
- Power and efficiency monitoring
- Pre-configured operating modes
- AC (120/240) and DC (24) supply power options
- (4) Inputs / (3) Outputs
- Integrated USB port
- Real time clock memory module option
- Multiple fieldbus communication options
- Status LEDs
- Provides power and communications 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 **System Configuration Operation** on **Page 75** 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 **System Configuration Operation** on **Page 75**.

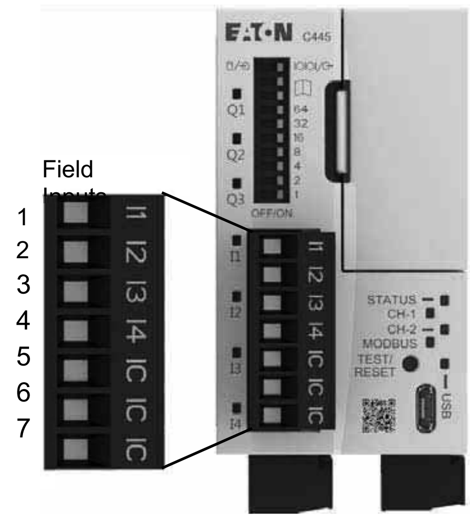
Below are wiring diagrams for the inputs on the Base Control Module assuming Field Wire is not one of the control sources, i.e. all inputs are available as general purpose inputs.

AC Input Option

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

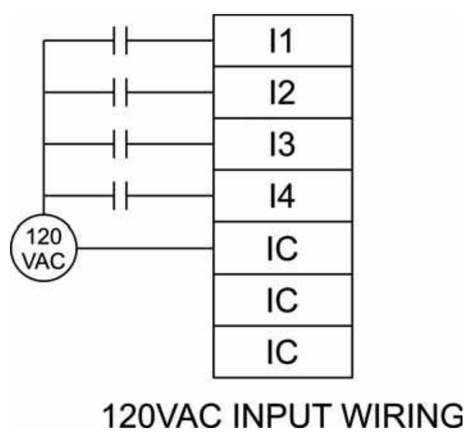
AC Input Field wiring is accomplished with a 7-pin, 5.00 mm pitch, removable screw terminal plug.

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

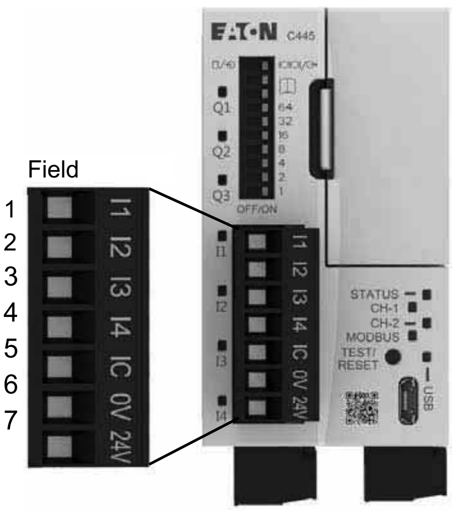
Figure 45. 120 Vac Input Terminal Diagram



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 2 (Isolated)

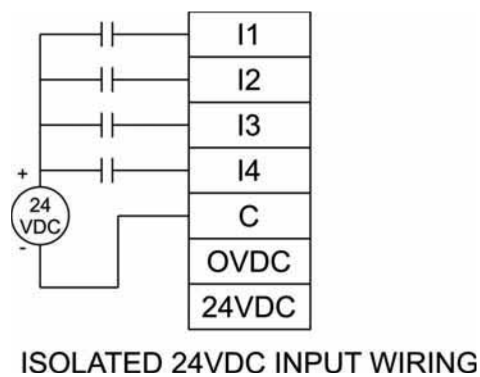
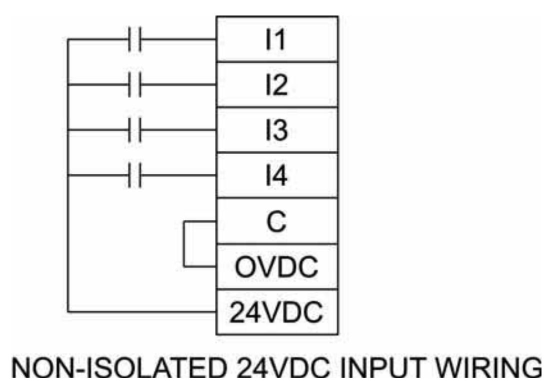


Figure 48. DC Input Wiring Option 2 (Non-Isolated)



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 **System Configuration Operation** on **Page 75**.

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 – Residual GF

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

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

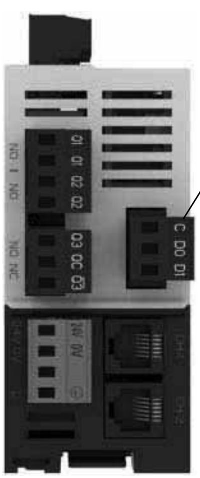
Q3	Output 3	Normally Open (NO)
C	Output 3	Common
Q3 (Not)	Output 3	Normally Closed (NC)

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



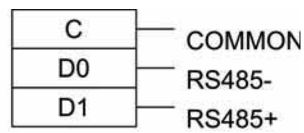
Modbus Serial Port (RS-485)

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

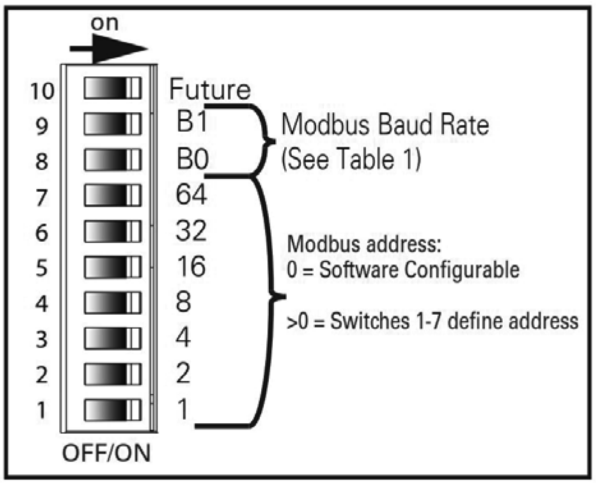


Figure 54. Base Control Module DIP Switches with PROFIBUS Card

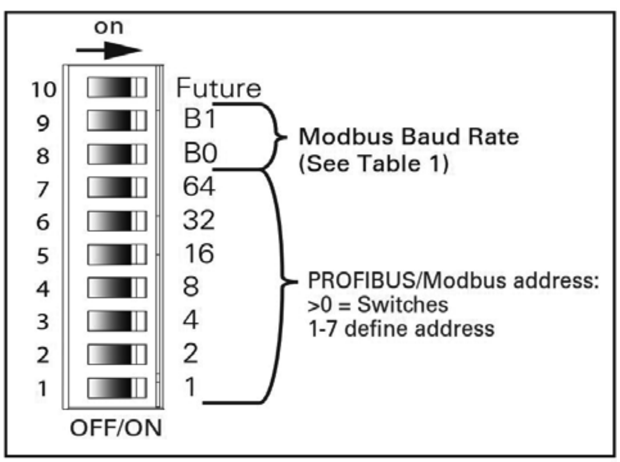
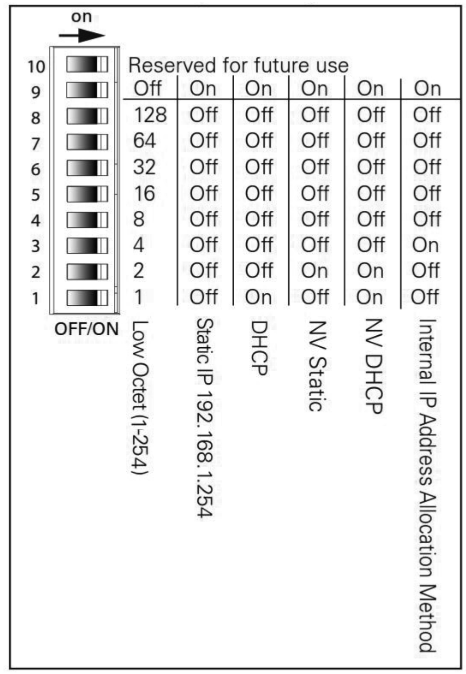


Table 9. Modbus Data Rate

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



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 5** on **Page 6** 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:

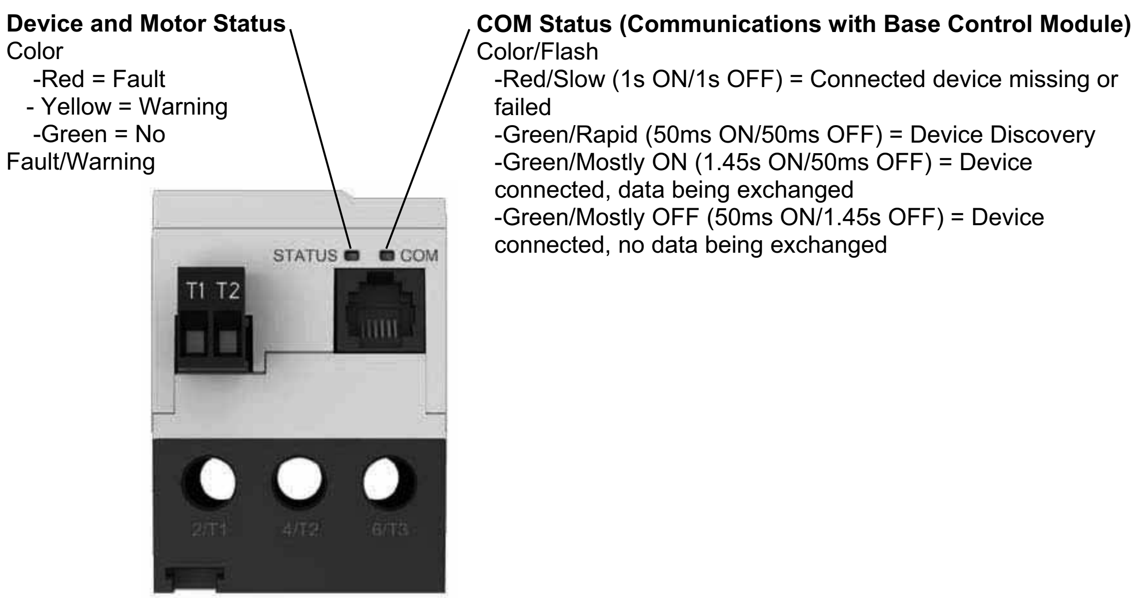
Table 10. PTC Sensor Status

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



User Interface

1. Input Connector

   The connector on the User Interface module is used for four 24 Vdc digital inputs. These inputs may be used as general purpose inputs. The state of these inputs is contained in the "Digital Input Status" Modbus register. They can be monitored by the system controller via any of the supported fieldbus networks.

Figure 57. User Interface Input Connector

Pin #	Description
1	24V Source for Inputs
2	24V Source for Inputs
3	24V Source for Inputs
4	24V Source for Inputs
5	Input 1
6	Input 2
7	Input 3
8	Input 4

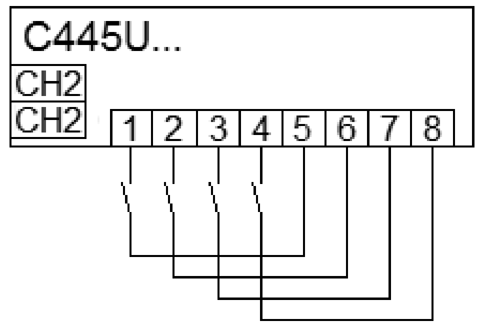
These inputs should only be used to monitor inputs from sources inside the same panel as the User Interface module they're wired to. The reason for this is that the 24 Vdc source for these inputs is also on the 8-position connector with the four inputs. Long runs outside of the panel are not recommended.

Some examples for the inputs on the User Interface are:

- Circuit Breaker On/Off status
- Circuit Breaker tripped
- AUX contact on the contactor
- Panel temperature switch

Below is a diagram showing the function of each of the 8 pins on the Input connector.

Figure 58. User Interface Input Connector Wiring



2. USB Port

The USB port on the User Interface 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

3. LEDs

The optional User Interface provides diagnostic information that is both fixed and optionally user defined.

The User Interface shown below provides operational run, stop status indication as well as diagnostic indication.

4. Fixed diagnostic indicators and user definable indicators.

Figure 59. User Interface LED Overview

The fixed LED indicators provide information whether a fault, warning or an overload trip occurred. The user defined LEDs, when left in their default state indicate whether the fault is a current, voltage or power issue.

The user defined LEDs can also be pre-defined by the user to specific fault or warning indications. In the box with the User Interface is a sheet of stickers with all other indications these three LEDs can be configured for as well as some blanks. The selections can be made from the Power Xpert *in*Control Software Tool, under the System/User Interface category. The selections for these three LEDs are as follows:

Table 11. User Defined LED Options for the User Interface

Description
None
Fault Reason Type – Load Fault (Power based)
Fault Reason Type – Supply Fault
Fault Reason Type – Motor Fault
Tripped Status Bits – PTC
Tripped Status Bits – phase rotation
Tripped Status Bits – stall
Tripped Status Bits – overload
Tripped Status Bits – exceeds starts limit
Tripped Status Bits – low power
Tripped Status Bits – high power
Tripped Status Bits – under current
Tripped Status Bits – freq deviation slow
Tripped Status Bits – freq deviation fast
Tripped Status Bits – voltage unbalance
Tripped Status Bits – voltage phase loss
Tripped Status Bits – PF deviation
Tripped Status Bits – jam
Tripped Status Bits – Instantaneous Over Current
Tripped Status Bits – Current Unbalance
Tripped Status Bits – Current Phase Loss
Tripped Status Bits – Residual GF
Motor Status – Up To Speed
Motor Status – 0 = Device not ready to take any commands; 1 = Device ready to take commands
Motor Status – Inhibited
Motor Status – Warning
Motor Status – Fault
Motor Status – Remote Enabled
Motor Status – Running 2
Motor Status – Running 1

Description
Warning Status Bits – PTC
Warning Status Bits – phase rotation
Warning Status Bits – stall
Warning Status Bits – overload
Warning Status Bits – exceeds starts limit
Warning Status Bits – low power
Warning Status Bits – high power
Warning Status Bits – under current
Warning Status Bits – freq deviation slow
Warning Status Bits – freq deviation fast
Warning Status Bits – voltage unbalance
Warning Status Bits – voltage phase loss
Warning Status Bits – PF deviation
Warning Status Bits – jam
Warning Status Bits – instantaneous over current
Warning Status Bits – current unbalance
Warning Status Bits – current phase loss
Warning Status Bits – residual GF
Warning Status Bits – External GF
Warning Status Bits – overvoltage
Warning Status Bits – undervoltage
Tripped Status Bits – undervoltage
Tripped Status Bits – overvoltage
Tripped Status Bits – External GF
BCM Field Output control word – bit 0 0 = disable 1= enable
BCM Field Output control word – bit 1 0 = disable 1= enable
BCM Field Output control word – bit 2 0 = disable 1= enable
BCM Field Output control word – bit 3 0 = disable 1= enable

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. 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.

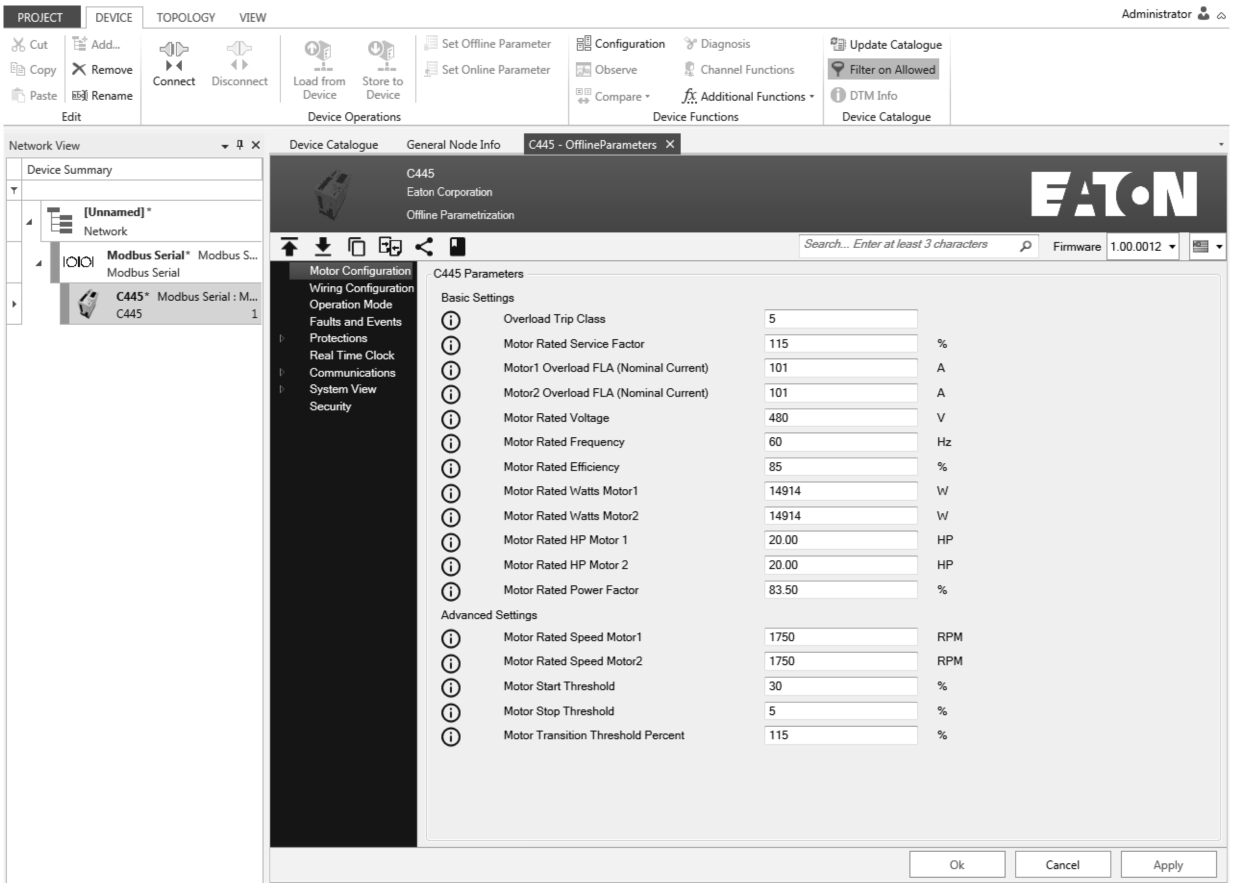
   (2) Categorized parameters for ease of finding the parameters needed to enable and configure particular features in the C445

   (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.



There are many more features offered by this Software Tool that are described in more detail in the Power Xpert inControl 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.

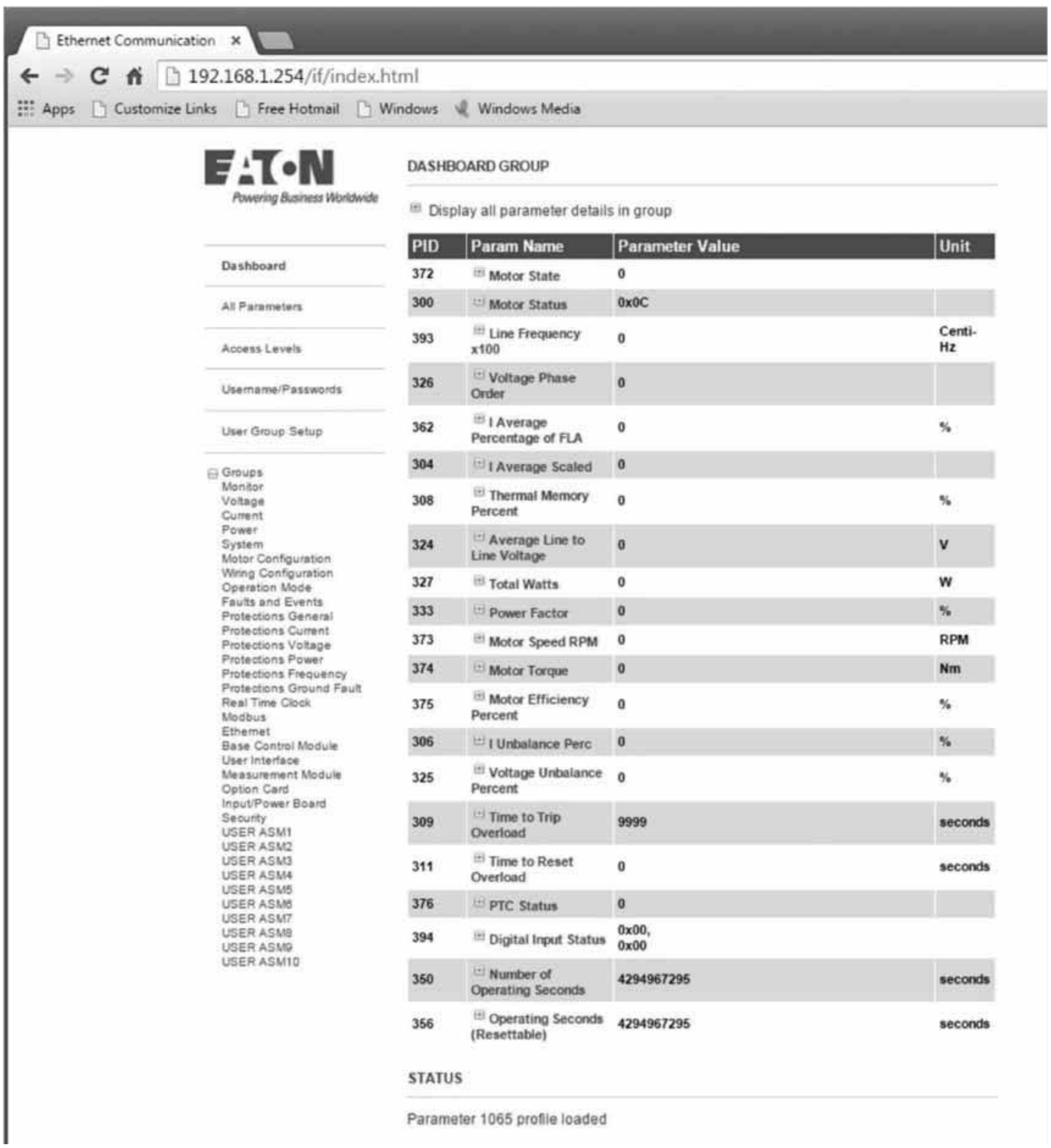
The Micro USB ports use a standard USB/Micro USB cable. This cable may be ordered from Eaton as catalog number: C445XS-USBMICRO.

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.

2. 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 13** 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:



PID	Param Name	Parameter Value	Unit
372	Motor State	0	
300	Motor Status	0x0C	
393	Line Frequency x100	0	Centi-Hz
326	Voltage Phase Order	0	
362	I Average Percentage of FLA	0	%
304	I Average Scaled	0	
308	Thermal Memory Percent	0	%
324	Average Line to Line Voltage	0	V
327	Total Watts	0	W
333	Power Factor	0	%
373	Motor Speed RPM	0	RPM
374	Motor Torque	0	Nm
375	Motor Efficiency Percent	0	%
306	I Unbalance Perc	0	%
325	Voltage Unbalance Percent	0	%
309	Time to Trip Overload	9999	seconds
311	Time to Reset Overload	0	seconds
376	PTC Status	0	
394	Digital Input Status	0x00, 0x00	
350	Number of Operating Seconds	4294967295	seconds
356	Operating Seconds (Resettable)	4294967295	seconds

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

3. 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.
4. 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.
5. 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.
6. 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.
7. 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 inControl 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.

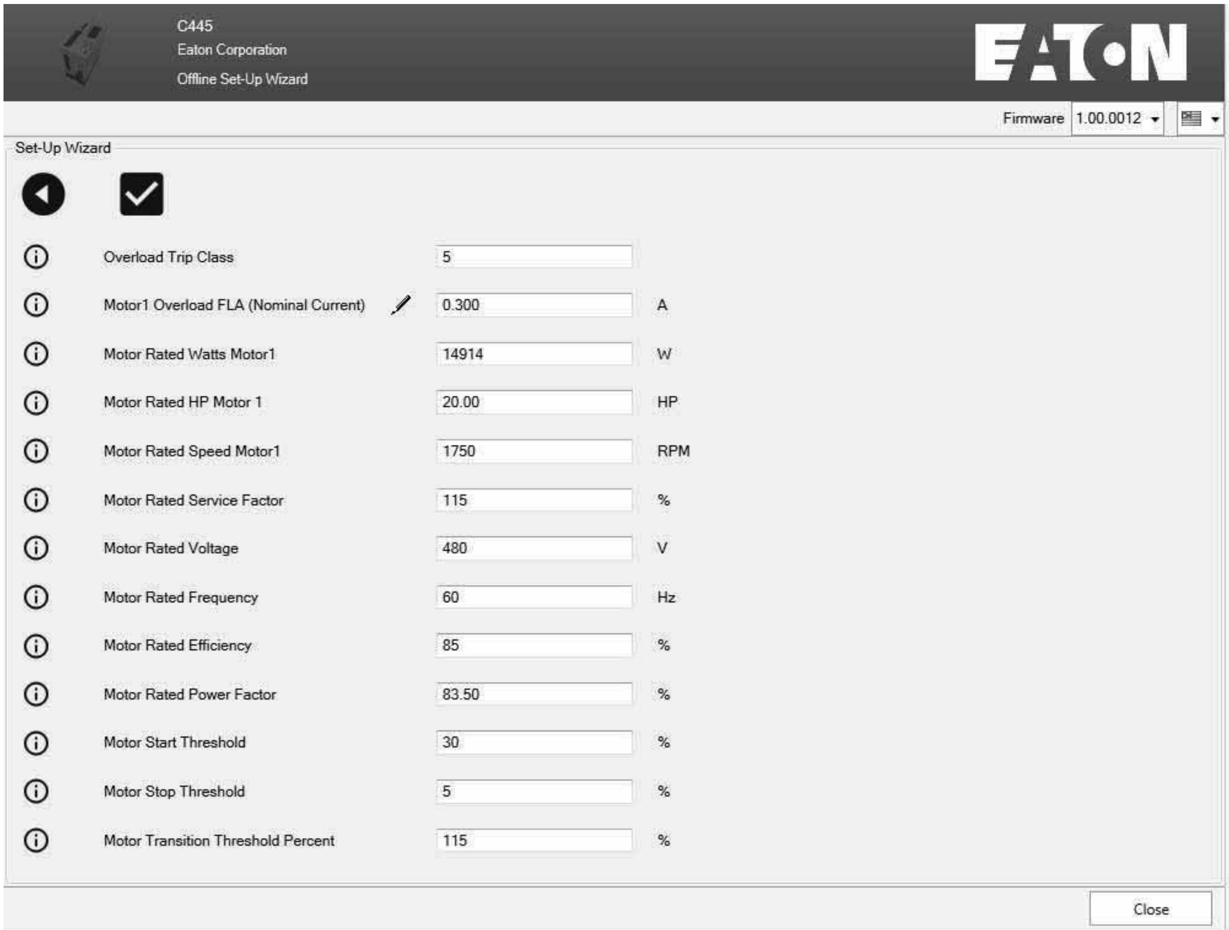
The wizard consists of 2 pages of parameters for single motor applications and 3 pages of parameters for two motor applications. The two pages of parameters for single motor applications are shown below:

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.

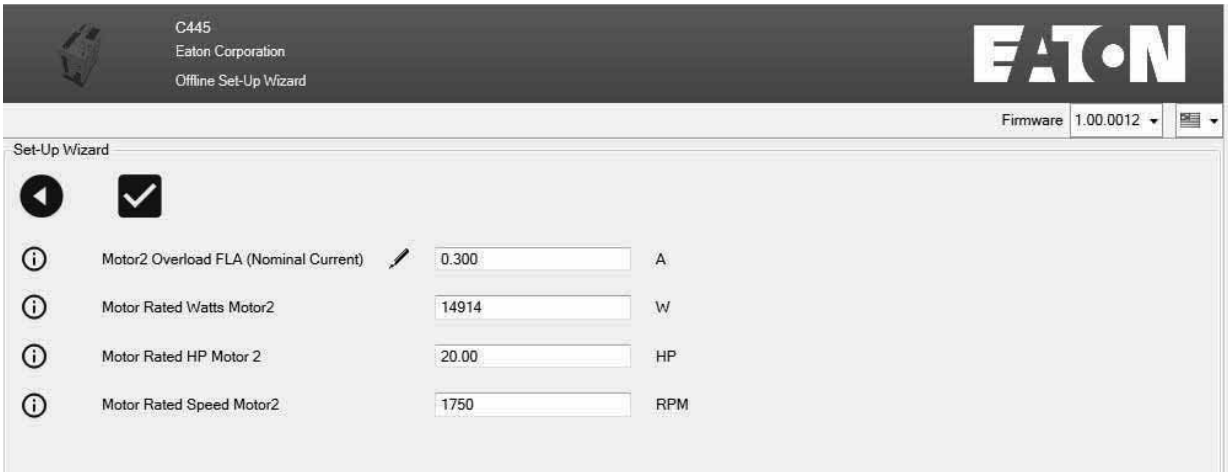


After modifying parameters on page 2 above, select the check mark to save all changes and Exit the wizard.

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:



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 two ways to set the Real Time Clock parameters:

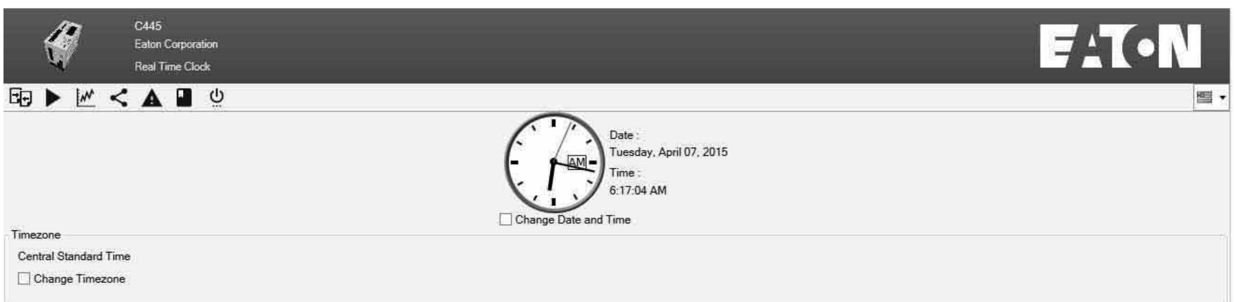
1. Using a Modbus or Modbus TCP master and writing to the RTC parameters. Refer to the Modbus register map in **Appendix D**.

   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.

2. 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:

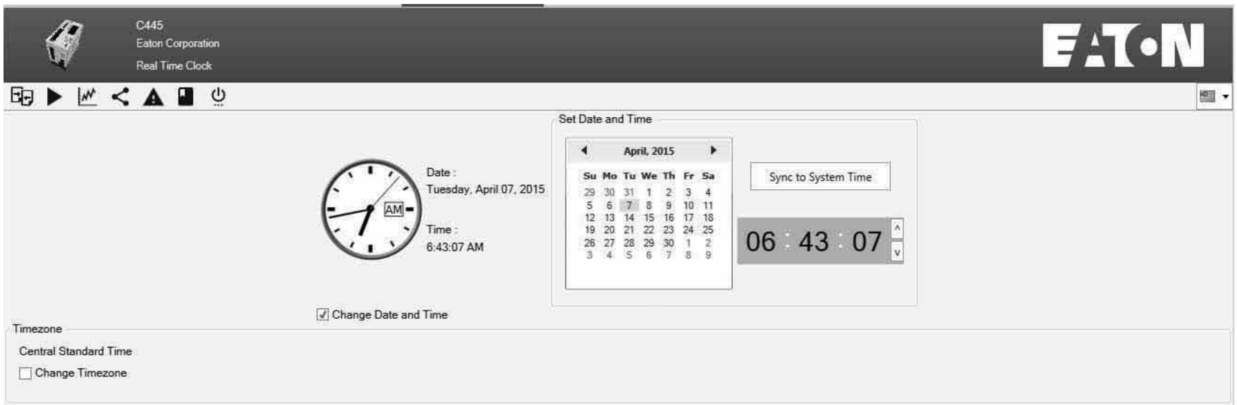
   (1) Once online with the C445, select the Real Time Clock icon as shown below.



The Real Time Clock window will open as below.

3. Select the proper time zone.

4. Select the box to the left of "Change Date and Time" below the clock to display all the RTC parameters as shown below.



5. 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.

Table 12. Administrator Password Lock Parameters

Parameters
Base Control Module Assigned Name
Active Operation Mode
Max Star Winding Time
Field Output Communication Fault Action
Field Output Communication Fault State
Field Output Communication Idle Action
Field Output Communication Idle State
Control Interlocking Time
Control Switching Time
Output 1 Function Select
Output 2 Function Select
Output 3 Function Select
Output 3 Function Select reset
Measurement Module Wire Config
Base Control Module Modbus Port Address
Base Control Module Modbus port Baud Rate
Base Control Module RS-485 Modbus Timeout
Base Control Module Modbus port Parity and Stop Bits
Base Control Module Modbus port TX mode
Modbus Scan List
Base Control Module USB Modbus Timeout
Motor Control Communication Loss Behavior
Motor Rated Frequency
CT Ratio - Primary
CT Ratio - Secondary
Maximum Start Current Floating Point
Maximum Start Current Scaled
Motor Rated Efficiency
Motor Rated Stator Resistance
Motor Rated HP Motor1 Scaled
Motor Rated HP Motor2 Scaled
Motor Rated PF (Scaled)
Motor Rated Service Factor

Table 12. Administrator Password Lock Parameters, continued

Parameters
Motor Rated Speed Motor1
Motor Rated Speed Motor2
Motor Rated Watts Motor1
Motor Rated Watts Motor2
Total Motor Run Time (Resettable)
Motor Start Threshold
Motor Stop Threshold
Motor Transition Threshold Percent
Motor Rated Voltage
Apparent Energy (Resettable) Scaled
Reactive Energy (Resettable) Scaled
Real Energy (Resettable) Scaled
Alarm Debounce Time
Global Auto Reset Enable
Trip Auto Reset Enable Bits
Auto Reset Delay
Backspin Inhibit Time
Motor State Transition to run delay from Start
Frequency Deviation Fast Alarm Level Scaled
Frequency Deviation Fast Debounce
Frequency Deviation Fast Trip Level Scaled
Frequency Deviation Slow Alarm Level Scaled
Frequency Deviation Slow Debounce
Frequency Deviation Slow Trip Level Scaled
Residual GF Debounce
Residual GF Inhibit Current Percent
Residual GF Alarm Threshold Scaled
Residual GF Threshold Scaled
Residual GF Start Delay
Residual GF Use Inhibit Current
I Unbalance Alarm Level Percent
I Unbalance Debounce
I Unbalance Trip Level Percent
Instantaneous Overcurrent Alarm Level
Instantaneous Overcurrent Debounce
Instantaneous Overcurrent Start Delay
Instantaneous Overcurrent Trip Level
Jam Alarm Level
Jam Debounce
Jam Trip Level
Overvoltage Alarm Level
Overvoltage Debounce

Table 12. Administrator Password Lock Parameters, continued

Parameters
Overvoltage Trip Level
Overload Alarm Level
Overload Trip Class
Motor1 Overload FLA (Nominal Current) Scaled
Motor2 Overload FLA (Nominal Current) Scaled
Overload Reset Threshold
Fault Reset on Power Up
Phase Rotation Protection
Power Factor Deviation Alarm Level High
Power Factor Deviation Alarm Level Low
Power Factor Deviation Debounce
Power Factor Deviation Trip Level Low
Power Factor Deviation Trip Level High
Stall Trip Level
Allowed Starts Per Hour
Trip Enable Bits
Undercurrent Alarm Level
Undercurrent Debounce
Undercurrent Trip Level
Undervoltage Alarm Level
Undervoltage Start Delay
Undervoltage Debounce
Undervoltage Trip Level
Voltage Unbalance Alarm Level
Voltage Unbalance Debounce
Voltage Unbalance Trip Level
Warning Enable Bits
High kW Alarm Level
High kW Debounce
High kW Trip Level
Low kW Alarm Level
Low kW Debounce
Low kW Trip Level
Output 3 Latching Relay Behavior at Power-down
RTC Manual DST Rule End
RTC Manual DST Rule Start
RTC DST Rule
RTC Time Zone Ahead of UTC
RTC Time Zone DST Setting Status
RTC Time Zone hh mm
Number of Starts (Resettable)
Delay before control fault (in 10ms)

Table 12. Administrator Password Lock Parameters, continued

Parameters
Stored Ethernet IP Address
Stored Ethernet Subnet Mask
Stored Ethernet Default Gateway
Ethernet Port 1 Speed Select
Ethernet Port 1 Full Duplex Enable
Ethernet Port 1 Autonegotiate Enable
Ethernet Port 1 Enabled
Ethernet Port 2 Speed Select
Ethernet Port 2 Full Duplex Enable
Ethernet Port 2 Autonegotiate Enabled
Ethernet Port 2 Enabled
Address Conflict Detection Enable
Modbus TCP Com Timeout
REST Web services Communication Timeout
If Protection Start Inhibit Enable
Undervoltage Start Inhibit Threshold
MCCB actuation pulse width
Voltage Unbalance Start Inhibit Threshold
Overvoltage Start Inhibit Threshold
Base Control Module Field Wiring Configuration Selector
Remote Control Source Select
Feedback Signal Source Select
Under Voltage Restart Fault Level
Under Voltage Restart Restoration Level
Demand (Resettable)
Peak Demand Time Stamp
Demand Window Duration
Local motor control source
User Interface Button LED 0 Purpose
User Interface Button LED 1 Purpose
User Interface Button LED 2 Purpose
User Interface Button LED 3 Purpose
User Interface Status LED 0 Purpose
User Interface Status LED 1 Purpose
User Interface Status LED 2 Purpose
User Interface User LED 0 Purpose
User Interface User LED 1 Purpose
User Interface User LED 2 Purpose
User Interface Button 0 CFG
User Interface Button 1 CFG
User Interface Button 2 CFG
User Interface Button 3 CFG

Table 12. Administrator Password Lock Parameters, continued

Parameters
User Interface Button 4 CFG
User Interface LED 0 color CFG
User Interface LED 1 color CFG
User Interface LED 2 color CFG
User Interface LED 3 color CFG
User Interface LED 4 color CFG
User Interface LED 5 color CFG
User Interface LED 6 color CFG
Peak Demand Warning Threshold
Enable MCCB Actuation
Voltage Loss Auto Time
Voltage Loss Short Time
Voltage Loss Long Time
Voltage Loss Short Delay
Voltage Loss Long Delay
Local/Remote power up mode
Motor Control Network Idle Behavior
Solenoid open delay time
Solenoid close delay time
Non-energized state
Input Debounce Time
Set Admin Password
Set USB Port Password
Motor Run Parameter Lock Override
Base Control Module Relay 3 Behavior
Profi-Modbus Mode
Marketing demo unlock

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 Admin password.

Table 13. USB Lockout Password Codes

Parameters
Base Control Module Assigned Name
Active Operation Mode
Max Star Winding Time
Fieldbus Motor Control
Field Output Communication Fault Action
Field Output Communication Fault State
Field Output Communication Idle Action
Field Output Communication Idle State
Control Interlocking Time
Control Switching Time
Output 1 Function Select
Output 2 Function Select
Output 3 Function Select
Output 3 Function Select reset
Measurement Module Wire Config
Base Control Module Modbus Port Address
Base Control Module Modbus port Baud Rate
Base Control Module RS-485 Modbus Timeout
Base Control Module Modbus port Parity and Stop Bits
Base Control Module Modbus port TX mode
Modbus Scan List

Table 13. USB Lockout Password Codes, continued

Parameters
Base Control Module USB Modbus Timeout
Motor Control Communication Loss Behavior
Motor Rated Frequency
CT Ratio - Primary
CT Ratio - Secondary
Maximum Start Current Floating Point
Maximum Start Current Scaled
Motor Rated Efficiency
Motor Rated Stator Resistance
Motor Rated HP Motor1 Scaled
Motor Rated HP Motor2 Scaled
Motor Rated PF (Scaled)
Motor Rated Service Factor
Motor Rated Speed Motor1
Motor Rated Speed Motor2
Motor Rated Watts Motor1
Motor Rated Watts Motor2
Total Motor Run Time (Resettable)
Motor Start Threshold
Motor Stop Threshold
Motor Transition Threshold Percent
Motor Rated Voltage
Apparent Energy (Resettable) Scaled
Reactive Energy (Resettable) Scaled
Real Energy (Resettable) Scaled
Alarm Debounce Time
Global Auto Reset Enable
Trip Auto Reset Enable Bits
Auto Reset Delay
Backspin Inhibit Time
Motor State Transition to run delay from Start
Frequency Deviation Fast Alarm Level Scaled
Frequency Deviation Fast Debounce
Frequency Deviation Fast Trip Level Scaled
Frequency Deviation Slow Alarm Level Scaled
Frequency Deviation Slow Debounce
Frequency Deviation Slow Trip Level Scaled
Residual GF Debounce
Residual GF Inhibit Current Percent
Residual GF Alarm Threshold Scaled
Residual GF Threshold Scaled
Residual GF Start Delay

Table 13. USB Lockout Password Codes, continued

Parameters
Residual GF Use Inhibit Current
I Unbalance Alarm Level Percent
I Unbalance Debounce
I Unbalance Trip Level Percent
Instantaneous Overcurrent Alarm Level
Instantaneous Overcurrent Debounce
Instantaneous Overcurrent Start Delay
Instantaneous Overcurrent Trip Level
Jam Alarm Level
Jam Debounce
Jam Trip Level
Overvoltage Alarm Level
Overvoltage Debounce
Overvoltage Trip Level
Overload Alarm Level
Overload Trip Class
Motor1 Overload FLA (Nominal Current) Scaled
Motor2 Overload FLA (Nominal Current) Scaled
Overload Reset Threshold
Fault Reset on Power Up
Phase Rotation Protection
Power Factor Deviation Alarm Level High
Power Factor Deviation Alarm Level Low
Power Factor Deviation Debounce
Power Factor Deviation Trip Level Low
Power Factor Deviation Trip Level High
Stall Trip Level
Allowed Starts Per Hour
Trip Enable Bits
Undercurrent Alarm Level
Undercurrent Debounce
Undercurrent Trip Level
Undervoltage Alarm Level
Undervoltage Start Delay
Undervoltage Debounce
Undervoltage Trip Level
Voltage Unbalance Alarm Level
Voltage Unbalance Debounce
Voltage Unbalance Trip Level
Warning Enable Bits
High kW Alarm Level
High kW Debounce

Table 13. USB Lockout Password Codes, continued

Parameters
High kW Trip Level
Low kW Alarm Level
Low kW Debounce
Low kW Trip Level
Output 3 Latching Relay Behavior at Power-down
RTC Manual DST Rule End
RTC Manual DST Rule Start
RTC DST Rule
RTC Time Zone Ahead of UTC
RTC Time Zone DST Setting Status
RTC Time Zone hh mm
Number of Starts (Resettable)
Delay before control fault (in 10ms)
Stored Ethernet IP Address
Stored Ethernet Subnet Mask
Stored Ethernet Default Gateway
Ethernet Port 1 Speed Select
Ethernet Port 1 Full Duplex Enable
Ethernet Port 1 Autonegotiate Enable
Ethernet Port 1 Enabled
Ethernet Port 2 Speed Select
Ethernet Port 2 Full Duplex Enable
Ethernet Port 2 Autonegotiate Enabled
Ethernet Port 2 Enabled
Address Conflict Detection Enable
Modbus TCP Com Timeout
REST Web services Communication Timeout
If Protection Start Inhibit Enable
Undervoltage Start Inhibit Threshold
MCCB actuation pulse width
Voltage Unbalance Start Inhibit Threshold
Overvoltage Start Inhibit Threshold
Base Control Module Field Wiring Configuration Selector
Remote Control Source Select
Feedback Signal Source Select
Under Voltage Restart Fault Level
Under Voltage Restart Restoration Level
Demand (Resettable)
Peak Demand Time Stamp
Demand Window Duration
Local motor control source
User Interface Button LED 0 Purpose

Table 13. USB Lockout Password Codes, continued

Parameters
User Interface Button LED 1 Purpose
User Interface Button LED 2 Purpose
User Interface Button LED 3 Purpose
User Interface Status LED 0 Purpose
User Interface Status LED 1 Purpose
User Interface Status LED 2 Purpose
User Interface User LED 0 Purpose
User Interface User LED 1 Purpose
User Interface User LED 2 Purpose
User Interface Button 0 CFG
User Interface Button 1 CFG
User Interface Button 2 CFG
User Interface Button 3 CFG
User Interface Button 4 CFG
User Interface LED 0 color CFG
User Interface LED 1 color CFG
User Interface LED 2 color CFG
User Interface LED 3 color CFG
User Interface LED 4 color CFG
User Interface LED 5 color CFG
User Interface LED 6 color CFG
Peak Demand Warning Threshold
Enable MCCB Actuation
Voltage Loss Auto Time
Voltage Loss Short Time
Voltage Loss Long Time
Voltage Loss Short Delay
Voltage Loss Long Delay
Local/Remote power up mode
Motor Control Network Idle Behavior
Solenoid open delay time
Solenoid close delay time
Non-energized state
Input Debounce Time
Set Admin Password
Set USB Port Password
Motor Run Parameter Lock Override
Base Control Module Relay 3 Behavior
Profi-Modbus Mode
Marketing demo unlock

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.

Table 14. Running Lock Option Codes

Parameters
Active Operation Mode
Max Star Winding Time
PT Ratio Primary
PT Ratio Secondary
Control Interlocking Time
Control Switching Time
Output 1 Function Select
Output 2 Function Select
Output 3 Function Select
Output 3 Function Select reset
Measurement Module Wire Config
Motor Rated Frequency
CT Ratio - Primary
CT Ratio - Secondary
Motor Rated HP Motor1 Scaled
Motor Rated HP Motor2 Scaled
Motor Rated PF (Scaled)
Motor Rated Service Factor
Motor Rated Watts Motor1
Motor Rated Watts Motor2
Motor Start Threshold
Motor Stop Threshold
Motor Transition Threshold Percent
Motor Rated Voltage
Global Auto Reset Enable
Trip Auto Reset Enable Bits
Auto Reset Delay

Table 14. Running Lock Option Codes, continued

Parameters
Motor State Transition to run delay from Start
Overload Trip Class
Motor1 Overload FLA (Nominal Current) Scaled
Motor2 Overload FLA (Nominal Current) Scaled
Force Overload Perc
Overload Reset Threshold
Phase Rotation Protection
Trip Enable Bits
Delay before control fault (in 10ms)
If Protection Start Inhibit Enable
MCCB actuation pulse width
Base Control Module Field Wiring Configuration Selector
Remote Control Source Select
Feedback Signal Source Select
Under Voltage Restart Fault Level
Under Voltage Restart Restoration Level
Local motor control source
Enable MCCB Actuation
Voltage Loss Auto Time
Voltage Loss Short Time
Voltage Loss Long Time
System Services
Profi-Modbus Mode
Marketing demo unlock

Web Pages Password Protection

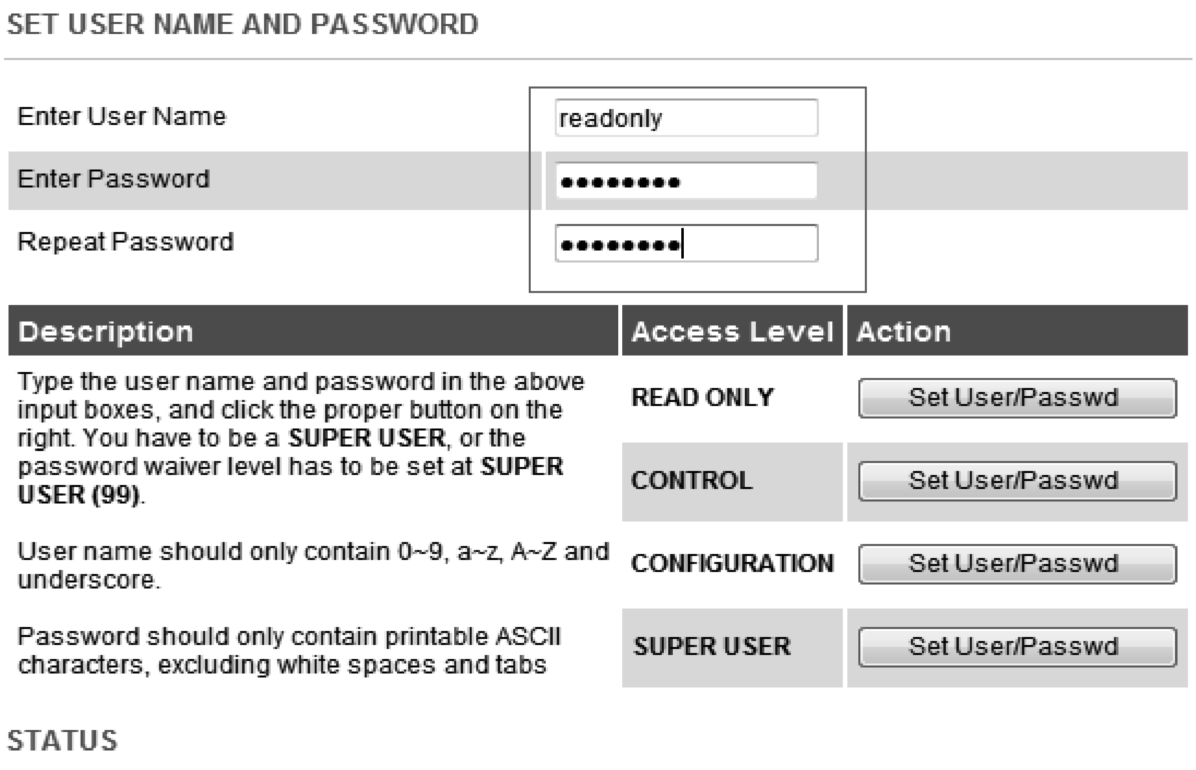
Only Super-User has the ability to change the User Names and Passwords for the various levels. The web page provides five levels of authorization.

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

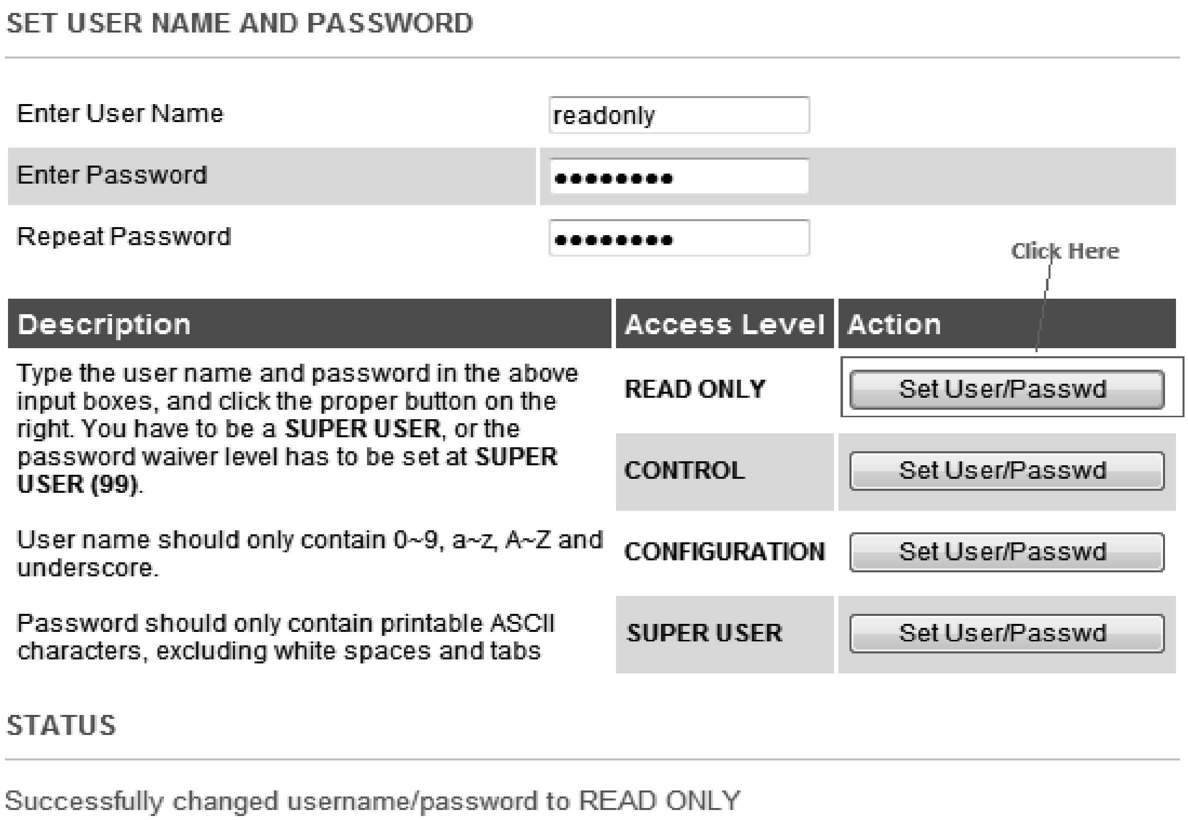
The following is a step by step process demonstrating how to set passwords for the Web Pages.

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

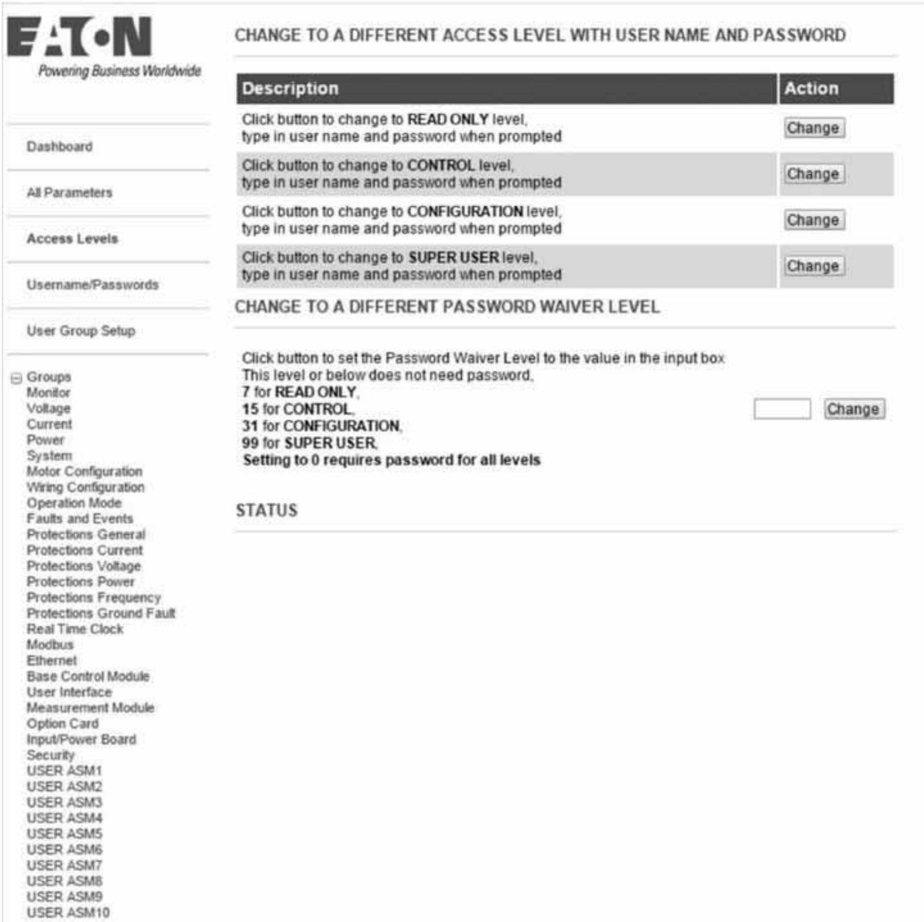
2. Enter a user name and password for each level.



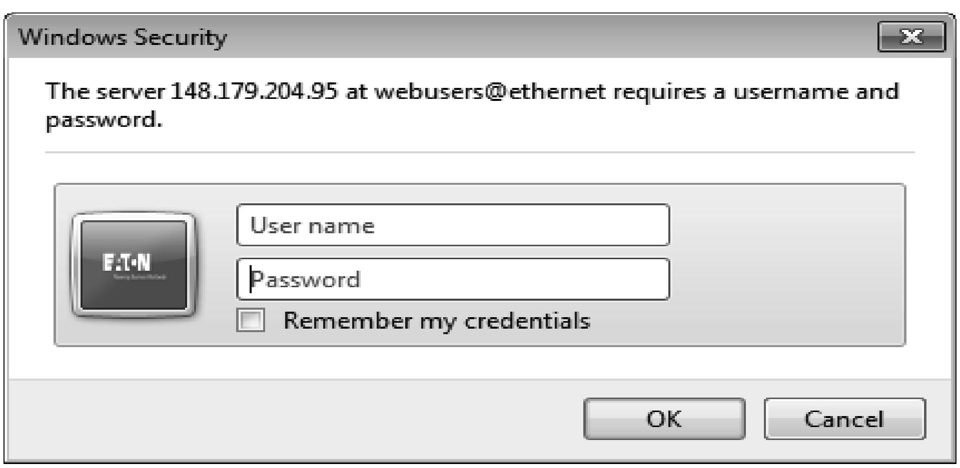
3. After entering the username & password, select the Set User/Password button for each level. A successful status message will be displayed per the following:



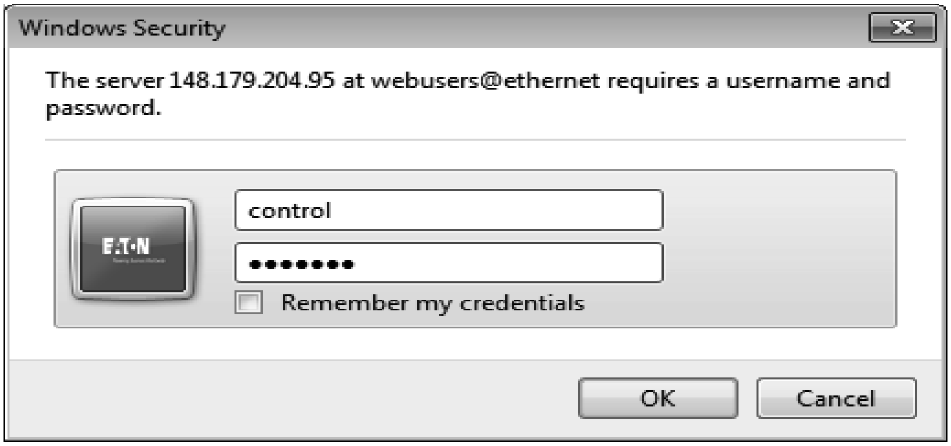
4. Select an access level to change the access level to something other than Super-User.



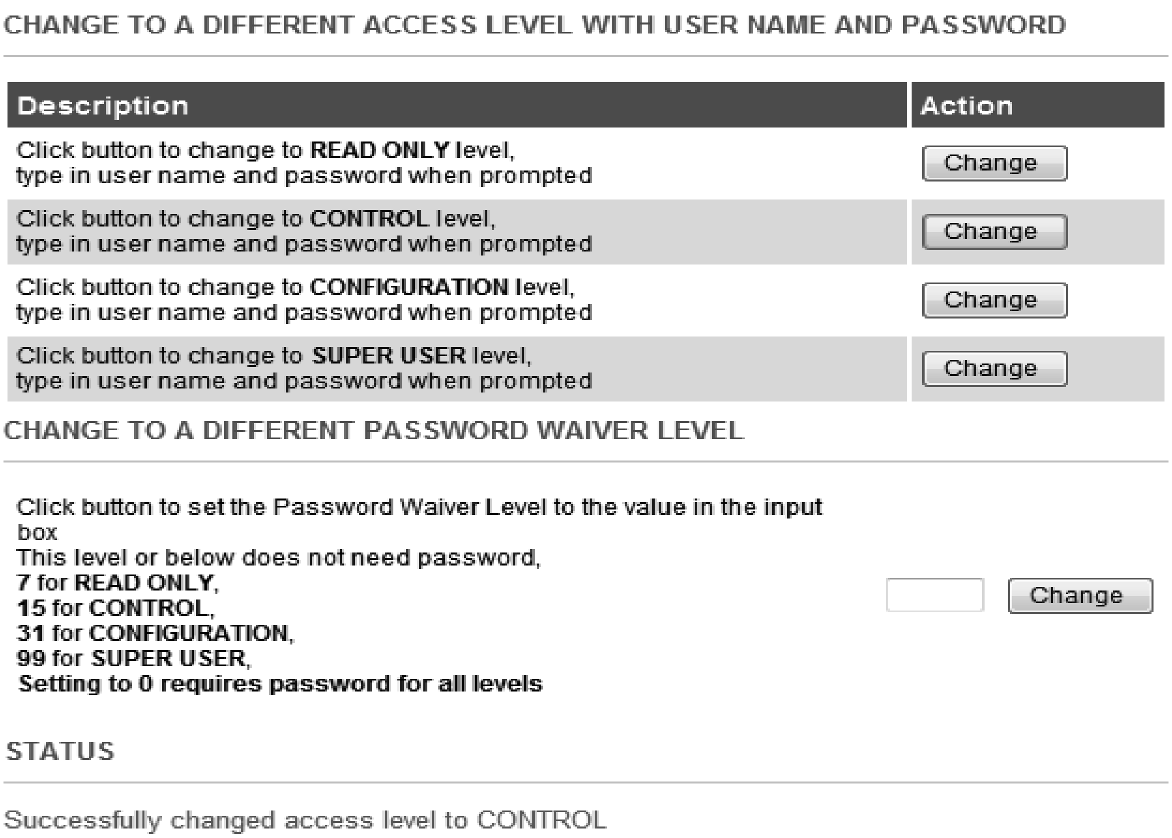
5. Select the Control Level then the Change Button and enter a User Name and Password when prompted.



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



7. The following message will be displayed if successful.



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 module with control buttons is connected, the User Interface will be the Local Control Source. If a Status only User Interface module without control buttons is connected or if no User Interface module is connected at all, the Local Control source will be treated as No Local Control.

No Local Control—Is not allowed, if a User Interface module with control buttons is connected.

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

Fieldwire Control—The Fieldwire will act as the Local Control Source. This selection is allowed if a Status only User Interface module without control buttons is connected or if no User Interface module is connected at all. The default wiring method is 2-wire control. 3-wire control is an option for all operation modes except Reverser and the Two-Speed Operation modes. **Page 79** displays the wiring options for all modes.

There are three options for the remote control source:

- No remote control source
- Fieldbus
- Fieldwire

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 for all operation modes. 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.

Pre-Defined Operation Modes

There are 11 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

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 Overlays for the Overload Only Operation Mode

Figure 60. C445UC-I9: IEC Control and Status

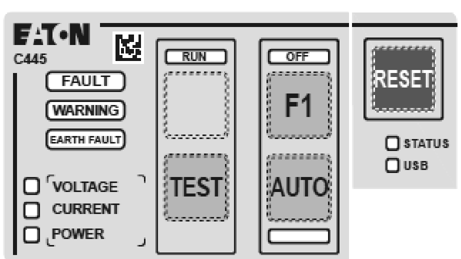


Figure 61. C445UC-I1: IEC Status Only

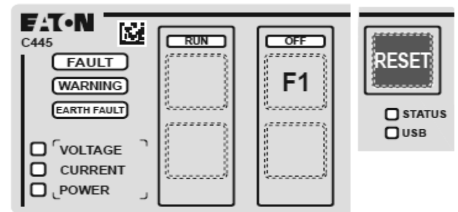
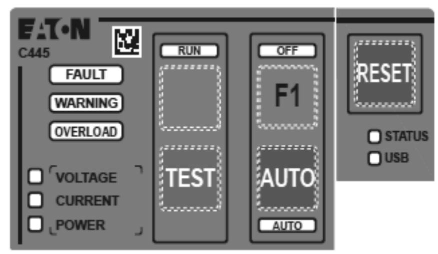


Figure 62. C445UC-N9: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in "ready" state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- RUN LED solid On – Motor is running and is up to speed – complete start detected
- RUN LED blinking On – Motor is running but is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- TEST button – Will put the control in "Local" and will cause the C445 to "trip" the overload.
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared

Control Settings

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

Table 15. Overload Only 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 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 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 anytime current readings exceed 5% the active overload FLA rating.

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 63. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

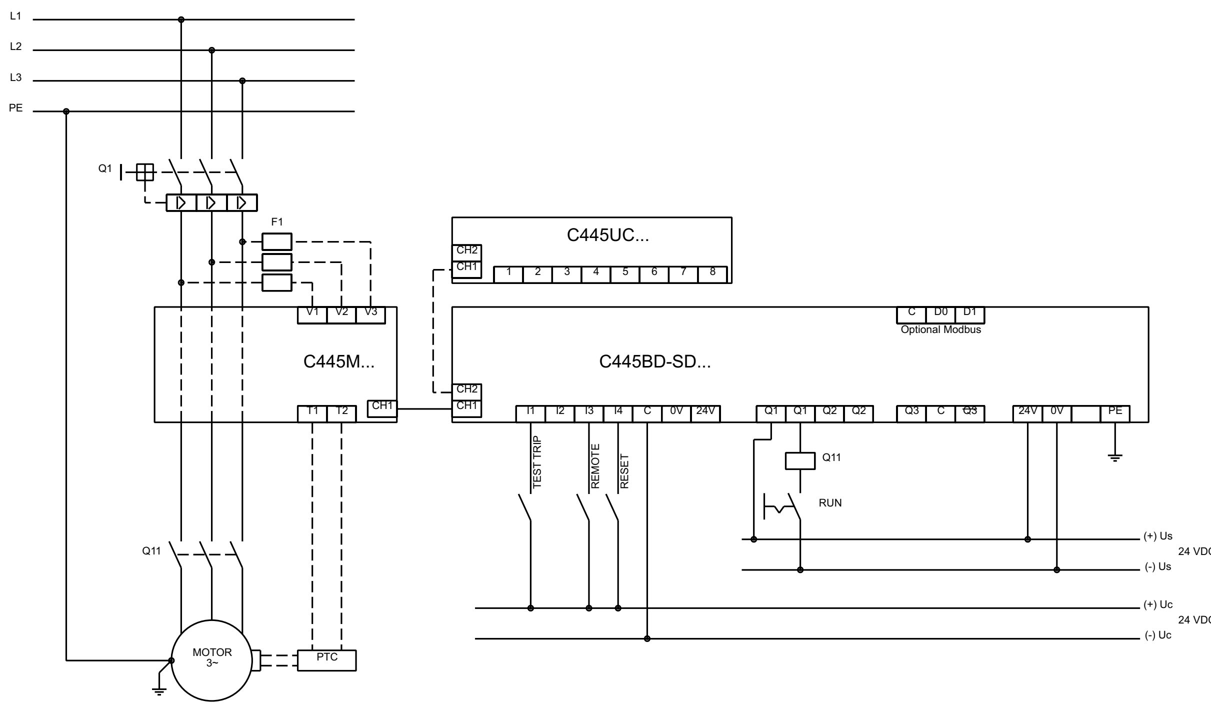


Figure 64. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

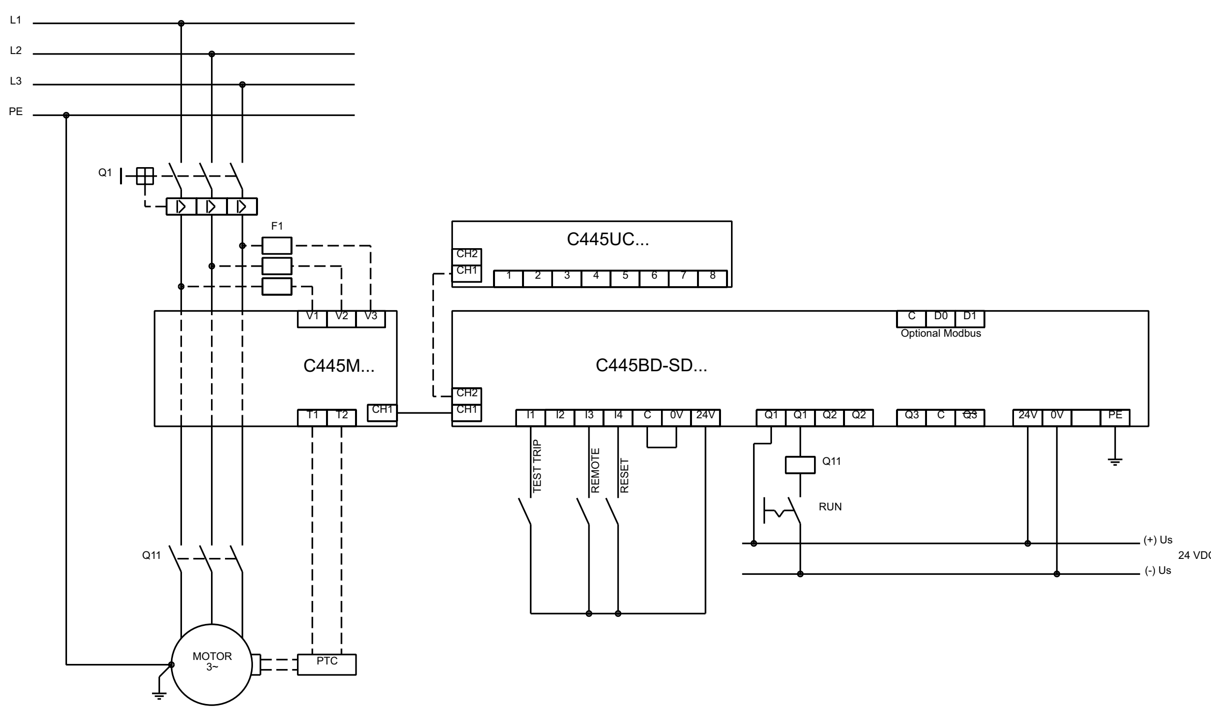
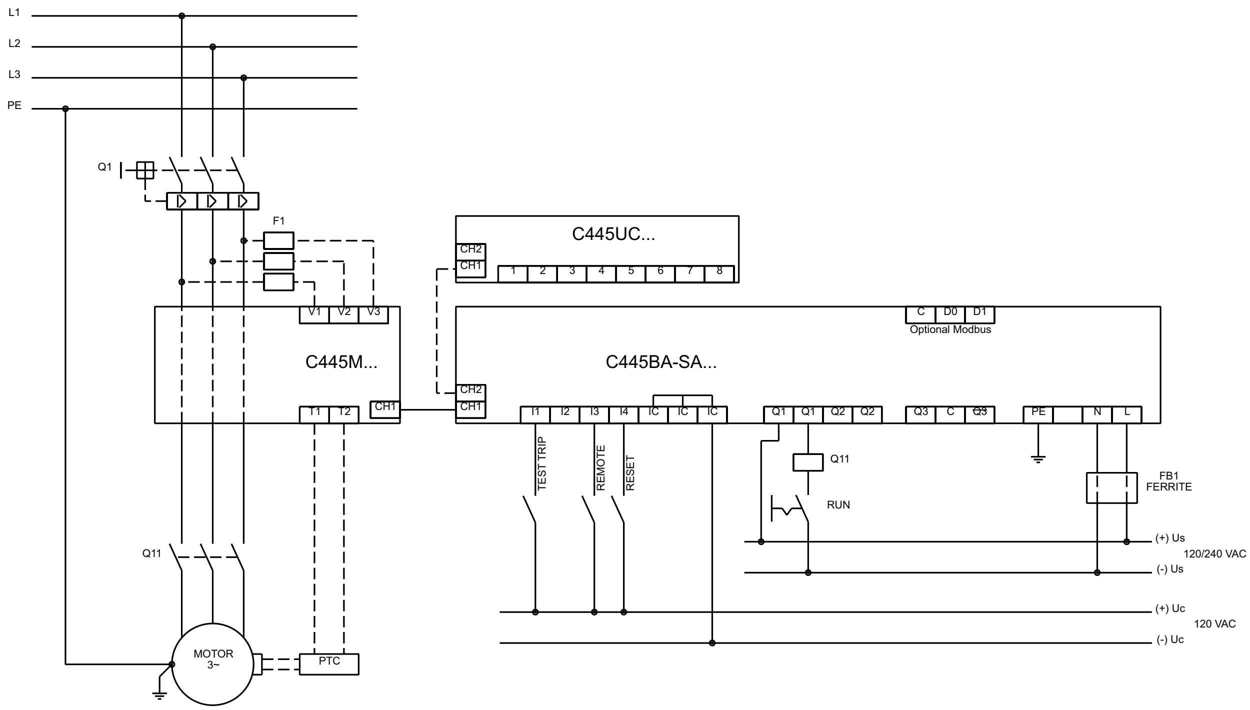


Figure 65. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.

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

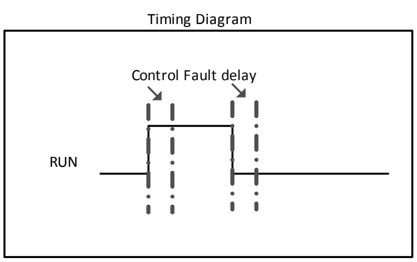
Output 1 controls and protects the contactor/motor. It will close when a valid RUN command is received by the C445, provided a fault or inhibit is not active and will open on a STOP command or if a trip occurs. A C445 Trip condition will cause the Output contact to open.

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 66. Timing Diagram for the Direct Mode Operation



Recommended User Interface Overlays for the Direct Operation Mode

Figure 67. C445UC-I0: IEC Control and Status

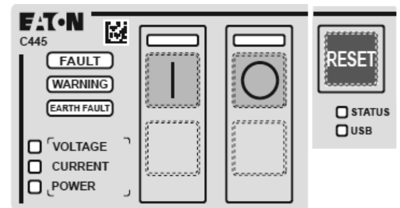


Figure 68. C445UC-I1: IEC Status only

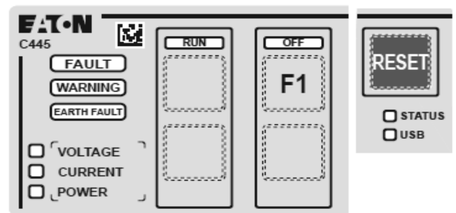


Figure 69. C445UC-I4: IEC Control and Status

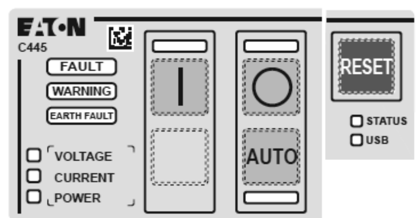


Figure 70. C445UC-N0: NEMA Control and Status

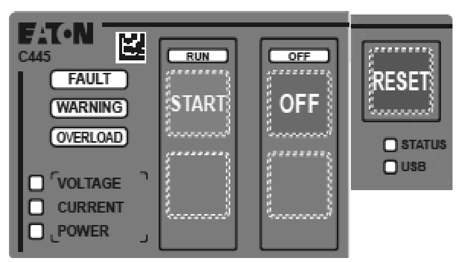


Figure 71. C445UC-N1: NEMA Status only

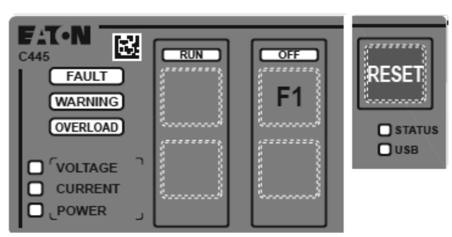
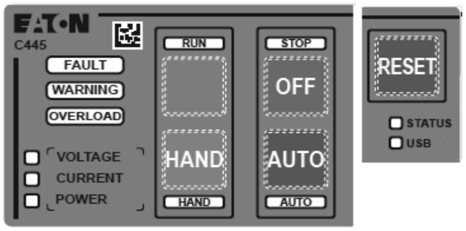


Figure 72. C445UC-N4: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in “ready” state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- RUN LED solid On – Active RUN1 command and motor is up to speed – complete start detected
- RUN LED blinking On – Active RUN1 command but motor is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in “Local” and will send a STOP command to the C445 overload to drop out the starter.
- RUN button – Button press will put the control in “Local” and will send a RUN1 command to the C445 overload to start the starter.
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared
- HAND button – Button press will put the control in “Local” and will send a RUN1 command to the C445 overload to start the starter.

Control Settings

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

Table 16. 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 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 anytime current readings exceed 5% the active overload FLA rating.

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 73. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

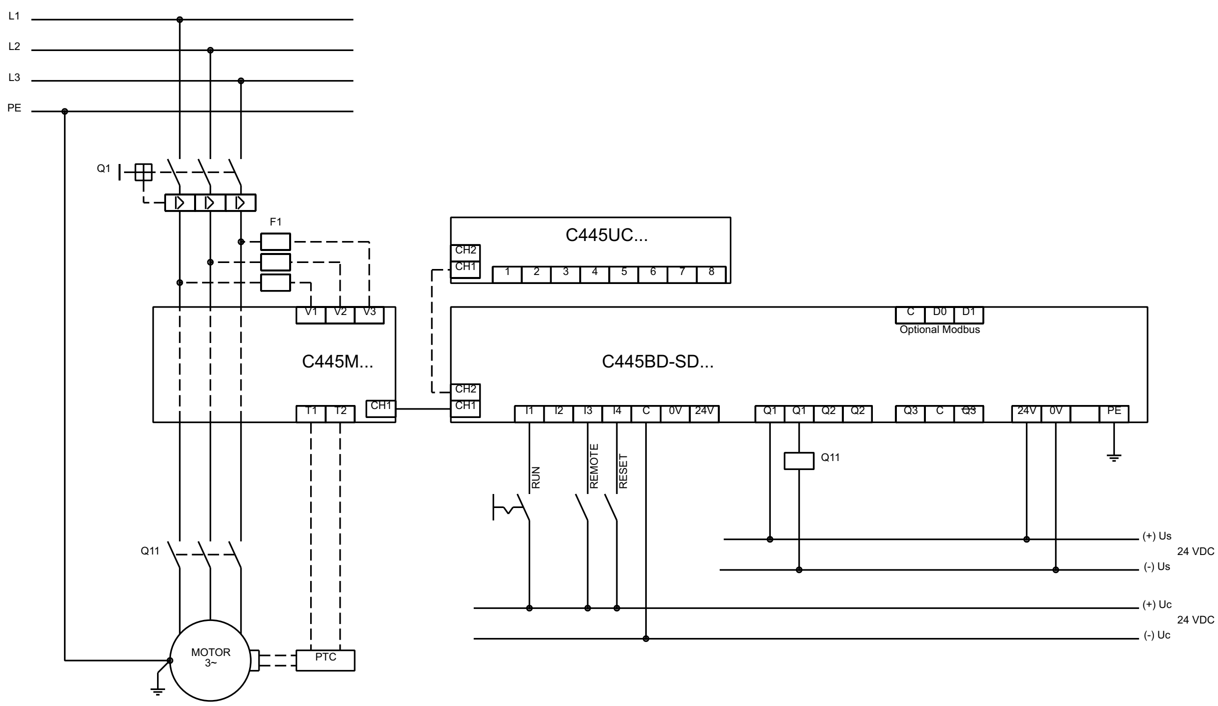


Figure 74. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

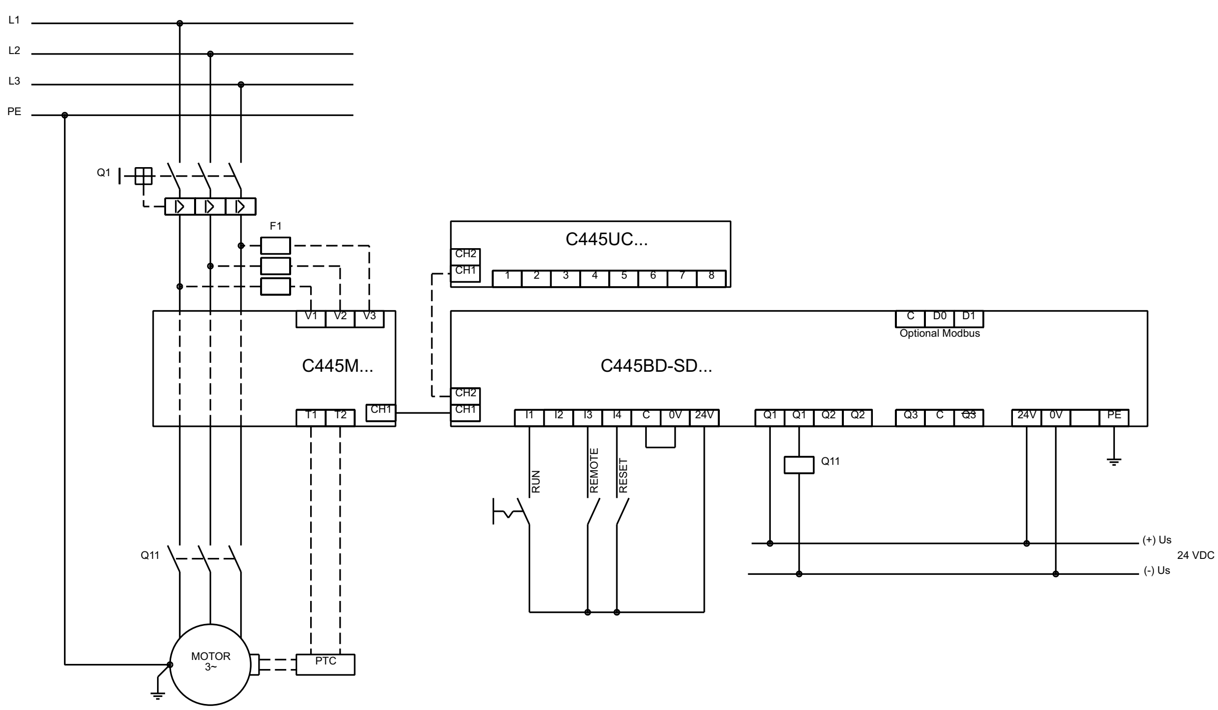
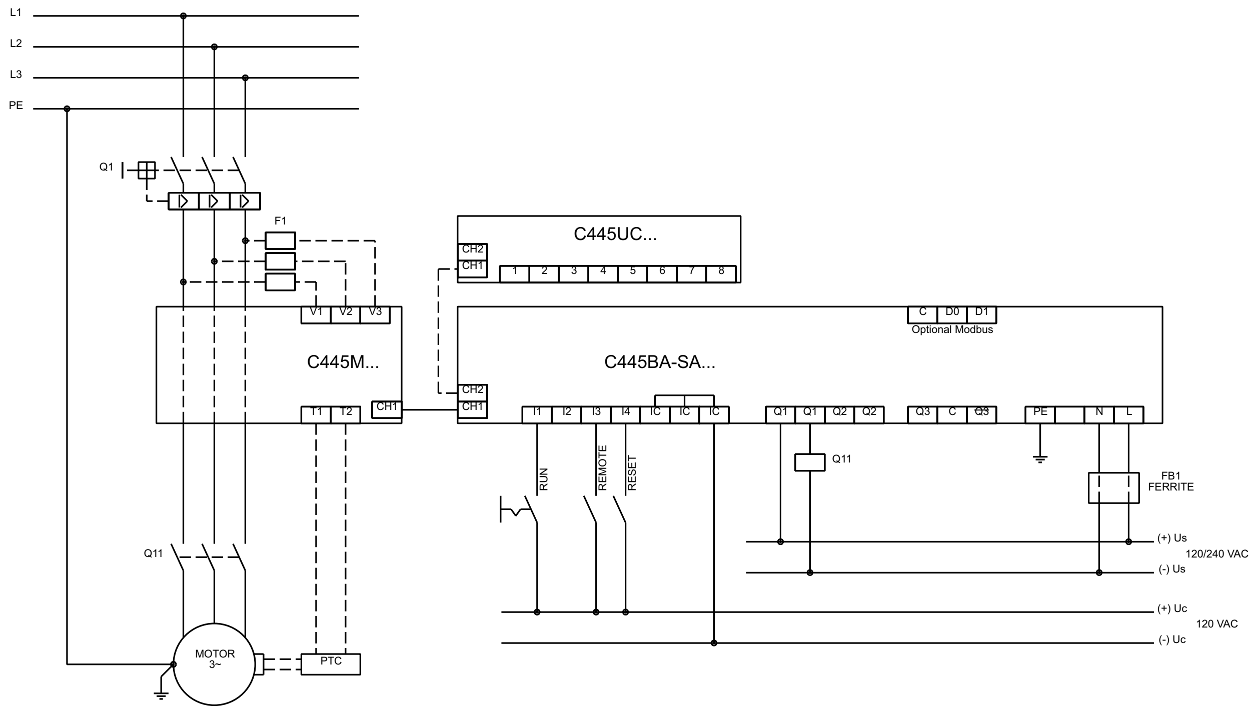


Figure 75. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.

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.

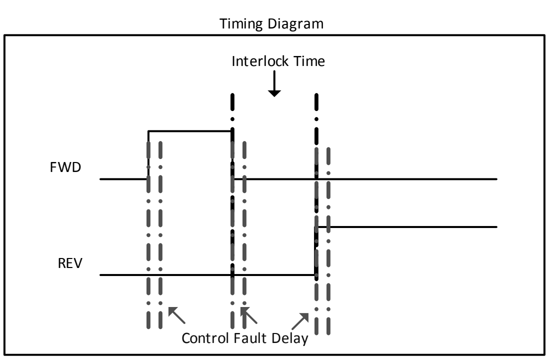
A transition from FWD to REV or REV to FWD must first go through STOP unless the Control Interlocking Time parameter is set to a value of 0. If the value of this parameter is greater than 0, the control will transition to Stop for that delay time before transitioning to the new direction. The Control 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 76. Timing Diagram for the Reverse Operation Mode



Recommended User Interface Overlays for the Reverser Operation Mode

Figure 77. C445UC-I3: IEC Control and Status

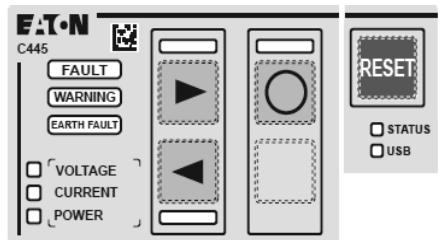


Figure 78. C445UC-I5: IEC Control and Status

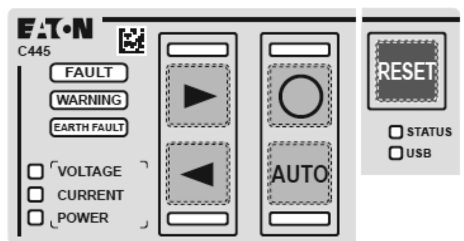


Figure 79. C445UC-N2: NEMA Status Only

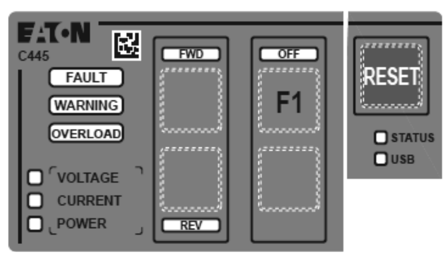
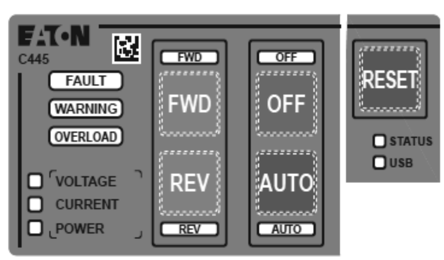


Figure 80. C445UC-N5: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in "ready" state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- FWD/REV LED solid On – Active RUN command and motor is up to speed – complete start detected
- FWD/REV blinking On – Active RUN command but motor is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in "Local" and will send a STOP command to the C445 overload which will drop out all control outputs and stop the motor.
- FWD button – Button press will put the control in "Local" and will send a FWD RUN command to the C445 overload to enable the forward output relay (Q1).
- REV button – Button press will put the control in "Local" and will send a REV RUN command to the C445 overload to enable the reverse output relay (Q2).
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared

Control Settings

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

Table 17. 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 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 81. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

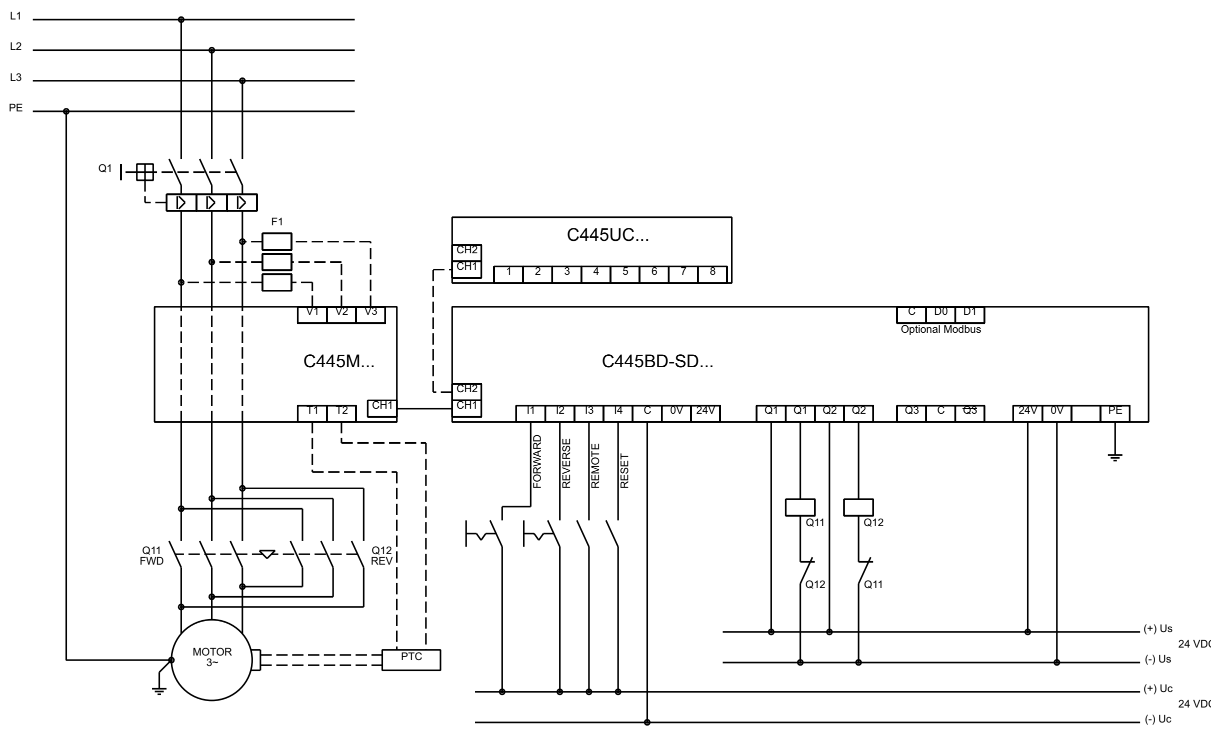


Figure 82. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

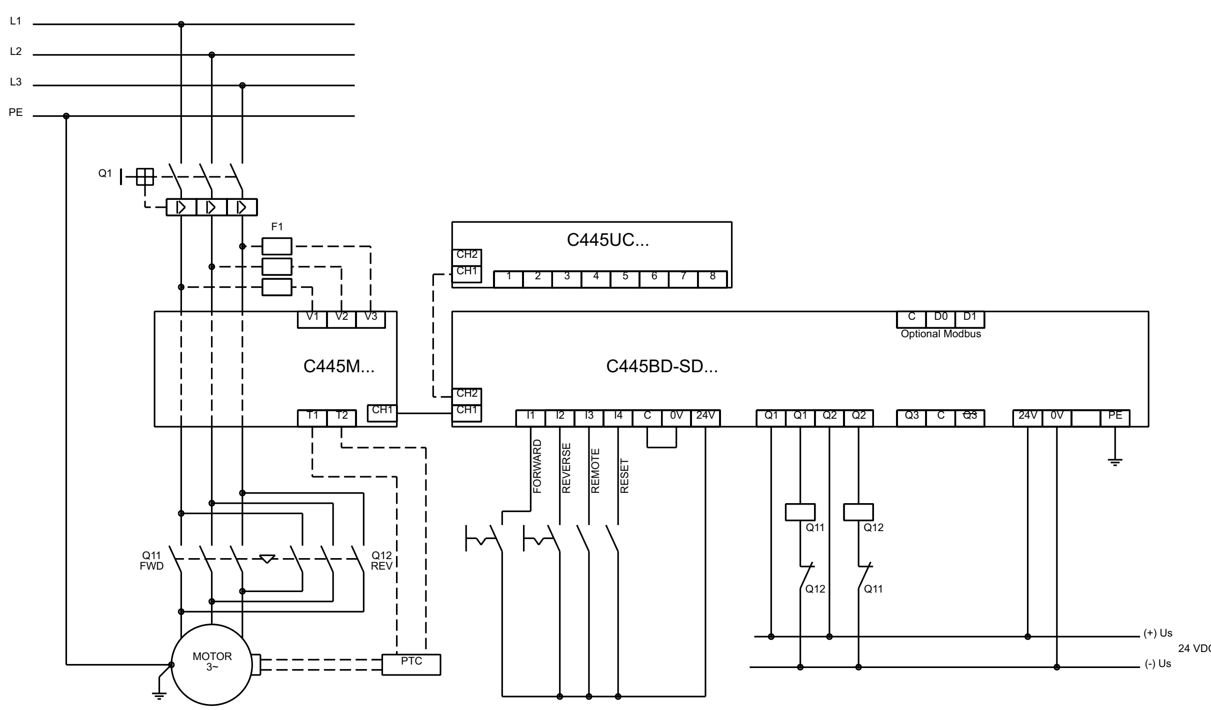
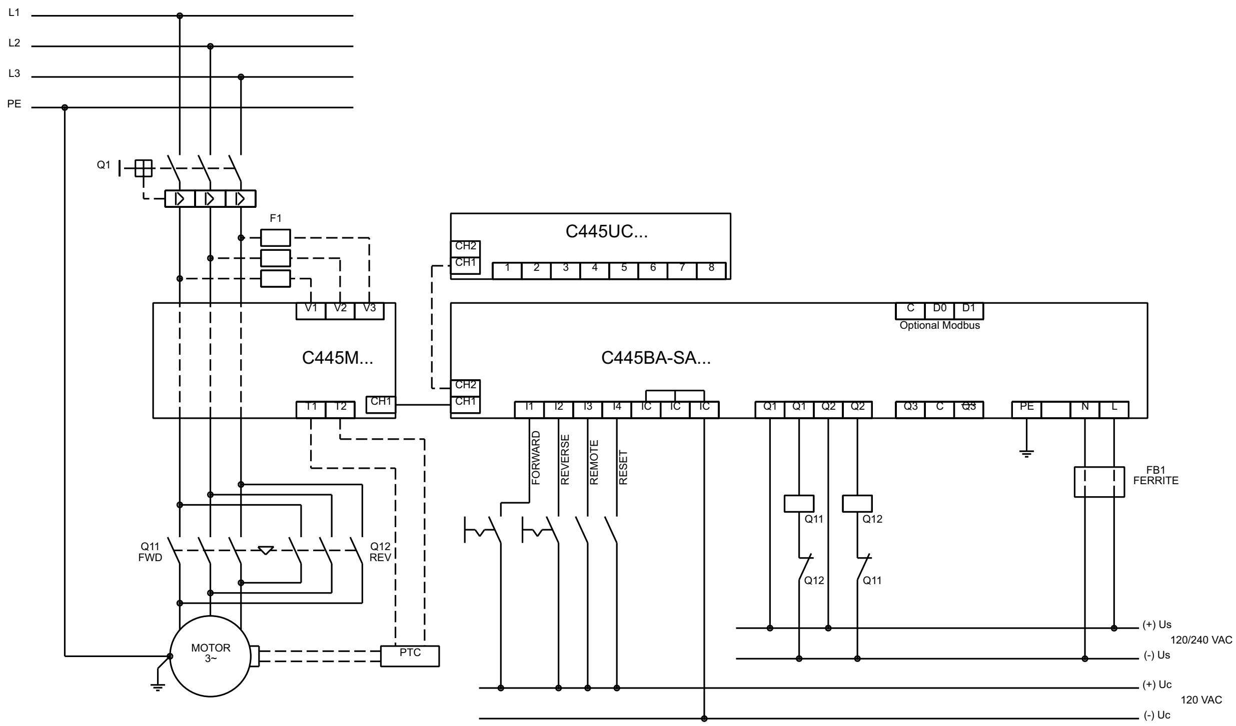


Figure 83. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, then input 3 is not used for 2-wire control, but is Permissive for 3-wire control.

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.

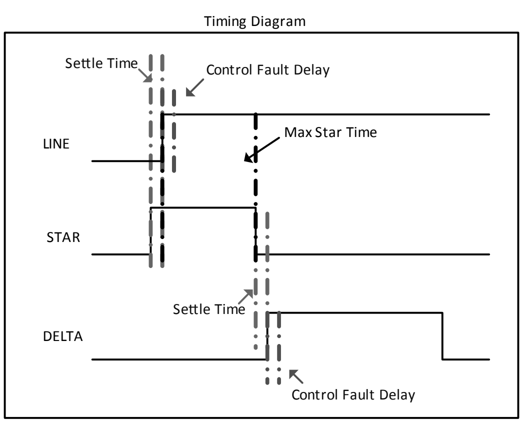
The control will set MOTOR1 as the active motor parameters when starting in the star configuration and will set MOTOR2 as the active motor parameters when running in the delta configuration.

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 84. Timing Diagram for the Star/Delta Operation Mode



Recommended User Interface Overlays for the Star/Delta Operation Mode

Figure 85. C445UC-I0: IEC Control and Status

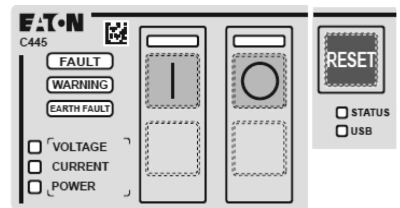


Figure 86. C445UC-I1: IEC Status Only

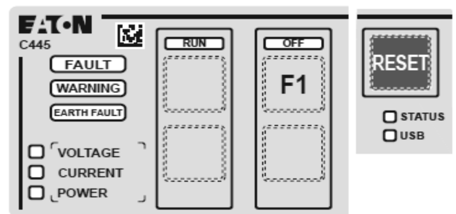


Figure 87. C445UC-I4: IEC Control and Status

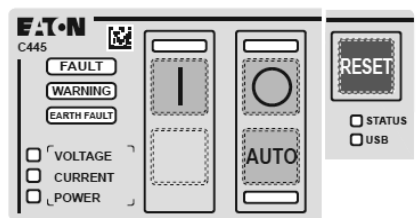


Figure 88. C445UC-N0: NEMA Control and Status

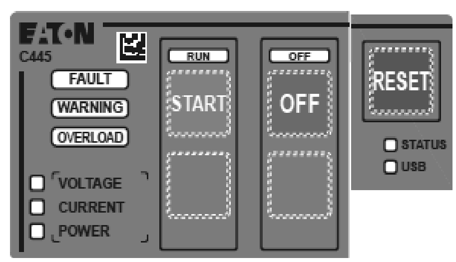


Figure 89. C445UC-N1: NEMA Status Only

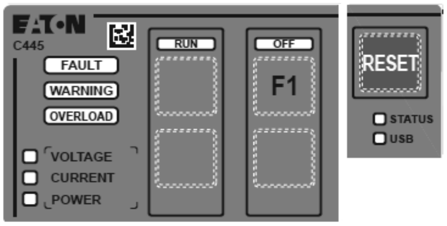
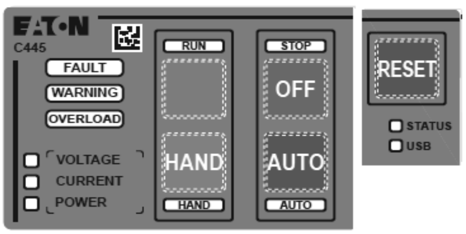


Figure 90. C445UC-N4: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in "ready" state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- RUN LED solid On – Active RUN1 command and motor is up to speed – complete start detected
- RUN LED blinking On – Active RUN1 command but motor is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in "Local" and will send a STOP command to the C445 overload to drop out the starter.
- RUN button – Button press will put the control in "Local" and will send a RUN1 command to the C445 overload to start the starter.
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared
- HAND button – Button press will put the control in "Local" and will send a RUN1 command to the C445 overload to start the starter.

Control Settings

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

Table 18. 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 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 91. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

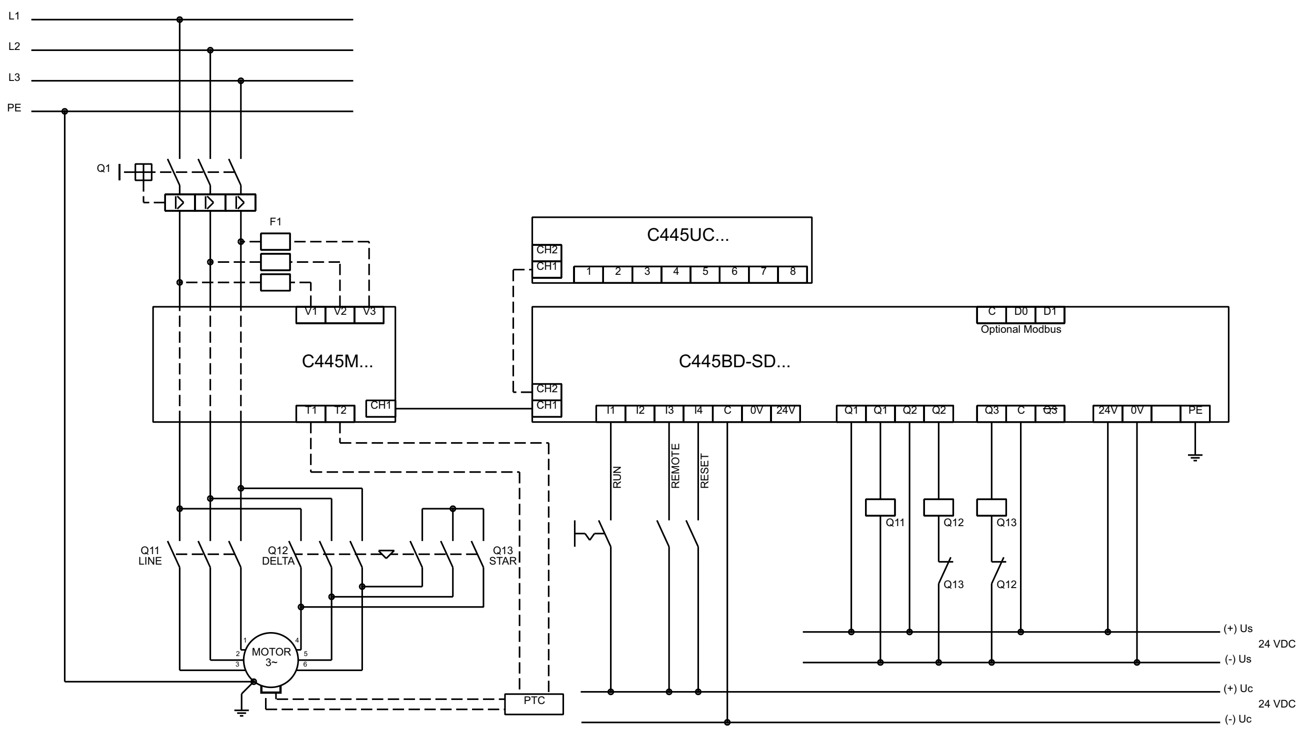


Figure 92. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

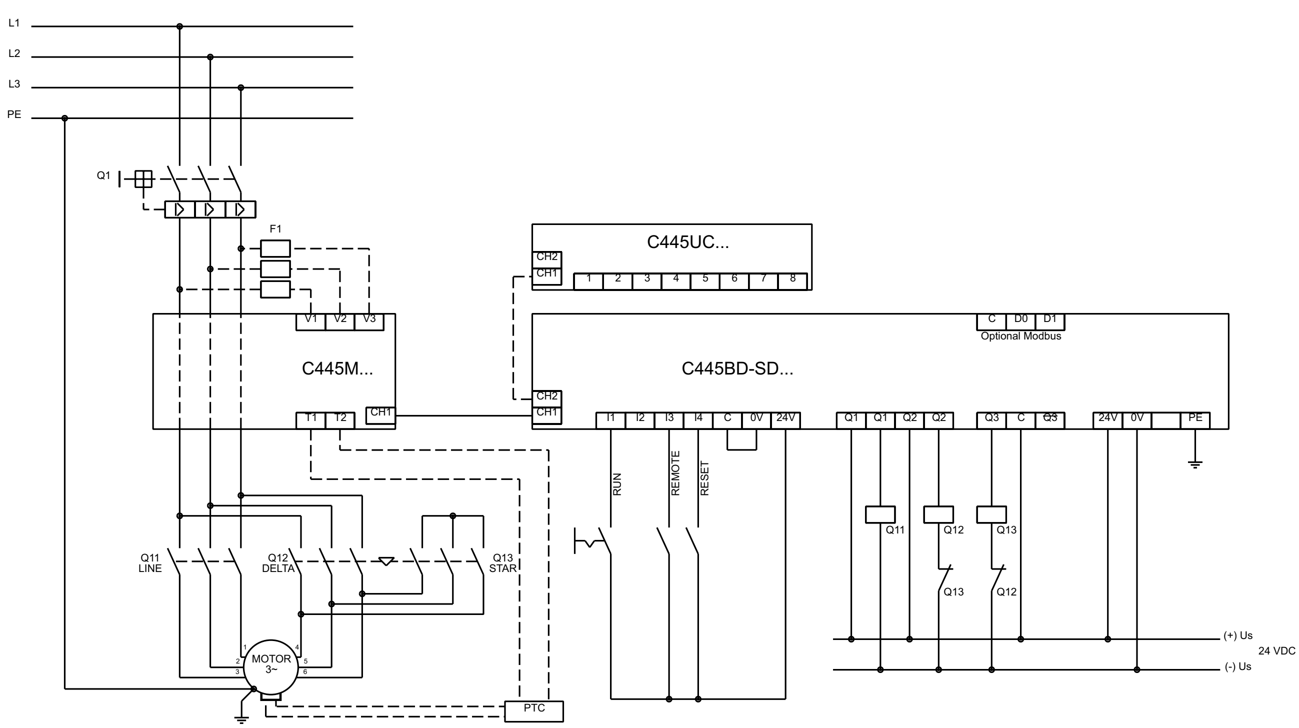
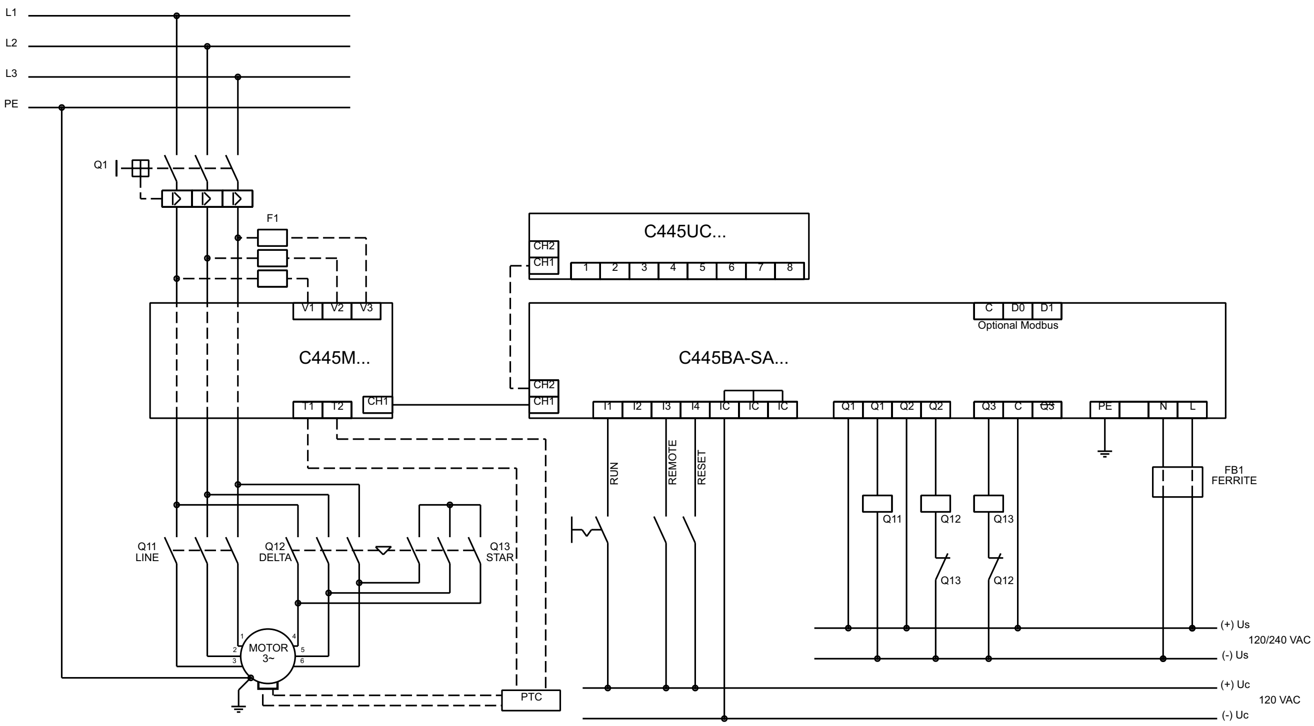


Figure 93. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.

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.

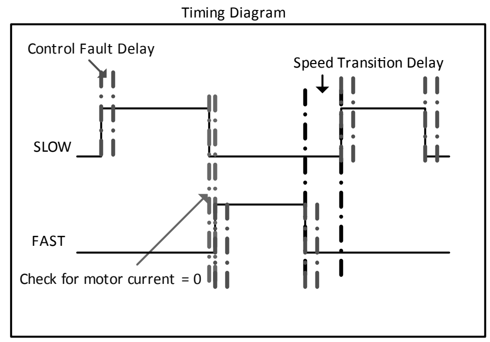
Note: Even with the control fault disabled, after de-activating the present speed, the C445 will NOT transition to the new speed until current readings decrease to zero.

- 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 94. Timing Diagram for the Two Speed Operation Mode



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

Figure 95. C445UC-I2: IEC Control and Status

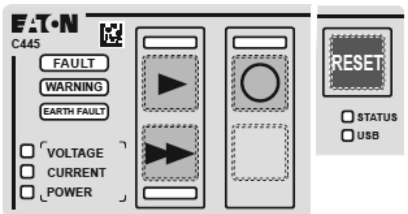


Figure 96. C445UC-I6: IEC Control and Status

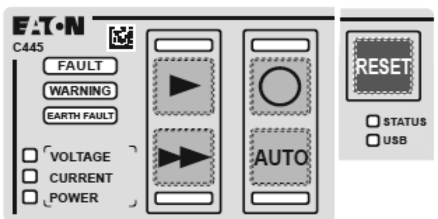


Figure 97. C445UC-N3: NEMA Status Only

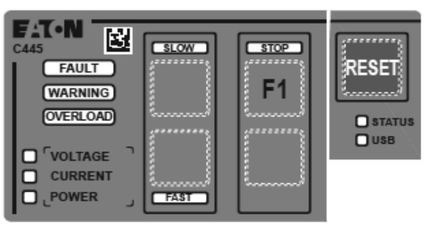
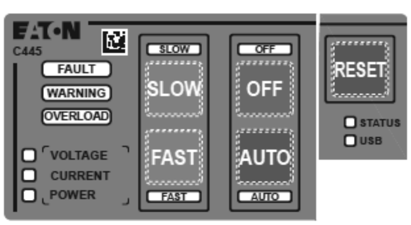


Figure 98. C445UC-N6: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in "ready" state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- SLOW/FAST LED solid On – Active RUN command and motor is up to speed – complete start detected
- SLOW/FAST blinking On – Active RUN command but motor is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in "Local" and will send a STOP command to the C445 which will drop out all control outputs and stop the motor.
- SLOW button – Button press will put the control in "Local" and will send a RUN SLOW command to the C445 to start the motor in slow mode.
- FAST button – Button press will put the control in "Local" and will send a RUN FAST command to the C445 to start the motor in fast mode.
- AUTO button – Selects the remote source as the active C445 control.

Control Settings

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

Table 19. 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 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 99. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

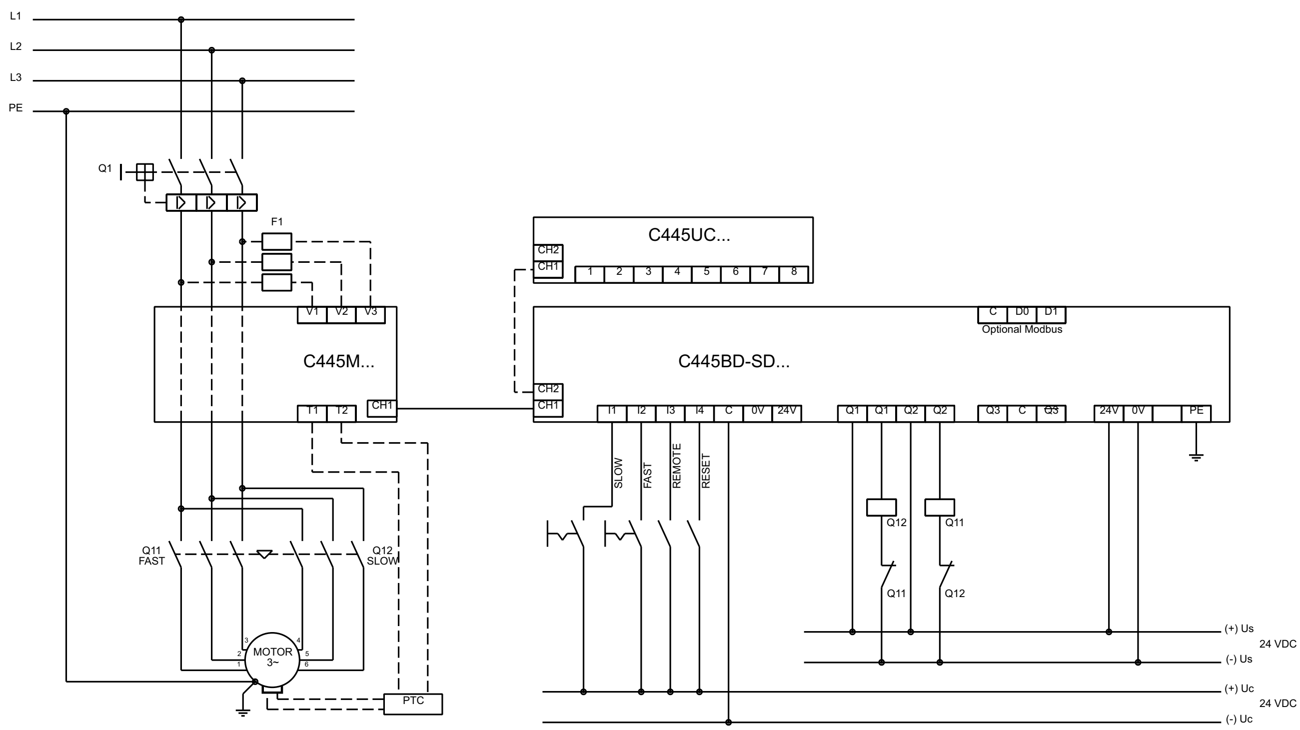


Figure 100. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

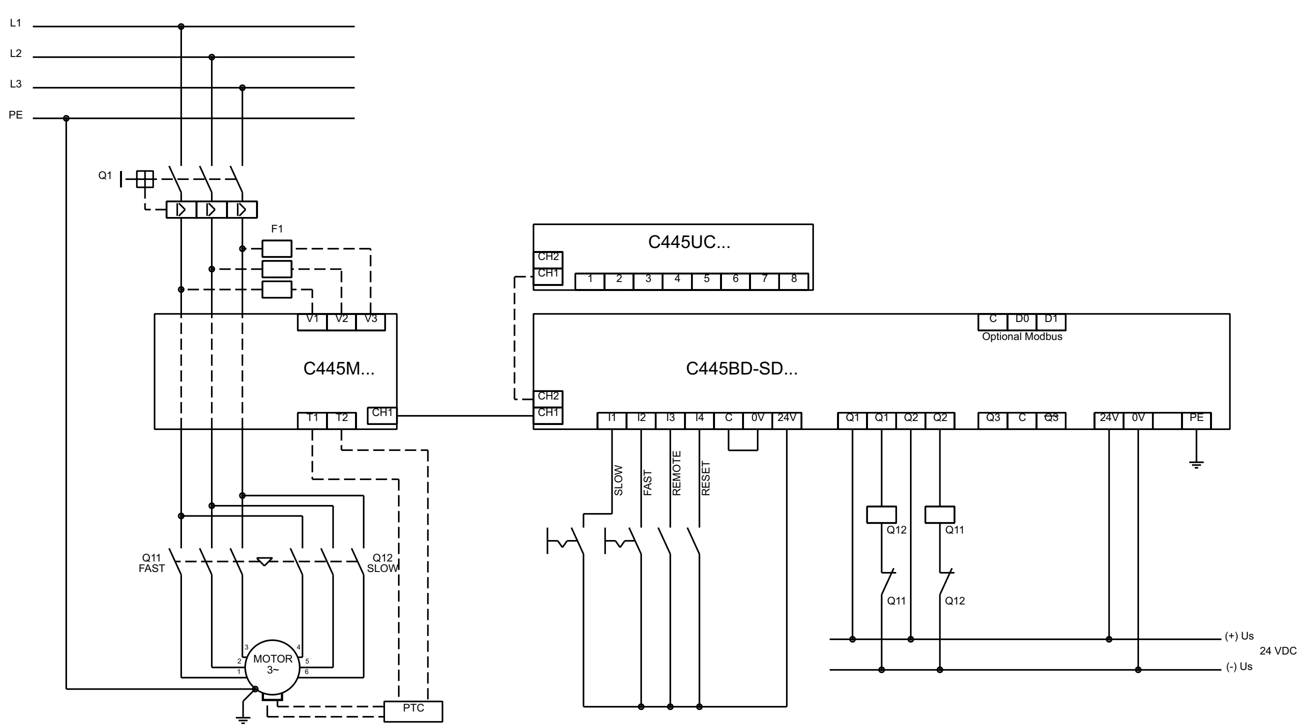
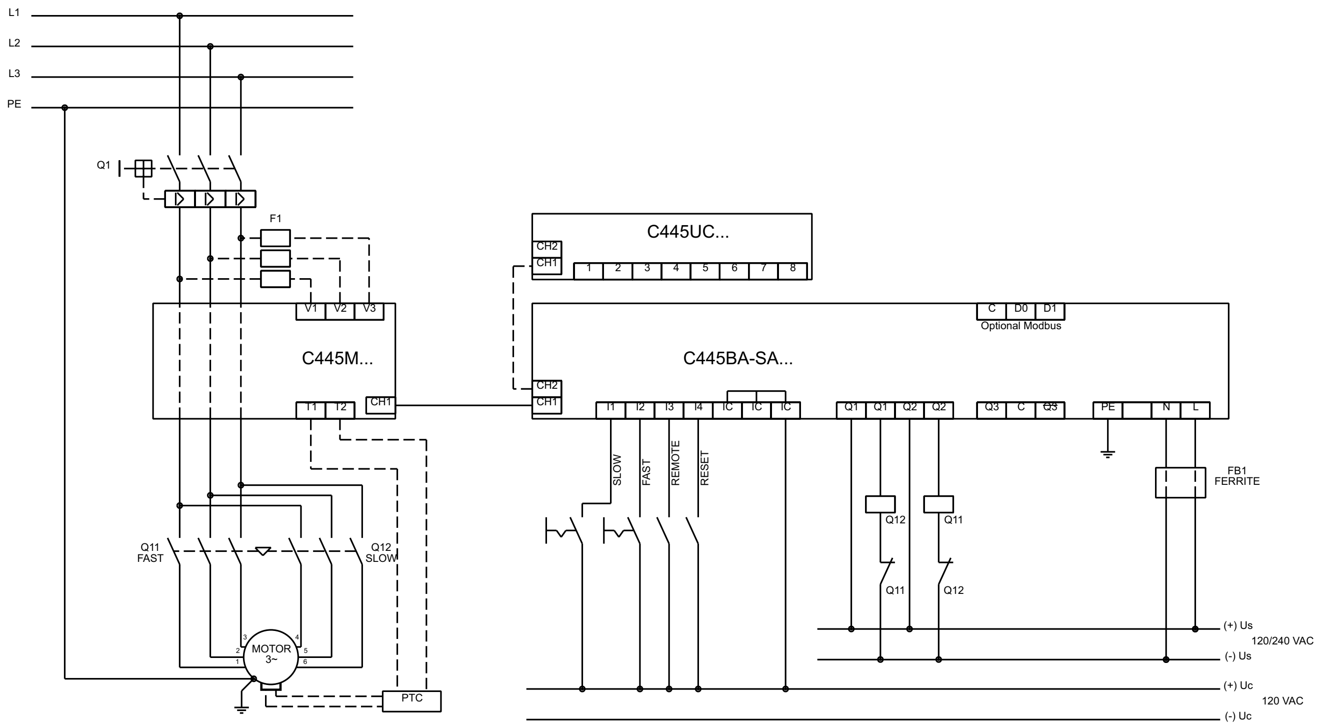


Figure 101. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, then input 3 is not used for 2-wire control, but is Permissive for 3-wire control.

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.

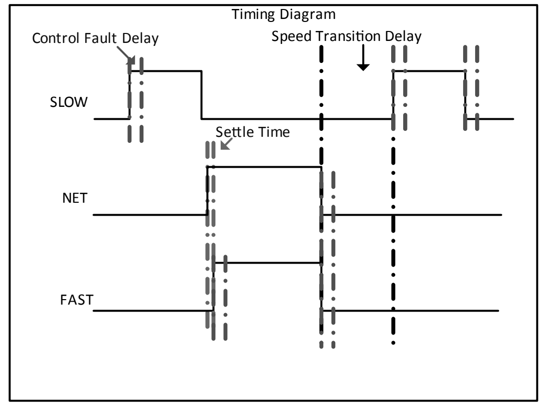
Note: Even with the control fault disabled, after de-activating the present speed, the C445 will NOT transition to the new speed until current readings decrease to zero.

- 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 102. Timing Diagram for the Two Speed Dahlander Operation Mode



Recommended Use Interface Overlays for the Two Speed Dahlander Operation Mode

Figure 103. C445UC-I2: IEC Control and Status

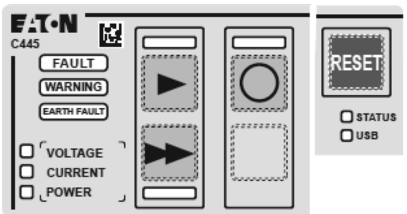


Figure 104. C445UC-I6: IEC Control and Status

Figure 105. C445UC-N3: NEMA Status Only

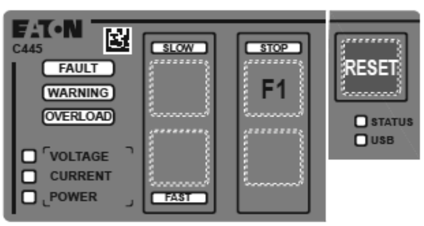
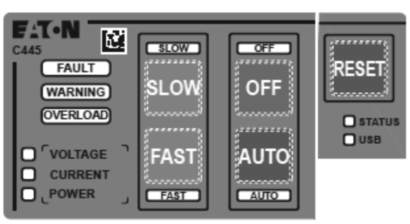


Figure 106. C445UC-N6: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in "ready" state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- SLOW/FAST LED solid On – Active RUN command and motor is up to speed – complete start detected
- SLOW/FAST blinking On – Active RUN command but motor is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in "Local" and will send a STOP command to the C445 which will drop out all control outputs and stop the motor.
- SLOW button – Button press will put the control in "Local" and will send a RUN SLOW command to the C445 to start the motor in slow mode.
- FAST button – Button press will put the control in "Local" and will send a RUN FAST command to the C445 to start the motor in fast mode.
- AUTO button – Selects the remote source as the active C445 control

Control Settings

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

Table 20. 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 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 107. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

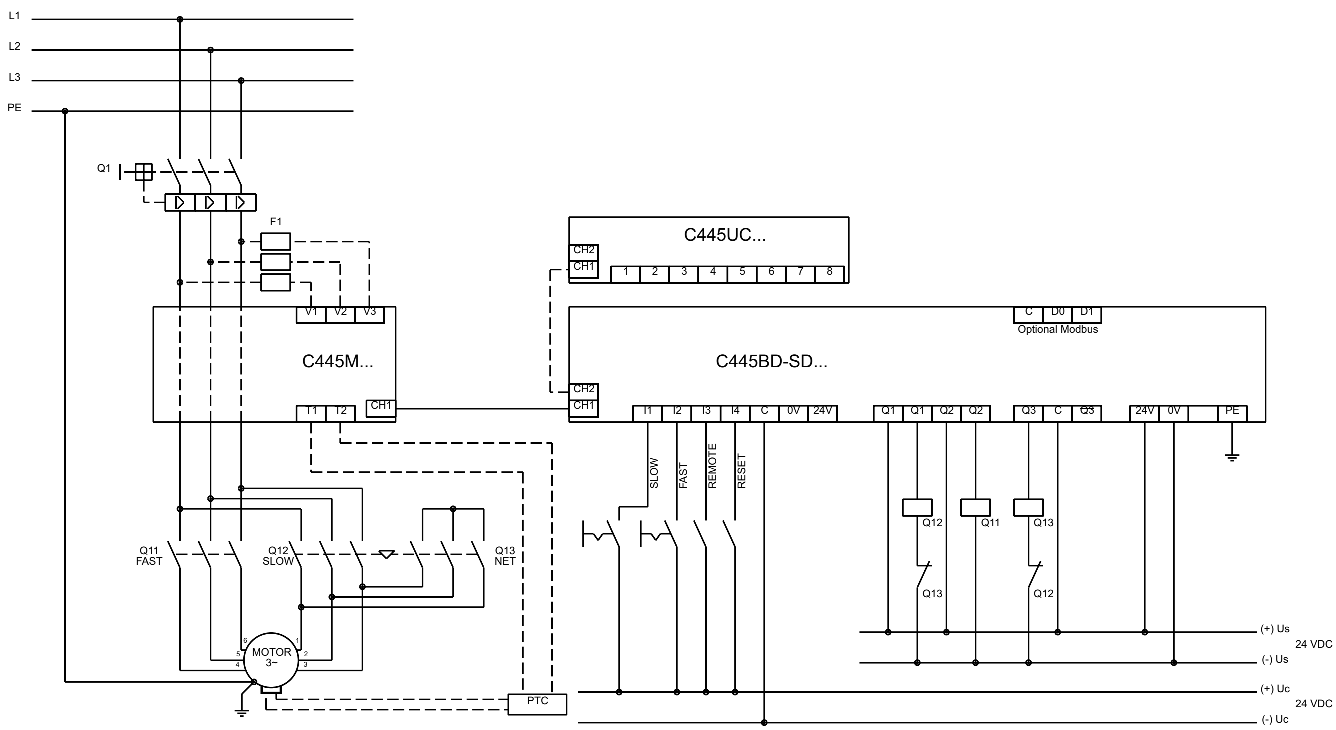


Figure 108. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

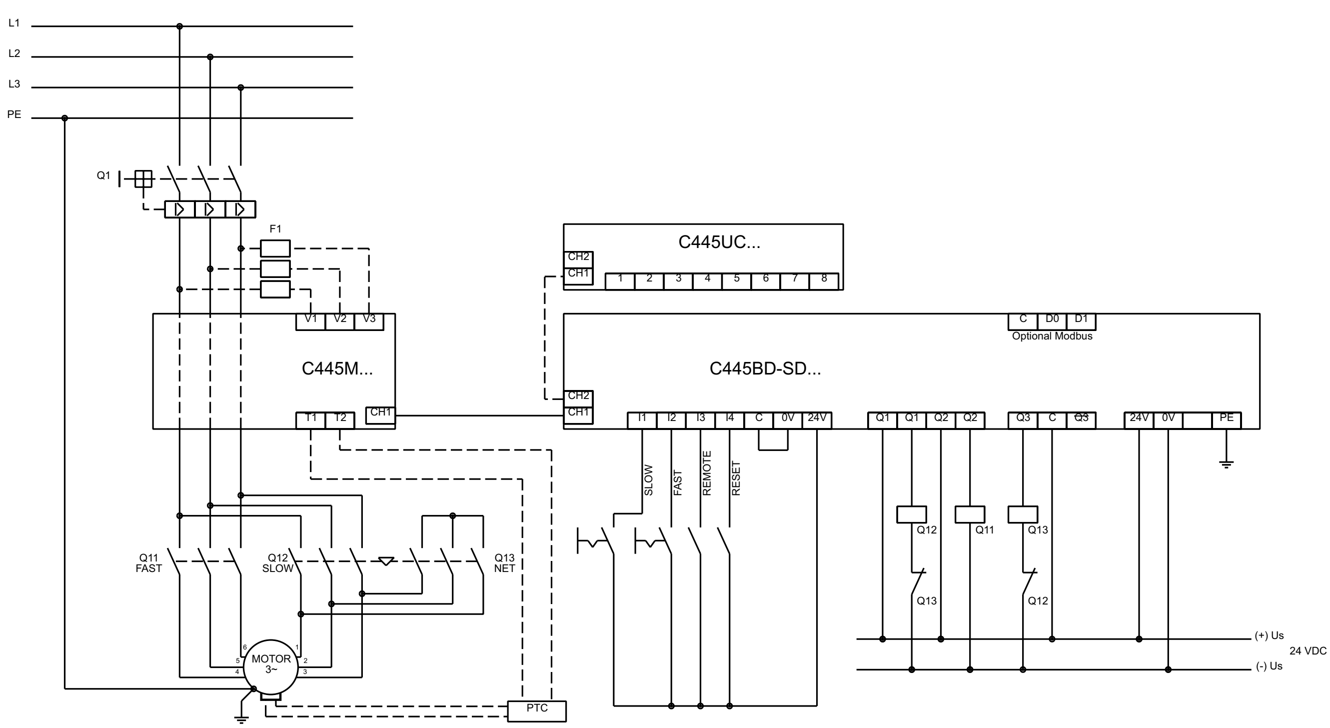
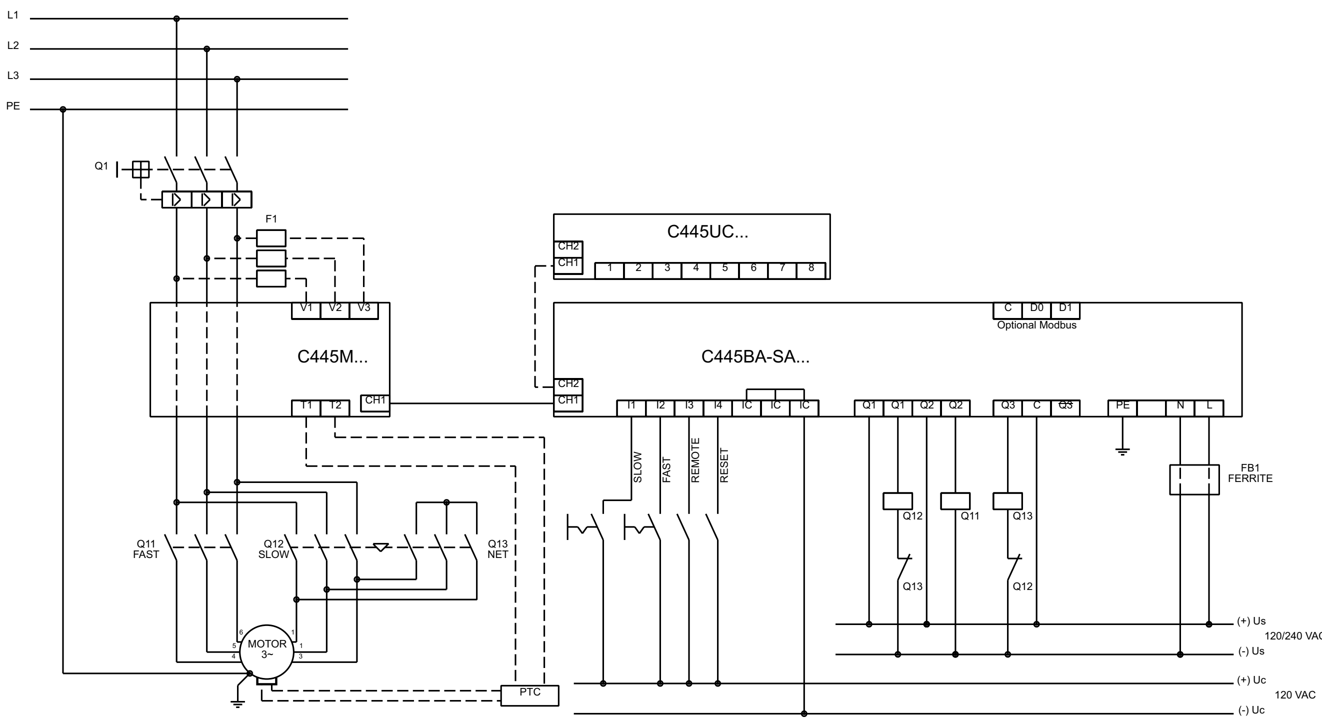


Figure 109. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, then input 3 is not used for 2-wire control, but is Permissive for 3-wire control.

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.

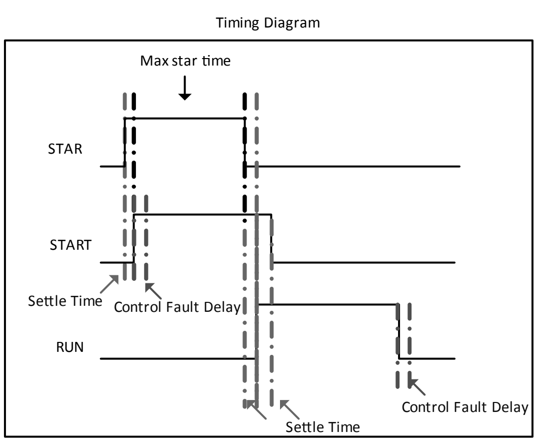
The C445 will issue a control fault when:

- 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 110. Timing Diagram for the Auto Transformer Operation Mode



Recommended User Interface Overlays for the Auto Transformer Operation Mode

Figure 111. C445UC-I0: IEC Control and Status

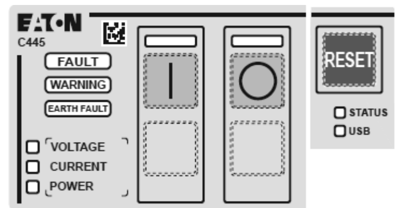


Figure 112. C445UC-I1: IEC Status Only

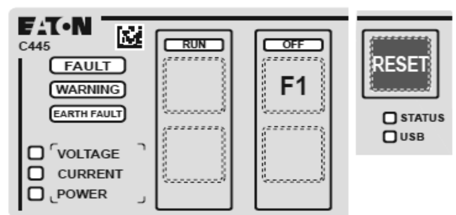


Figure 113. C445UC-I4: IEC Control and Status

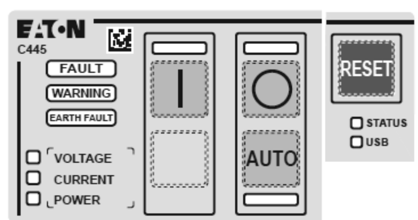


Figure 114. C445UC-N0: NEMA Control and Status

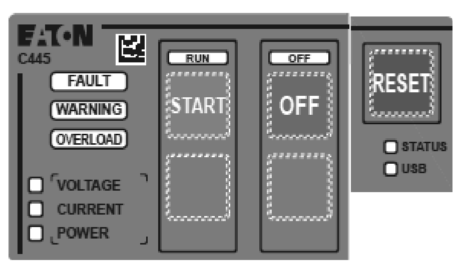


Figure 115. C445UC-N1: NEMA Status Only

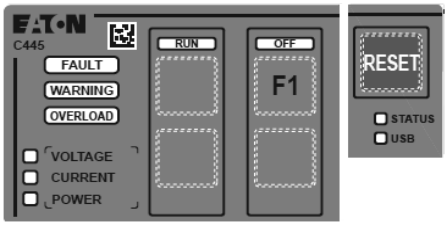
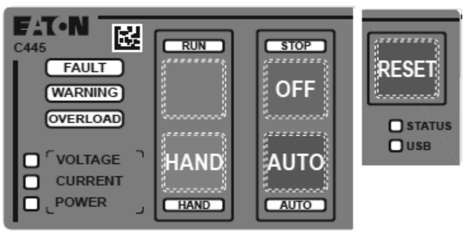


Figure 116. C445UC-N4: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Motor is off in "ready" state – no current detected, no faults present
- OFF LED blinking On – Motor is off, C445 control is faulted and/or a control inhibit is present
- RUN LED solid On – Active RUN1 command and motor is up to speed – complete start detected
- RUN LED blinking On – Active RUN1 command but motor is NOT up to speed
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in "Local" and will send a STOP command to the C445 overload to drop out the starter.
- RUN button – Button press will put the control in "Local" and will send a RUN1 command to the C445 overload to start the starter.
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared
- HAND button – Button press will put the control in "Local" and will send a RUN1 command to the C445 overload to start the starter.

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 21. 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 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 117. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

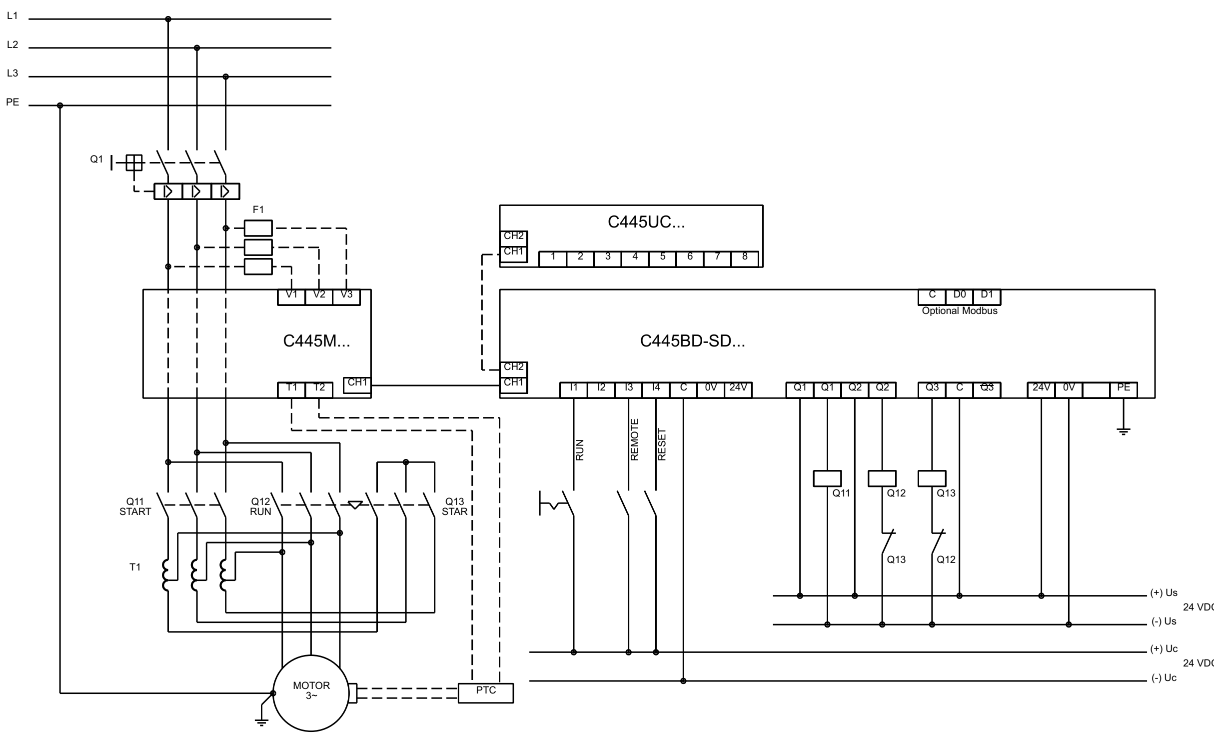


Figure 118. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

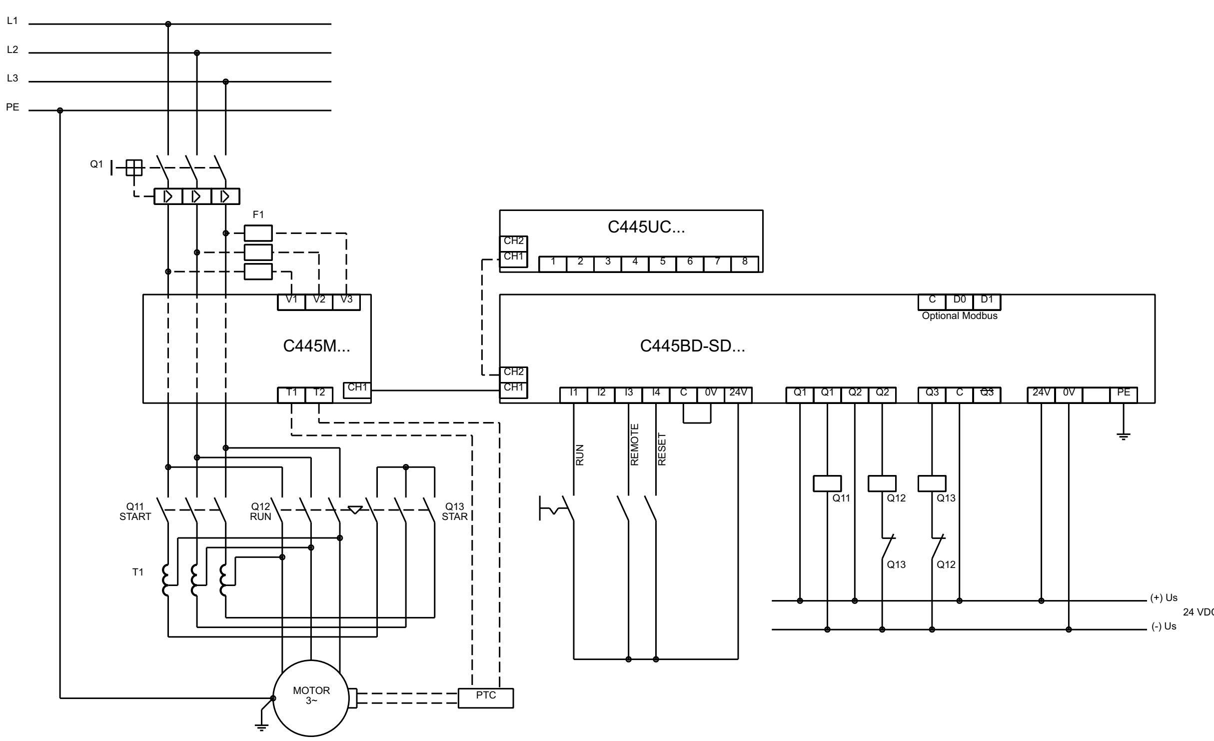
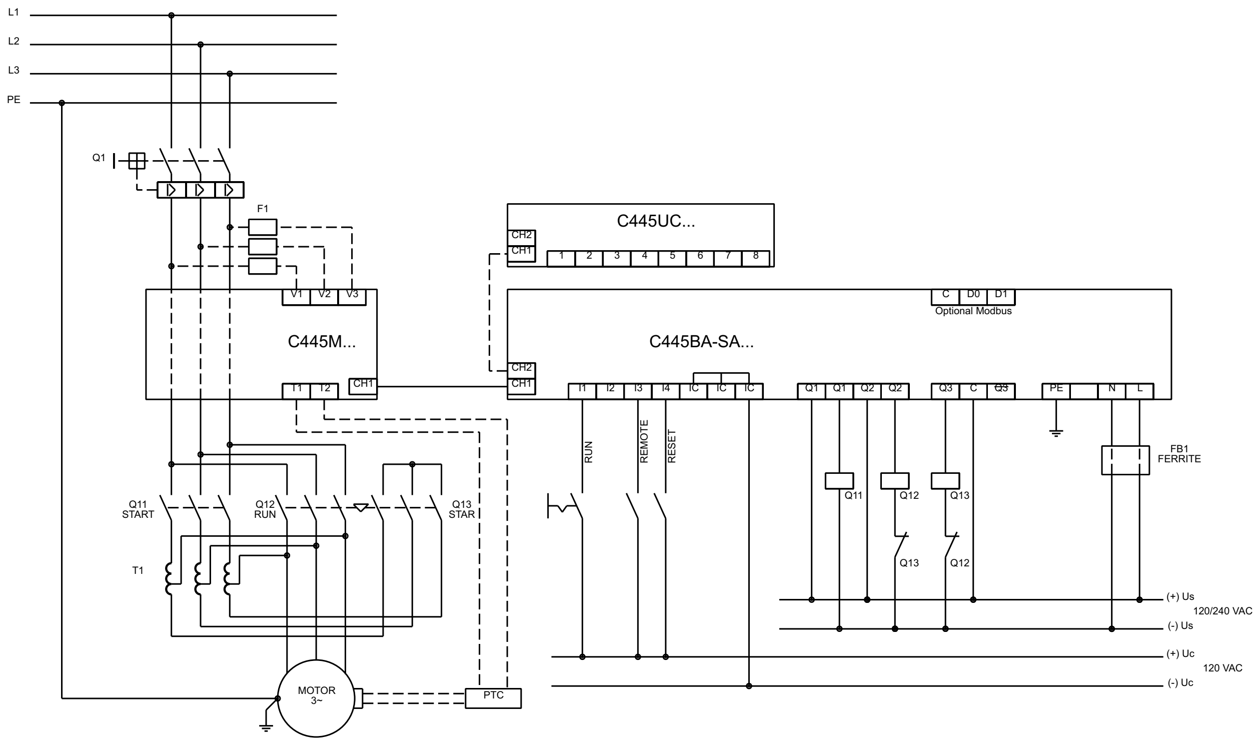


Figure 119. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.

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

C445 Feedback Signal Source Selector parameter.

Input source of the feedback signals:

- 0 – No feedback source
- 1 – User interface inputs (In#2 – open_fb, In#3 – close_fb)
- 2 – Base control inputs (In#2 – open_fb, In#3 – close_fb)
- 3 – Fieldbus parameter (2nd bit – open_fb, 3rd bit – close_fb)

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

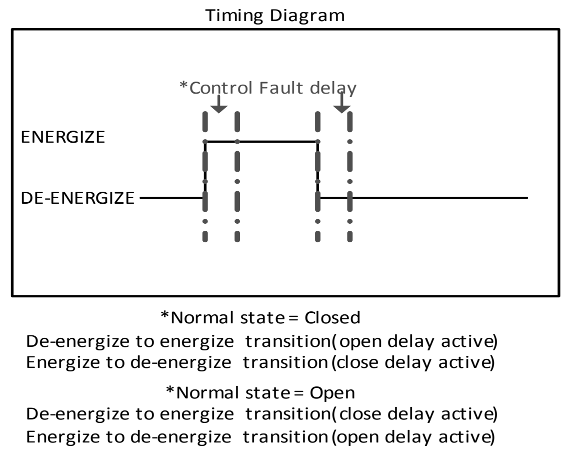
Output 1 will be de-activated when the C445 experiences a fault/inhibit condition.

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 120. Timing Diagram for the Solenoid Valve Operation Mode



Recommended User Interface Overlays for the Solenoid Valve Operation Mode

Figure 121. C445UC-I0: IEC Control and Status

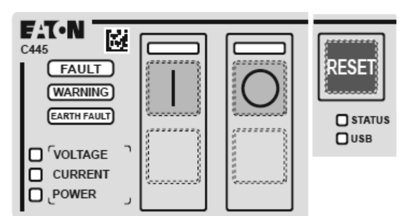


Figure 122. C445UC-I4: IEC Control and Status

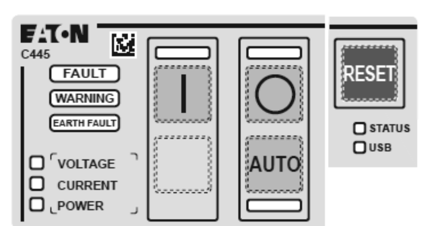


Figure 123. C445UC-N0: NEMA Control and Status

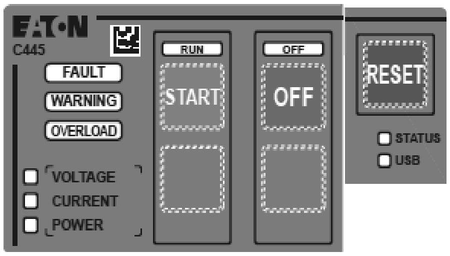
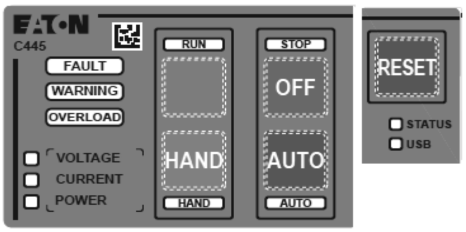


Figure 124. C445UC-N4: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Solenoid in non-energized state; no faults/inhibits present, "Ready"
- OFF LED blinking On – Solenoid in non-energized state; faults/inhibits is present, "Not Ready"
- RUN LED solid On – Energize command is active - Not in position (feedback open)
- RUN LED blinking On – Energize command is active - In position (feedback closed)
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source

Overlay Buttons:

- OFF button – Button press will put the control in "Local" and will send a STOP command to the C445 overload to de-energize the solenoid
- RUN button – Button press will put the control in "Local" and will send a RUN1 command to the C445 overload to energize the solenoid
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared
- HAND button – Button press will put the control in "Local" and will send a RUN1 command to the C445 overload to energize the solenoid

Control Settings

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

Table 22. 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 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 125. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

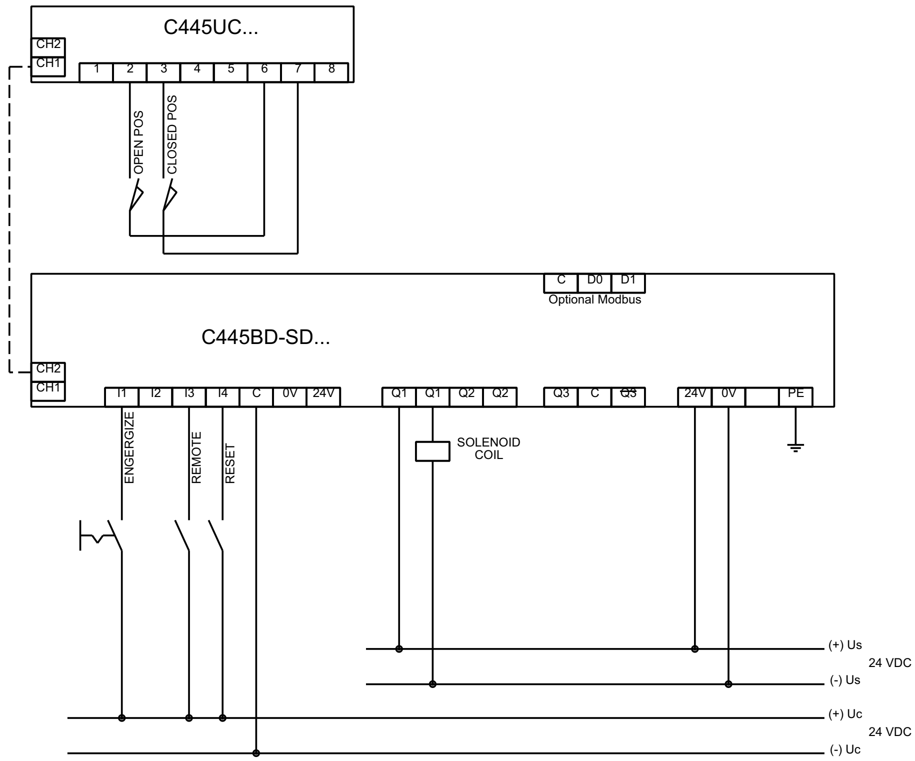


Figure 126. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

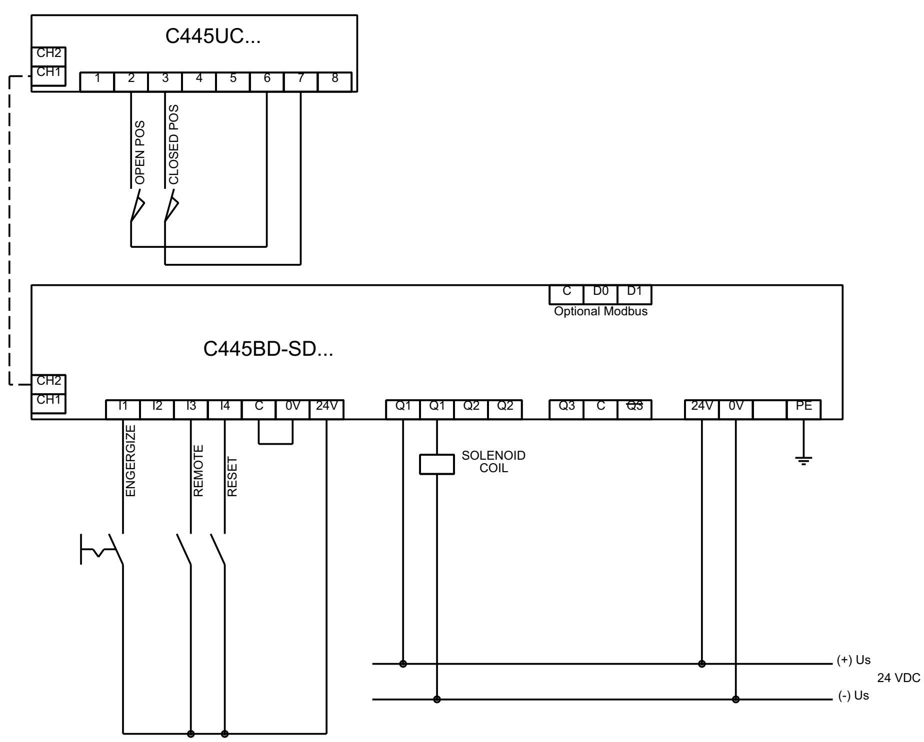
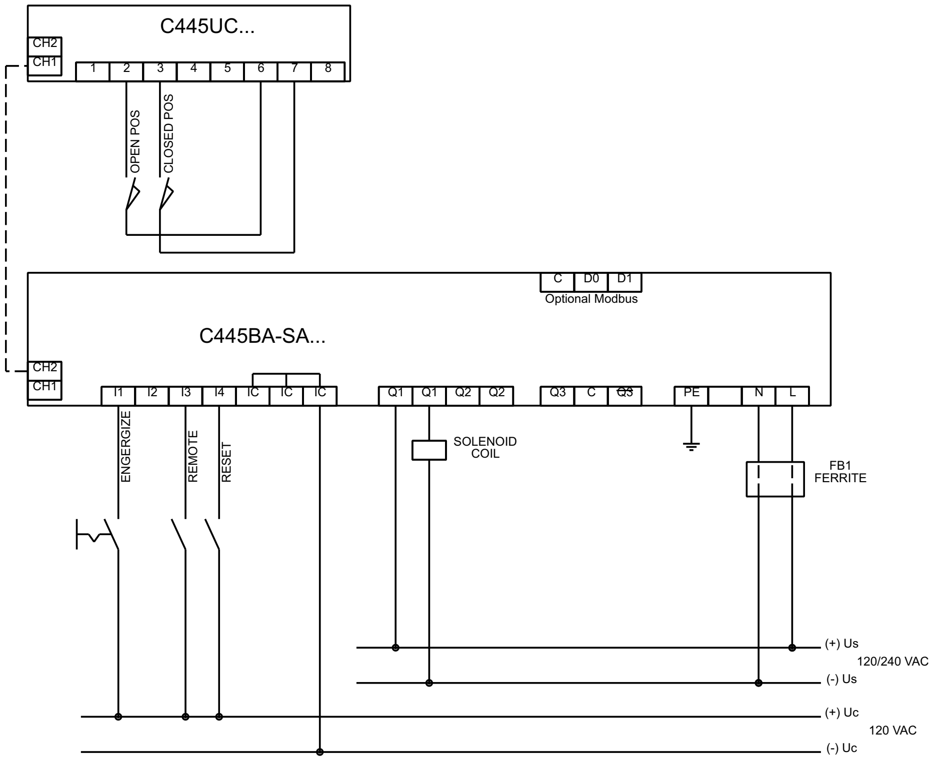


Figure 127. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.
5. If 3-wire control is selected along with Fieldwire for either control source, Input 2 is Permissive.

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.

C445 Feedback Signal Source Selector parameter.

Input source of the feedback signals:

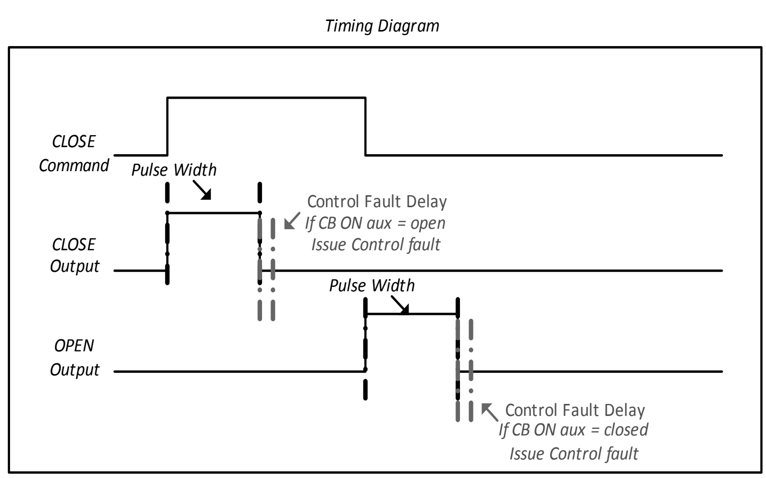
0 – No feedback source

1 – User interface inputs (In#2 – cb_on, In#3 – cb_alarm)

2 – Base control inputs (In#2 – cb_on, In#3 – cb_alarm)

3 – Fieldbus parameter (2nd bit – cb_on, 3rd bit – cb_alarm)

Figure 128. 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 Overlays for the MCCB Feeder Operation Mode

Figure 129. C445UC-I7: IEC Control and Status

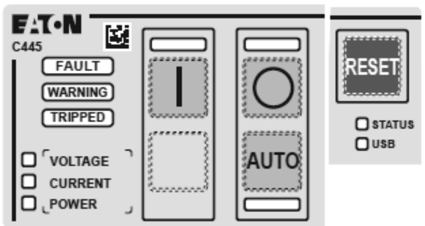


Figure 130. C445UC-I8: IEC Control and Status

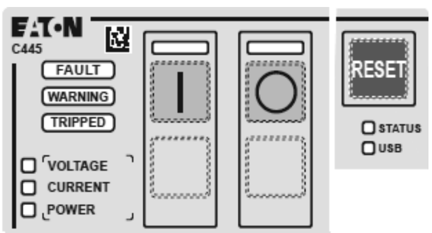


Figure 131. C445UC-N7: NEMA Control and Status

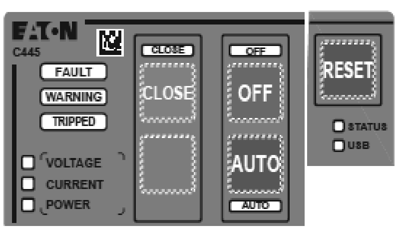
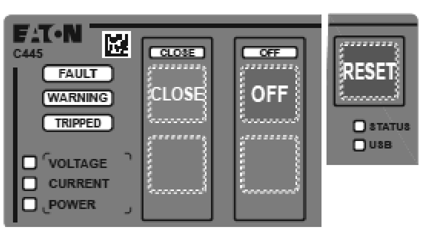


Figure 132. C445UC-N8: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Feeder is in “Off” or “Tripped” position; CB ON aux input is low.
- RUN LED blinking On – Feeder has an active “Close” command but is in open position; CB ON aux input is low.
- RUN LED solid On – Feeder is in “On” position; CB ON aux input is high.
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source
- FAULT LED solid On – C445 controller is faulted.
- WARNING LED solid On – C445 controller has an active warning present.
- TRIPPED LED solid On – Feeder is in the “Tripped” state CB ALARM aux input is high

Overlay Buttons:

- OFF button – Button press will put the control in “Local” and will send an OPEN command to the C445 to open the feeder.
- CLOSE button – Button press will put the control in “Local” and will send an CLOSE command to the C445 to close the feeder.
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared

Control Settings

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

Table 23. 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 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 133. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

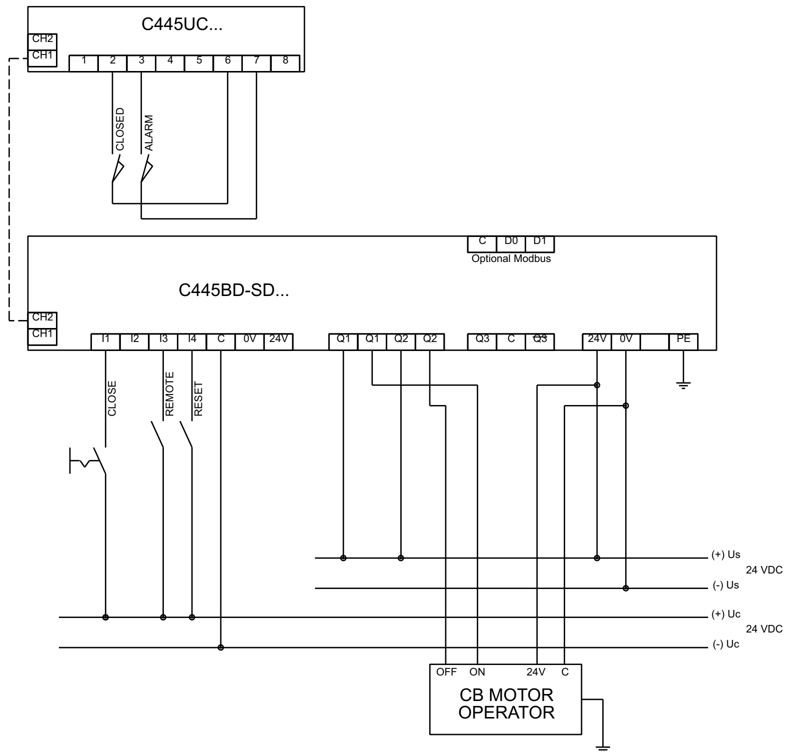


Figure 134. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

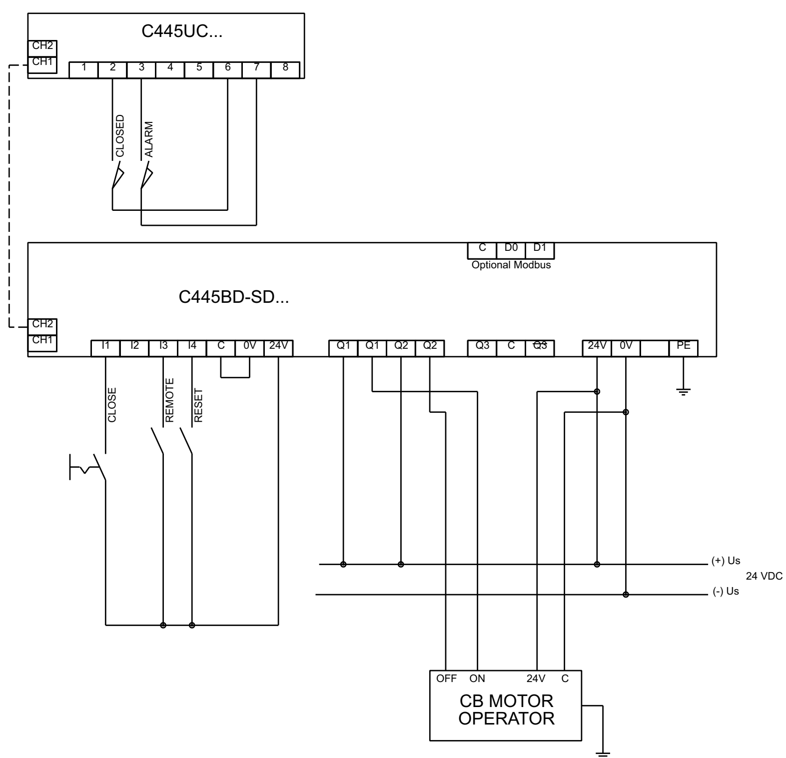
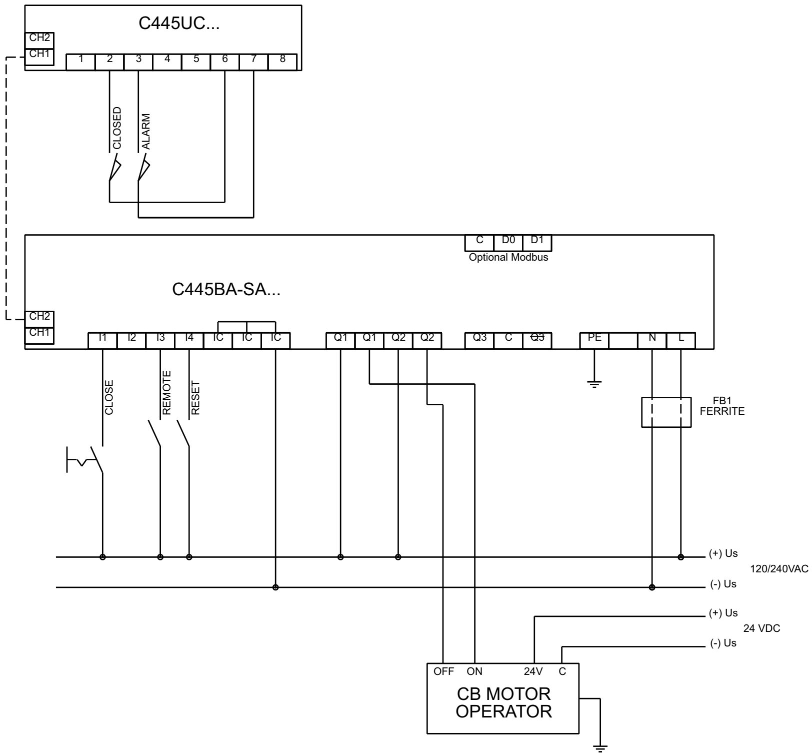


Figure 135. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.

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.

C445 Feedback Signal Source Selector parameter.

Input source of the feedback signals:

- 0 – No feedback source
- 1 – User interface inputs (In#2 – aux on)
- 2 – Base control inputs (In#2 – aux on)
- 3 – Fieldbus parameter (2nd bit – aux on)

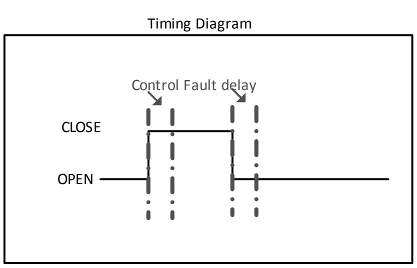
The C445 will issue a control fault when:

- 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 136. Timing Diagram for the Contactor Feeder Operating Mode



Recommended User Interface Overlays for the Contactor Feeder Operating Mode

Figure 137. C445UC-I7: IEC Control and Status

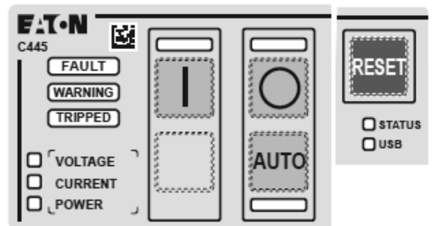


Figure 138. C445UC-I8: IEC Control and Status

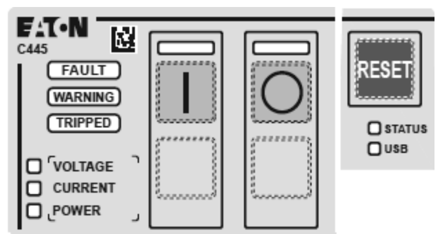


Figure 139. C445UC-N7: NEMA Control and Status

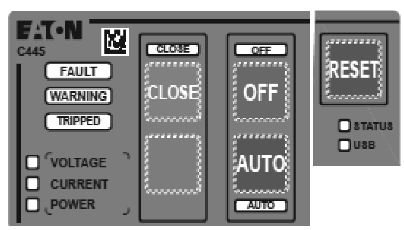
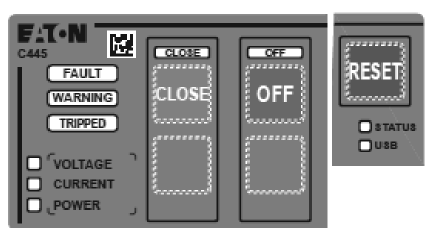


Figure 140. C445UC-N8: NEMA Control and Status



Overlay Display:

- OFF LED solid On – Feeder is in “Off” or “Tripped” position; CB ON aux input is low.
- RUN LED blinking On – Feeder has an active “Close” command but is in open position; CB ON aux input is low.
- RUN LED solid On – Feeder is in “On” position; CB ON aux input is high.
- AUTO LED Off – C445 control is local source
- AUTO LED On – C445 control is remote source
- FAULT LED solid On – C445 controller is faulted.
- WARNING LED solid On – C445 controller has an active warning present.
- TRIPPED LED solid On – Feeder is in the “Tripped” state CB ALARM aux input is high

Overlay Buttons:

- OFF button – Button press will put the control in “Local” and will send an OPEN command to the C445 to open the feeder.
- CLOSE button – Button press will put the control in “Local” and will send an CLOSE command to the C445 to close the feeder.
- AUTO button – Selects the remote source as the active C445 control
- RESET button – Resets fault if condition has cleared

Control Settings

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

Table 24. 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 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 141. Isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc Power

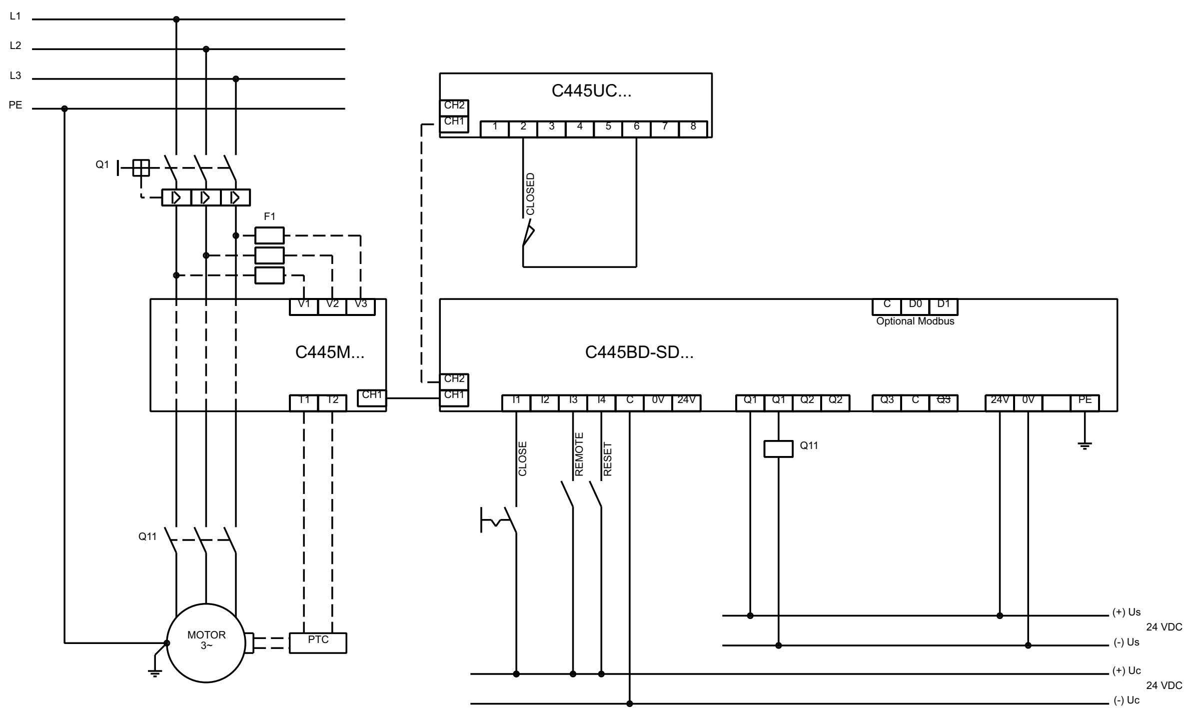


Figure 142. Non-isolated 24 Vdc Inputs/24 Vdc Outputs/24 Vdc C445 Power

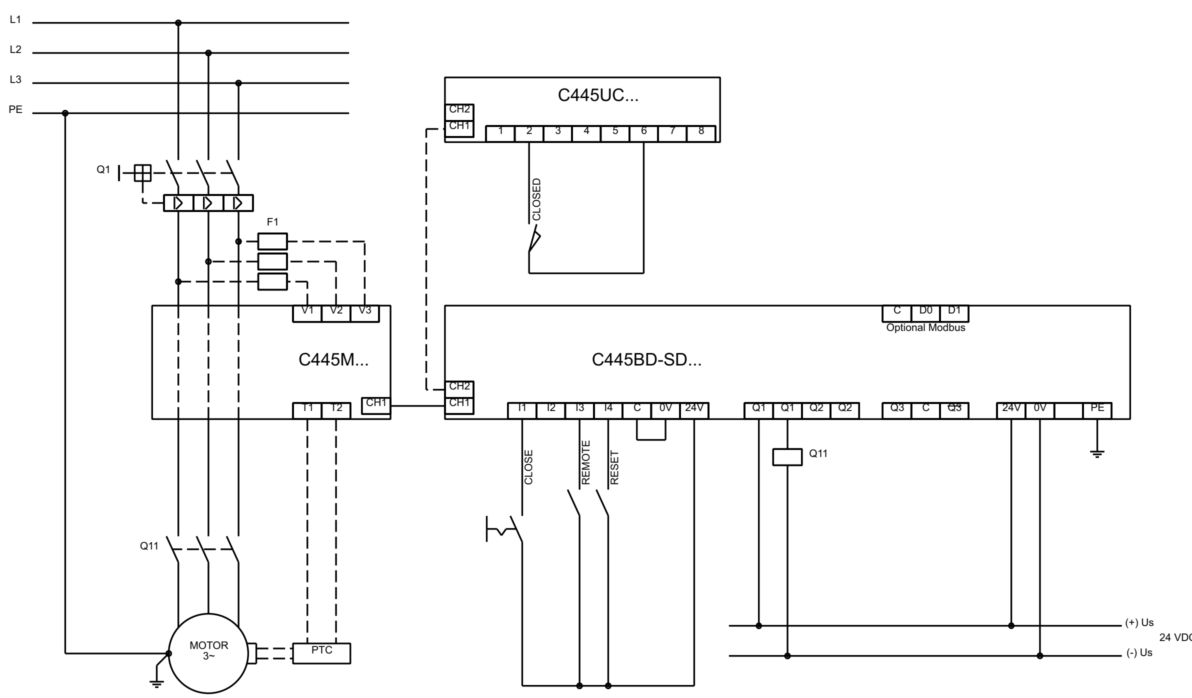
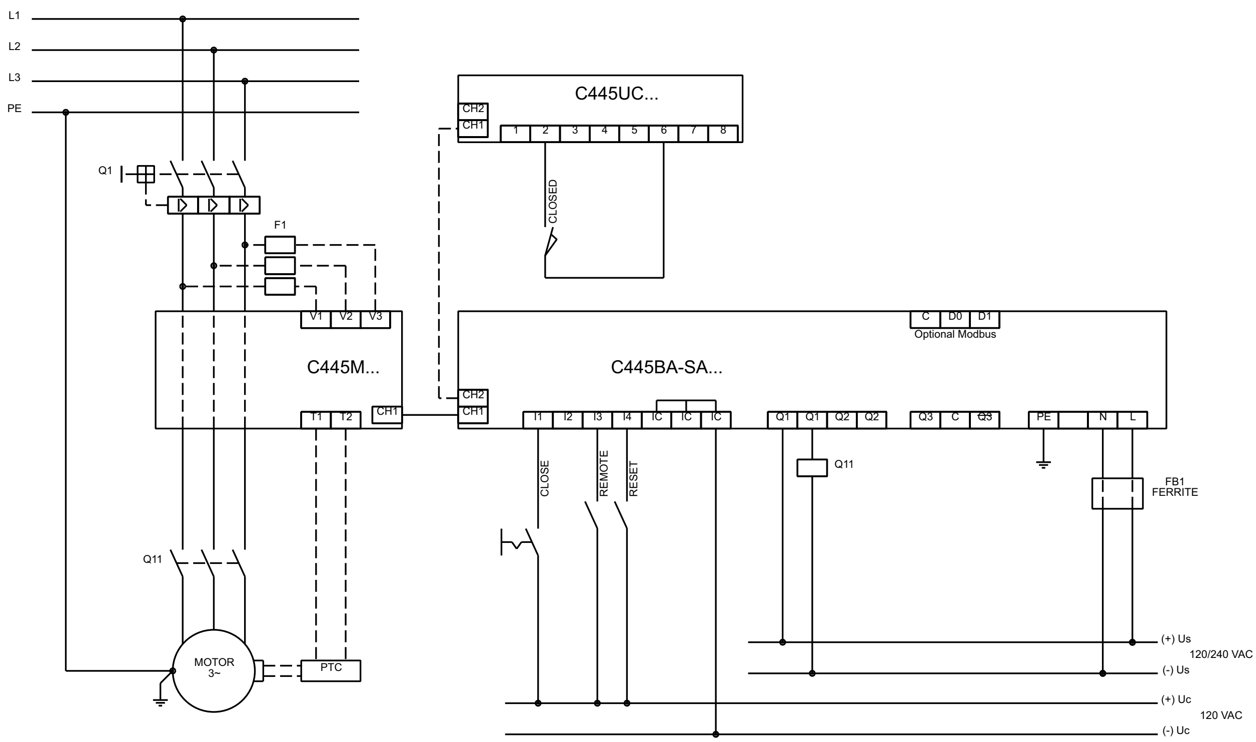


Figure 143. 120 Vac Inputs and 120/230 Vac Outputs/C445 Power



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, Input 3 is unused by this operation mode.

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 25. 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 = user interface input 1 off
1= user interface input 1 on

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

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

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

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 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 Power Xpert C445 Motor Management Relay.

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 C** – List of Locked Configuration Parameters. The attributes column will show which locks (if any) affect the parameter.

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 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 Power Xpert *in*Control Software Tool, navigate to the following parameter:

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 Power Xpert *in*Control Software Tool, navigate to the following parameter:

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 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 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 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.

Refer to Register 312: Active Fault, to determine faults that must be cleared.

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.

Motor Control Operation

The Base Control Module monitors the motor during periods of normal operation (see Figure 1). 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.

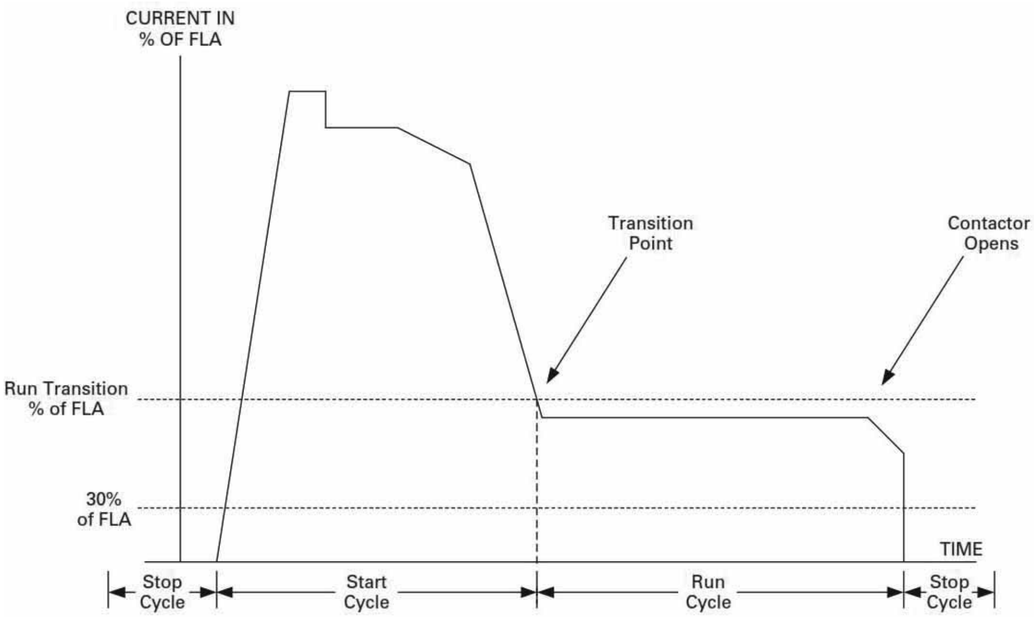
Note: The C445 transition from the Start cycle to the Run cycle is based on set time or current value, whichever occurs first.

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

Table 26. 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 144. 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 MANUAL RESET button is located on the faceplate of the unit. 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 145. Overload Trip Curves—Cold Coil (–40 °C to +60 °C)

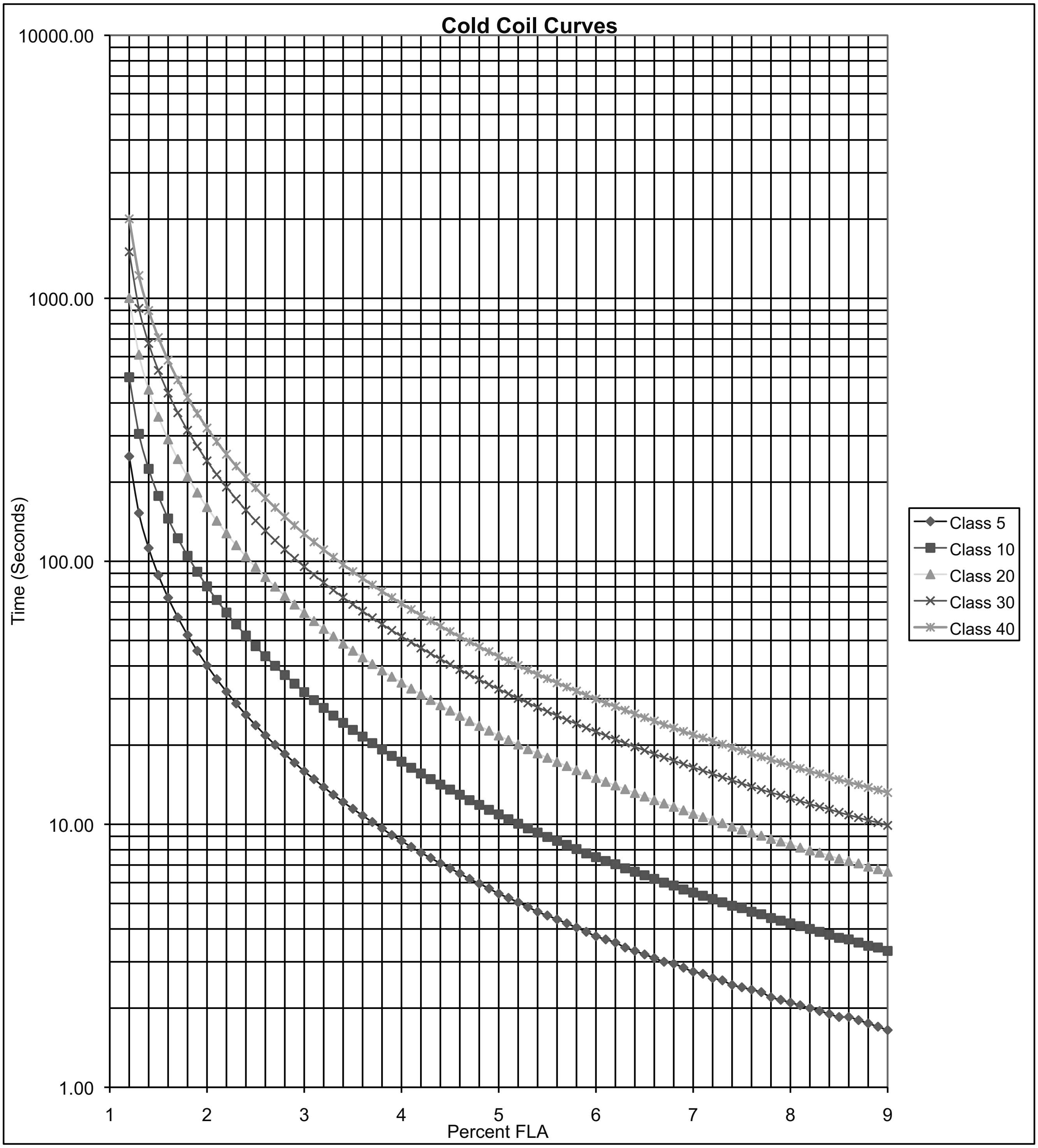
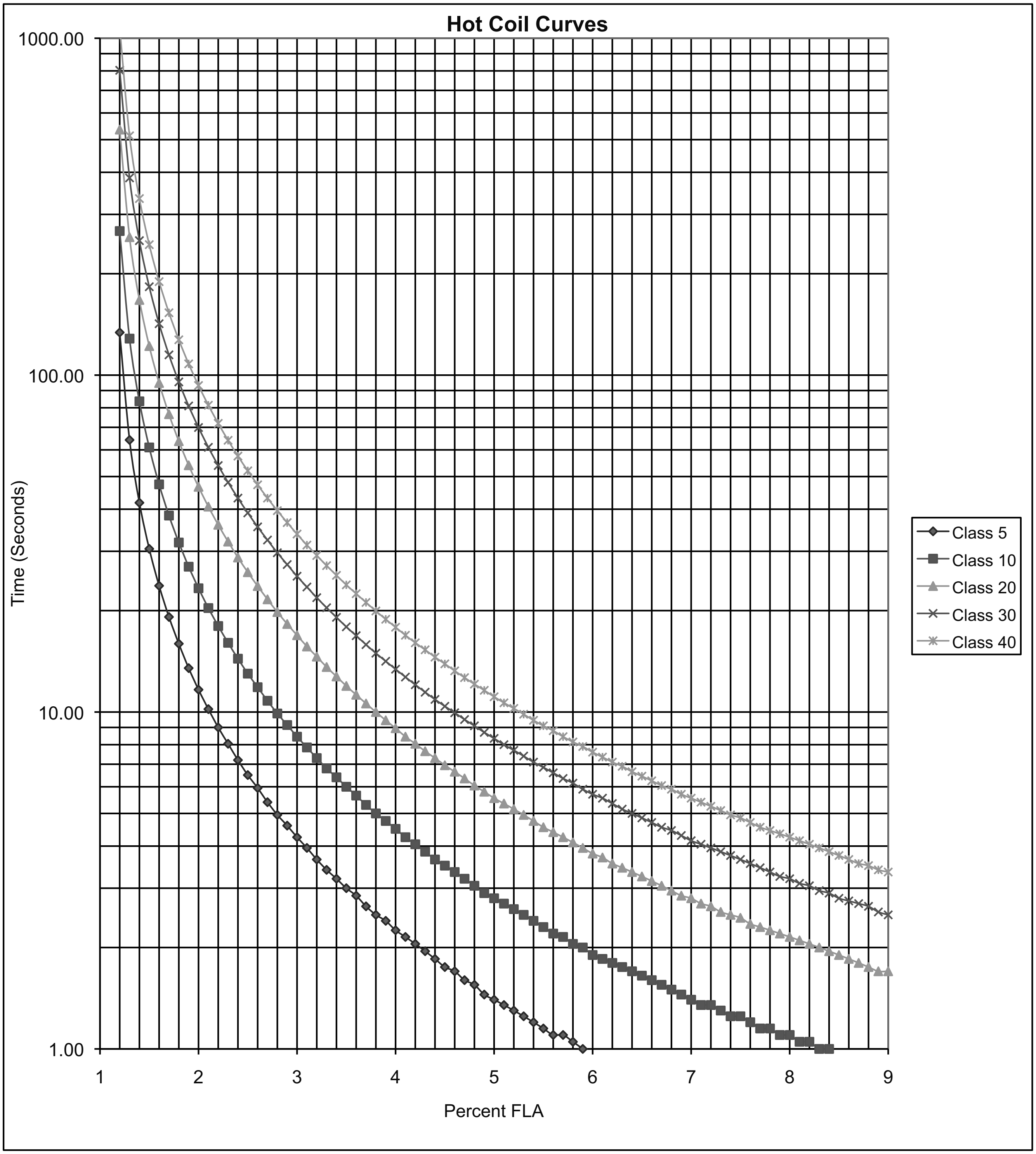


Figure 146. Overload Trip Curves—Hot Coil (–40 °C to +60 °C)



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.

Application Configuration

Basic Parameters

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

Table 27. Basic Parameters

Parameter	Units	Increment	Minimum	Maximum	Default	Notes
Motor1 Overload FLA Scaled	amps	1	1 ①	65535 ①	101 ①	ModBus Register = 900
Motor2 Overload FLA Scaled	amps	1	1 ②	65535 ②	101 ②	ModBus Register = 901
Overload Trip Class		1	5	40	5	ModBus Register = 1004
Motor Rated Voltage	volts	1	100	5000	480	ModBus Register = 903
Motor1 Rated HP	hp	1	1	500000	2000	ModBus Register = 909
Motor2 Rated HP	hp	1	1	500000	2000	ModBus Register = 911
Motor Rated Frequency	Hz	1	50	60	60	ModBus Register = 904
Phase Sequence			ABC	ACB	ABC	
Motor1 Rated Watts	watts					
Motor2 Rated Watts	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 need to be configured so that the monitoring and protection functions can be implemented.

Table 28. 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 Efficiency	%	1	50	100	85	Modbus Register = 916
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 Pickup 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 Pickup Level—Level of a measurement element that will begin the timing of the delay (start or run).
- Fault Warning Delay—also referred to as debounce time. 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 parameters 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 Algorithms
  - Voltage Loss Restart
  - Motor Torque
  - Motor Efficiency
  - Energy Deviation

Current Based Protection Parameters

Table 29. Current Based Protections

Fault Code	Protection	Action	Default Status	Fault Action Units	Fault Action Note	Motor FLA Min.	Motor FLA Max.	Motor FLA Default	Delay (Seconds) Min.	Delay (Seconds) Max.	Delay (Seconds) 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			
					C445MA032…	4	32	4			
					C445MA045…	5.6	45	5.6			
					C445MB072…	9	72	9			
					C445MC090…	11	90	11			
					C445MC136…	17	136	17			
					C445...ext	ext	800	ext			
		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	Disabled	%		1	60	15	1	60	15
		Fault Warning	Disabled	%		1	60	15	0.2	5	2
10	Phase Loss	Fault Trip	Disabled	%		60	60	60	2	2	2
4	Ground Fault (earth)	Fault Trip	Disabled	Amps	C445MA2P4…	0.12	2.4	1	1	60	5
					C445MA005…	0.25	5	3			
					C445MA032…	1 ①	9.6	3			
					C445MA045…	1 ①	13.5	3			
					C445MB072…	3 ①	21.6	3			
					C445MC090…	3	27	3			
					C445MC136…	34	40.8	34			
					C445...ext	30% of CT Primary	50% of CT Primary	50% of CT Primary			

Note

① ABC wiring recommended.

Voltage Based Protection Parameters

Table 30. Voltage Based Protections

Fault Code	Protection	Action	Default Status	Fault Action Units	Min.	Max.	Default	Delay (Seconds) 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	Frequency 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	Frequency 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 31. Power Based Protections

Fault Code	Protection	Action	Default Status	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Units
16	Low Power	Fault Trip	Disabled	%	–200	200	50	1	60	20
		Fault Warning	Disabled	%	–200	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 (VL) Restart

The Voltage Loss Restart protection offers several options that allow the user to select how the C445 unit responds to a mains voltage loss condition. The Voltage Loss Restart protection is designed to safely reclose any contactor(s) that has opened during the voltage loss event. The Voltage Loss restart parameter is not intended to hold the contactor(s) closed in the event of mains voltage loss.

Note: For the C445 to provide complete functionality in mains voltage loss conditions, the C445 must maintain control power. Under most conditions, the C445 relay can withstand control power drops as low as 65% (70% default) for up to 200 ms (default) without the need for a separate power source and/or a UPS device. This will allow restarts after very short periods of voltage loss without additional UPS devices or independently sourced control power. In the event a voltage dip occurs in excess of 70% and/or 200 ms (default), the C445 may power down.

Note: If one or more of the Voltage Loss Restart time settings are enabled, the standard undervoltage protection parameter must be disabled.

VL Restart

Table 32. 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
		Restart Fault Trip	1032	%	65	90	70	0	0		
		Restart Restore	1033	%	80	100	90	0	0		

Table 33. Voltage Loss Restart

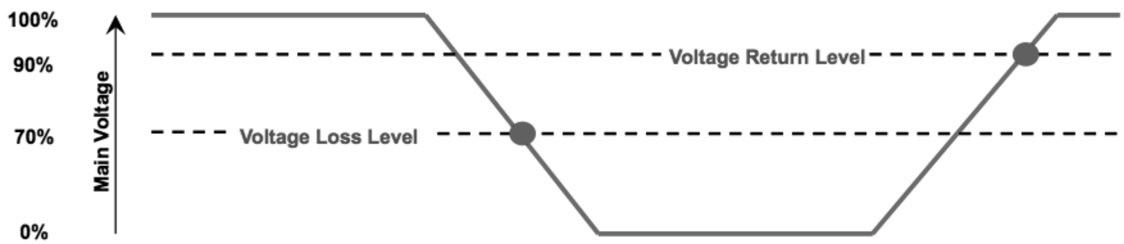
Fault Code	Protection	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
	Voltage Loss Auto	1034	Seconds	0.1	0.4	0.2	0	0	0	
	Voltage Loss Short	1037	Seconds	0.2	5.0	0.4	0.1	500.0	1.0	1035
	Voltage Loss Long	1040	Seconds	0	3600	4	1	3600	10	1039
	Restart Fault Level	1032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

Figure 147. Voltage Loss/Return Levels

Parameters:

Voltage Loss Level – When the main voltage falls below this user settable value (70% default) a voltage loss has occurred

Voltage Return Level – After a voltage loss, when the main voltage rises above this user settable value (90% default) the main voltage is restored



VL Auto Time

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 VL 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 Undervoltage Restart Fault Level setting.

- Undervoltage Restart Fault 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.

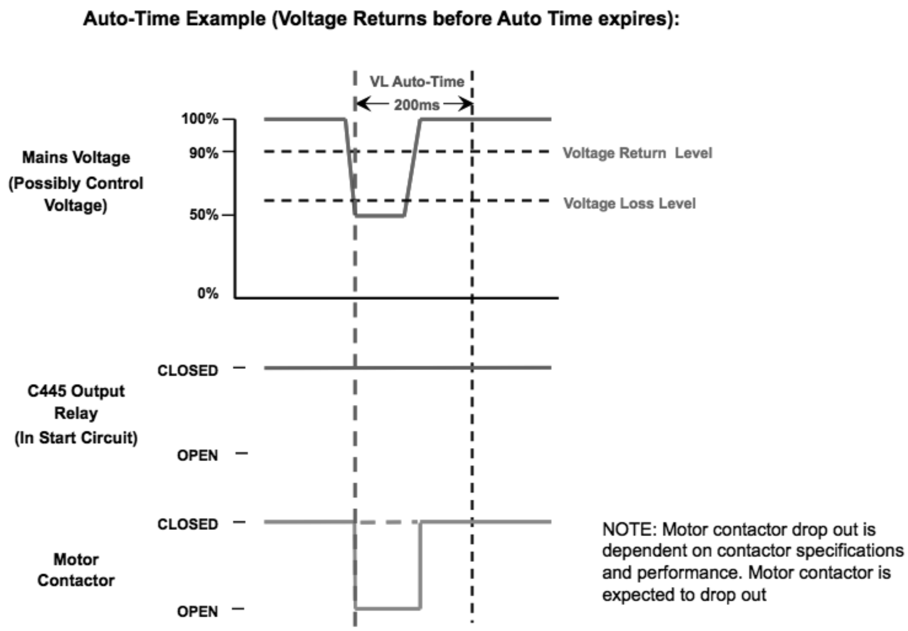
Example #1

Mains voltage returns above Undervoltage Restart Restoration 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, source of contactor coil power, or contactor specifications, the contactor may not open.

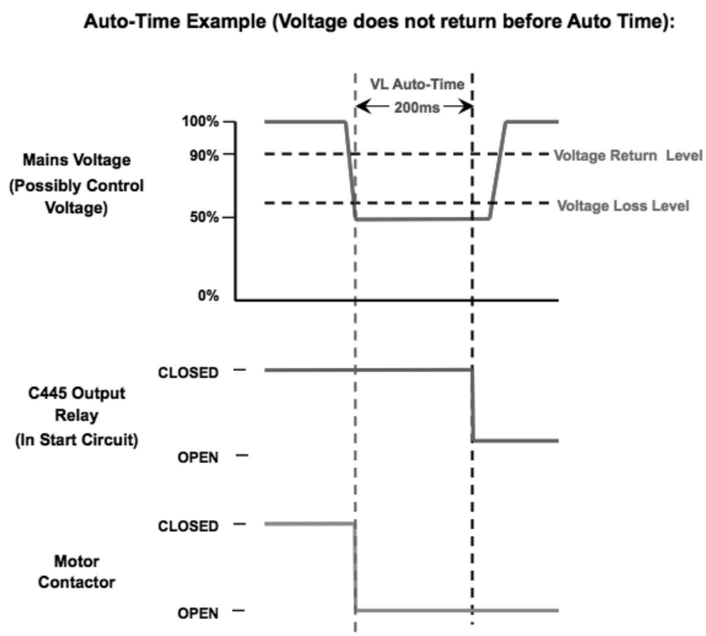
Figure 148. Example #1: Auto-Time—Mains Voltage Returns Before Auto Time Expires



Example #2

Mains voltage does not return above Undervoltage Restart Restoration Level setting in <200 ms (default) ~ 12 Cycles. In this case the contactor does not re-close and normal protections, if enabled, take over. The start circuit aux relay opens at the Auto Time Threshold. If the control voltage to the C445 is not being supplied by UPS or separate source, the C445 relay may power down from loss of control power and VL Short Time/VL Long Time restart protections cannot be utilized. If the control voltage to the C445 remains intact (UPS or separate source), the VL Short Time/VL Long Time restart protections can be utilized after VL Auto Time has expired.

Figure 149. Example #2: Auto-Time—Mains Voltage Does Not Return Before Auto Time Expires



VL Short Time

VL Short Time 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 Undervoltage Trip Level setting for longer than VL Auto Time. Contactor remains open. Start circuit Aux relays are now open as VL Auto Time has expired.

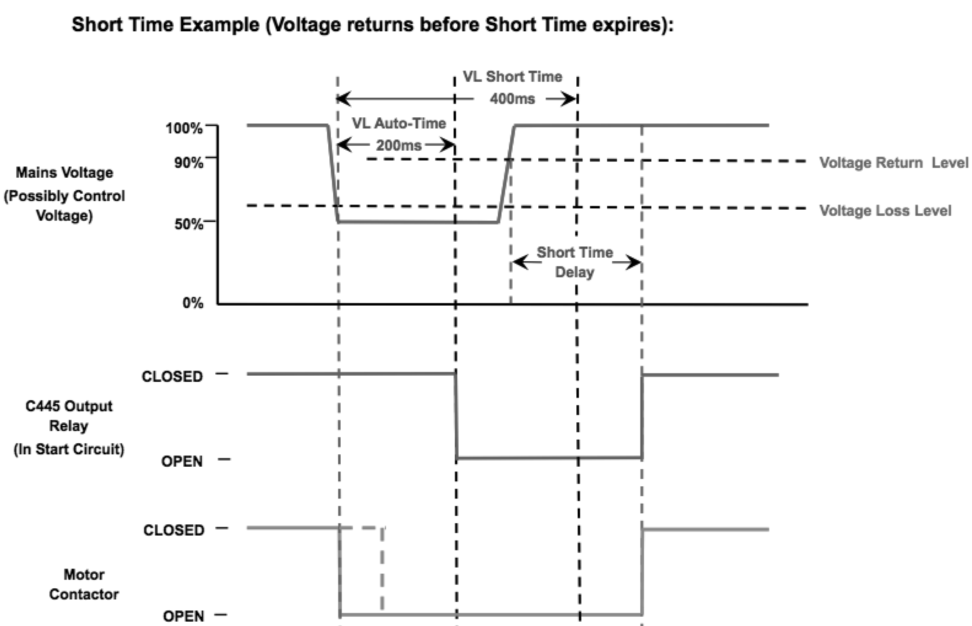
Note: C445 control-voltage must remain available during main voltage loss or C445 relay may power down.

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: If there is a run permissive in the circuit from a PLC/ DCS, it must remain active or restart will not occur.

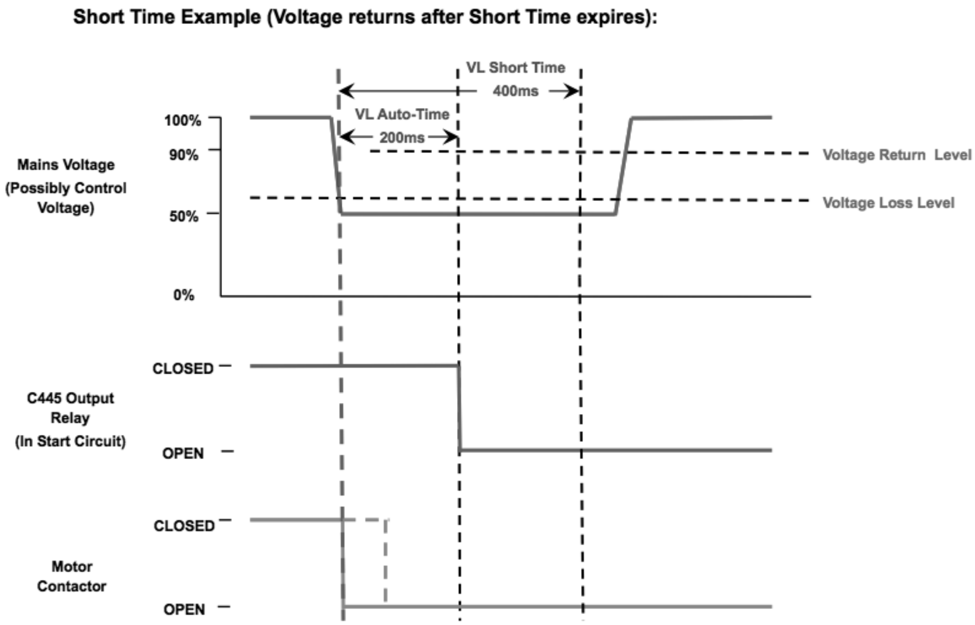
Figure 150. Example #3: Short-Time—Mains Voltage Returns Before Short Time Expires



Example #4

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

Figure 151. Example #4: Short-Time—Mains Voltage Does Not Return Before Short Time Expires



VL Long Time

VL Long Time 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 VL 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 VL Short Time delays for multiple motors, a second timer can be utilized after VL Long Time to further avoid brownouts from motors restarting together based on a common undervoltage condition. Any voltage loss longer than VL Long Time will require the user to manually go through the restart sequence as the voltage loss restart functionality can no longer be used.

Operation

Main voltage remains below Undervoltage Level setting for longer than VL Short Time. Contactor remains open. Start circuit Aux relays remain open.

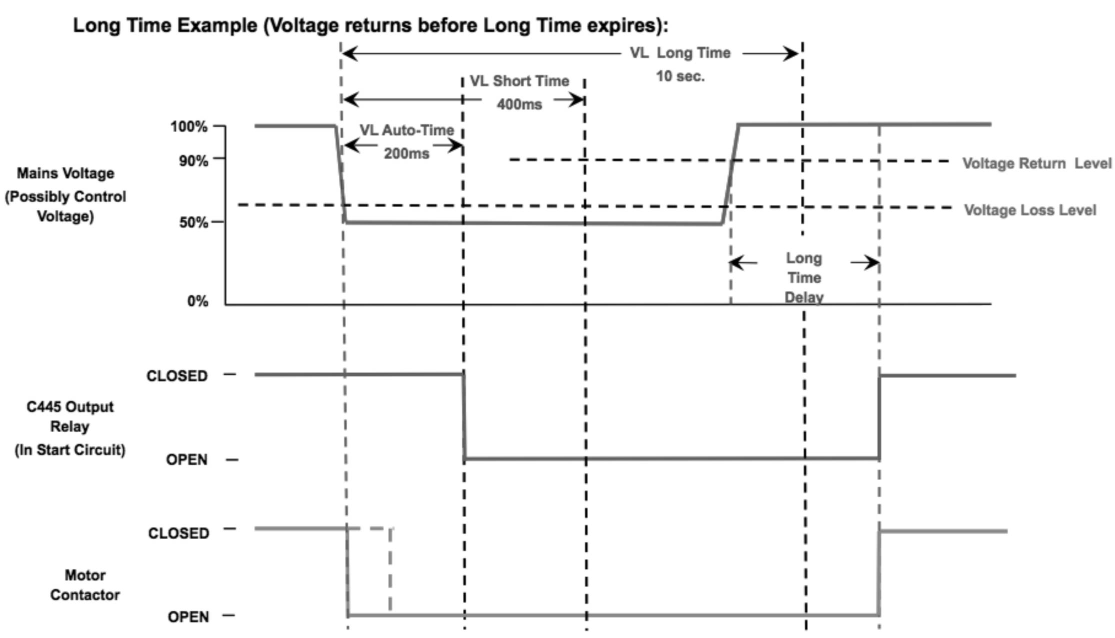
Note: C445 control-voltage must remain available during main voltage loss or C445 relay may power down.

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: If there is a run permissive in the circuit from a PLC/ DCS, it must remain active or restart will not occur.

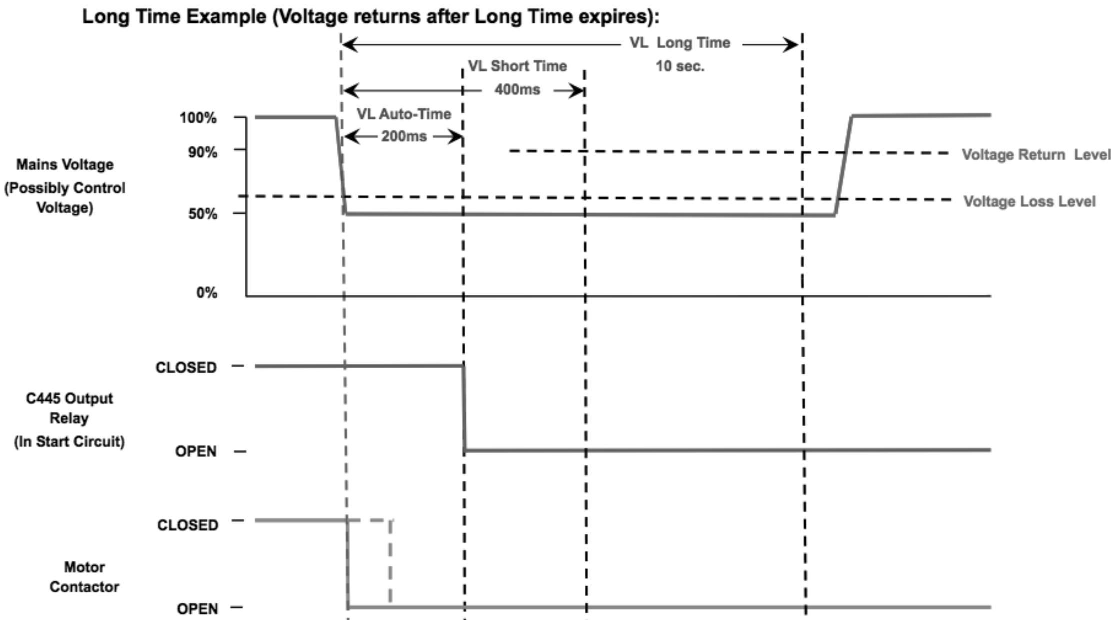
Figure 152. Example #5: Long-Time—Mains Voltage Returns Before Long Time Expires



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 153. 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. The Power Xpert *in*Control Software provides two displays for parameter monitoring.

- The data analyzer graph is available to display changes in the values of the parameters.
- The monitoring menu displays all of the available monitoring parameters. The current values are shown in windows that are updated.

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 restart feature may be configured to attempt to restart the motor.

Advanced Protection Parameters

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

Table 34. 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
Fault 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
Fault Trip Auto Reset Enable Bits					1073	Select Fault Trip Parameters to Auto Reset
Fault Trip Enable Bits		Checked	Unchecked	Unchecked	1000	User input bit field that is used to enable or disable a protection function trip
Fault Warning Enable Bits		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.

Use Power Xpert *in*Control to configure protection behaviors to navigate the selected device. The web page interface may also be used for navigation.

Offline Parameters → Control/Monitor Dashboard → Protections

Then follow the path to the protection settings.

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 35. Fault Warnings

			Fault Action			
Protection	**Action**	**Modbus**	**Units**	**Min.**	**Max.**	**Default**
Fault Warning	Fault Warning 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 36. 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			
					C445MA032…	4	32	4			
					C445MA045…	6	45	6			
					C445MB072…	9	72	9			
					C445MC090…	11	90	11			
					C445MC136…	17	136	17			
					C445…ext	ext	800	ext			
		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.

Current → Instantaneous Overcurrent

Table 37. 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. The Jam protection feature can be disabled by modifying the TRIP ENABLE/DISABLE register over the network.

General → Trip Enable Bits → Jam

Table 38. Jam

Fault				Fault Action				Delay (Seconds)			
Code	**Protection**	**Action**	**Modbus**	**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.

General → Stall Trip Level

Table 39. Stall ①

Fault				Fault Action				Delay (Seconds)			
Code	**Protection**	**Action**	**Modbus**	**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:

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

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.

Current → I Unbalance

Table 40. Current Unbalance

Fault				Fault Action				Delay (Seconds)			
Code	**Protection**	**Action**	**Modbus**	**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

Protections → Current → I Phase Loss

Table 41. 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 42. 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

Residual 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.

Protections → Ground Fault → Residual GF

Table 43. Ground Fault

Fault Code	Protection	Action	Modbus	Fault Action Units	Frame	Min.	Max.	Default	Delay (Seconds) 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				
					C445MA032…	1 ①	9.6	3				
					C445MA045…	1 ①	13.5	3				
					C445MB072…	3 ①	21.6	3				
					C445MC090…	3	27	3				
					C445MC136…	34	40.8	34				
					C445M…EXT	30% of CT Primary	50% of CT Primary	50% of CT Primary				
		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.

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.

Use the *in*Control Interface to navigate the selected device:

Offline Parameters → Control/Monitor Dashboard → Protections

Then follow the path to the protection device settings.

In this mode, a Start may be inhibited if the fault condition is present by setting the Low Voltage Start Inhibit Enable bit. Starts will be allowed as soon as the fault condition is cleared.

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.

Undervoltage

The Undervoltage protection monitors the minimum phase voltage of the motor and will trip the motor if the voltage exceeds 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.

Protections → Voltage → Undervoltage

Table 44. 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

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.

Protections → Voltage → Overvoltage

Table 45. Overvoltage

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) 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.

$$\%PhaseUnbalance = 100 \times \left[\frac{max(Phase\ Vrms) - min(Phase\ Vrms)}{avg(Phase\ Vrms)}\right]$$

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.

Protections → Voltage → V Unbalance

Table 46. Voltage Unbalance

Fault				Fault Action				Delay (Seconds)			
Code	Protection	Action	Modbus	Units	Min.	Max.	Default	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 47. Voltage Phase Loss

Fault				Fault Action				Delay (Seconds)			
Code	Protection	Action	Modbus	Units	Min.	Max.	Default	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.

Protections → General → Phase Rotation Protection

Table 48. 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.

Protections → Power → PF Deviation

Table 49. 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 50. Hz Dev – Slow

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
13	Frequency 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 51. Hz Dev – Fast

Fault Code	Protection	Action	Modbus	Fault Action Units	Min.	Max.	Default	Delay (Seconds) Min.	Max.	Default	Modbus
12	Frequency 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

Use the *in*Control Interface to navigate the selected device:

Offline Parameters → Control/Monitor Dashboard → Protections

Then follow the path to the protection device settings.

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.

Protections → Current → Undercurrent

Table 52. 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.

Protections → Power → Low kW

Table 53. 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	%	–200	200	50	1	60	20	1051
		Fault Warning	1050	%	–200	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.

Protections → Power → High kW

Table 54. 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 55. 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

There are a number of different ways to monitor operating parameters from a C445 Motor Management Relay System.

One way to monitor operating parameters from a C445 is to use the Power Xpert *in*Control Software Tool. All available parameters are viewable from this software and the most common operating parameters are located in a Control/ Monitor (Dashboard) category, while other parameters related to current, voltage, power and system parameters are categorized under a Measurement category. In addition, there is a Faults and Events category where all active faults, warnings and inhibits are displayed, along with the 10-deep fault queue and snap shot values. Snap shot values are parameters values saved with the last fault code to provide more detailed information on that fault, such a current values, power factor, thermal memory, voltages, power and more.

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 56. Current Based Monitoring

Parameter Name	Range/Units	Description
IA (L1) float	Depends on frame size (amps)	Phase A (L1) motor current. 2% accuracy within 30–125% of FLA.
IB (L2) float	Depends on frame size (amps)	Phase B (L2) motor current. 2% accuracy within 30–125% of FLA.
IC (L3) float	Depends on frame size (amps)	Phase C (L3) motor current. 2% accuracy within 30–125% of FLA.
I average float	Depends on frame size (amps)	Average motor current. 2% accuracy within 30–125% of FLA.
I unbalance percent	0–100%	Motor current unbalance percent
I average % of FLA (nominal current)	0–720% of FLA (amps)	Average motor current as a percentage of FLA
Maximum start current floating point	Depends on frame size (amps)	Maximum motor starting current
Motor residual GF RMS	Depends on frame size (amps), scaled via fieldbus	Motor residual ground fault current RMS. Accuracy meets UL-1053 / IEC Class II-B
IA (L1) scaled	Depends on frame size (amps, scaled)	Phase A (L1) motor current scaled. Scaled by parameter "I Scale Factor."
IB (L2) scaled	Depends on frame size (amps, scaled)	Phase B (L2) motor current scaled. Scaled by parameter "I Scale Factor."
IC (L3) scaled	Depends on frame size (amps, scaled)	Phase C (L3) motor current scaled. Scaled by parameter "I Scale Factor."
I average 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 57. Voltage Based Monitoring

Parameter Name	Range/Units	Description
Voltage AB (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
Voltage BC (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
Voltage CA (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 line-to-line voltage	0–690 V; max 4,160 V with PT ratios	Supply line-to-line voltage average. 2% accuracy up to 690 Vac
Line frequency x 100	47–63 Hz (centi-Hz)	Supply frequency in centi-Hz
Voltage phase order	0: unknown; 1: ABC (L1-L2-L3); 2: ACB (L1-L3-L2)	Reports phase sequence of the line voltage
Voltage unbalance percent	0–100%	Supply voltage unbalance percentage
VAB (L1-L2) scaled	V, scaled	Supply line-to-line voltage AB (L1-L2) scaled
VBC (L2-L3) scaled	V, scaled	Supply line-to-line voltage BC (L2-L3) scaled
VCA (L3-L1) scaled	V, scaled	Supply line-to-line voltage CA (L3-L1) scaled
Average line-to-line voltage scaled	V, scaled	Supply line-to-line voltage average scaled
Voltage scale		Voltage scale factor applied to scaled voltage measurements

Table 58. Power-Based Monitoring

Parameter Name	Range/Units	Description
Total watts	Depends on frame size (watts)	Total real power. 5% accuracy.
Total VA	Depends on frame size (Volt-Amps)	Total apparent power. 5% accuracy.
Total VARS	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.
Motor speed RPM	Depends on motor (0.1 RPM)	Motor speed in RPM
Motor torque	Depends on motor (0.01 Nm)	Motor torque
Motor 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 59. 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 memory percent	0–250%	Thermal memory in percent—overload trip occurs at 100%.

Table 60. Faults and Events

Parameter Name	Range/Units	Description
Active fault	See **Table 61** below	Active fault
Active warning	See **Table 61** below	Active warning
Active inhibit	See **Table 61** below	Active inhibit
Fault queue—event order	See **Table 61** below	A list of the last 10 faults shown in the order they occurred. Most recent at top.

Table 61. 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 memory	0–250%	Overload thermal memory 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 62. PTC Status Bits

Value	Description
0	PTC OK—no fault
1	PTC over temperature fault
2	PTC shorted fault
3	PTC open fault

Table 63. 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 64. Active Fault, Warning and Inhibit Values

Value	Description
Active Fault	
0	No Faults
1	Under voltage
2	Over voltage
3	External GF
4	Residual GF
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 64. 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
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 - CUI NV memory error
510	Internal - Option card NV memory error
Active Warning	
0	No Warnings
1	Under voltage
2	Over voltage
3	External GF
4	Residual GF
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

Table 64. Active Fault, Warning and Inhibit Values, continued

Value	Description
Active Warning, continued	
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	CUI high ambient temperature
30	Option card high ambient temperature
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

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 65. 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
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 66. 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 77**.

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 67. 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 68. 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 77**.

Table 69. 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 77**. 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

Table 70. 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 71. 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 72. 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 73. 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
	ATEX 95 (directive 94/9/EC) ① [Ex I (M2), Ex II (2) GD], EN 50495:2010 (to SIL 1)
	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)

Note

① ATEX Certification will apply to BCM, PROFIBUS option card, Ethernet option card, and MM (including PTC option to satisfy NAMUR requirements).

Table 74. 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

Table 75. 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 76. 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 77. 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 78. 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, pair Power Xpert with Eaton's D64 External GF relay. **Note:** GF settable thresholds vary with motor FLA. See **Table 29** 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 78. 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 79. 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 80. 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.

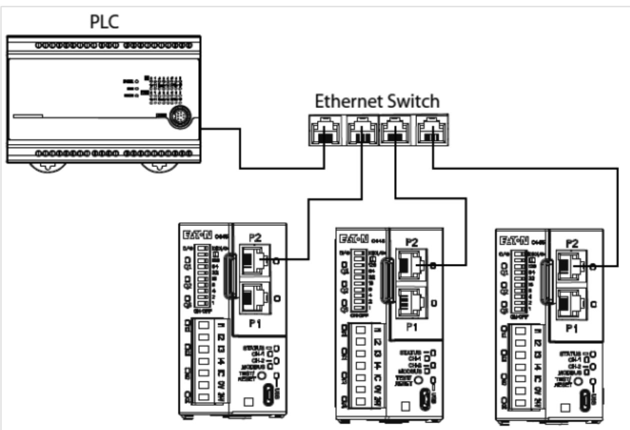
Appendix C—Optional Communication Cards

Ethernet Card (C445CX-E)

Introduction

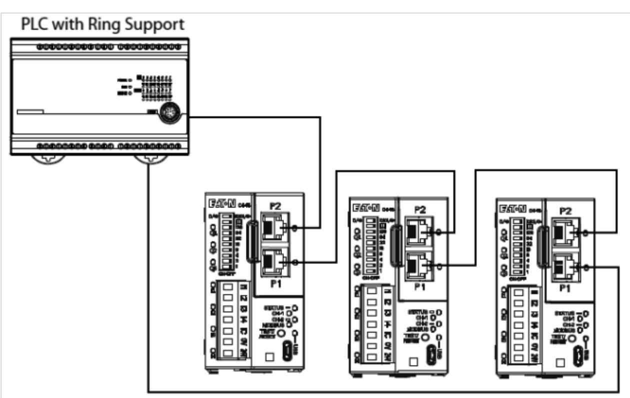
The C445 Ethernet option card (C445XC-E) supports both the Modbus TCP and EtherNet/IP protocols. This card contains two Ethernet ports but only one IP address. The ports act as a two-port Ethernet switch, allowing the user to optionally daisy chain modules together in a Ring or Linear network, instead 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 154. C445 Ethernet Star Network Connection Example



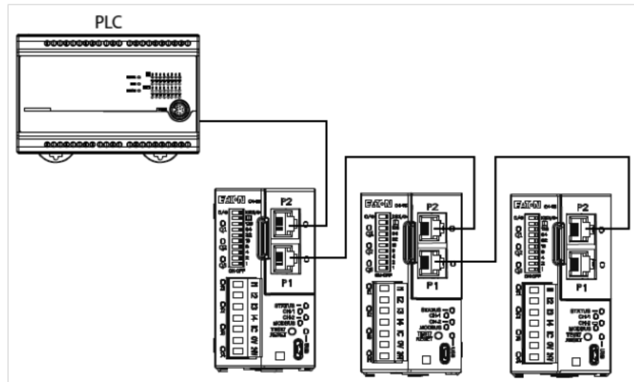
Star Network Connection Example

Figure 155. C445 Ethernet Ring Network Connection Example



Ring Network Connection Example

Figure 156. C445 Ethernet Linear Network Connection Example



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
2. Locate the communication card slot
3. Plug the Ethernet communication card into location

Figure 157. Installing the Ethernet Communication Card

Ethernet Communication Card and DIP Switches

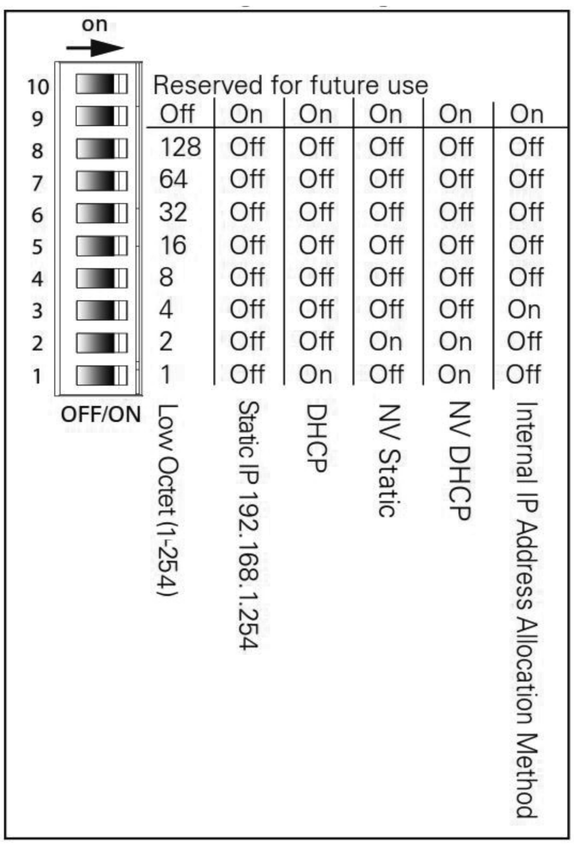
When an optional Ethernet card is connected to a C445, the DIP switches on the Base Control Module are dedicated to determining the IP address of this card per the diagram below.

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 158. Base Control Module DIP Switches with Ethernet Card



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 81. 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 82. 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

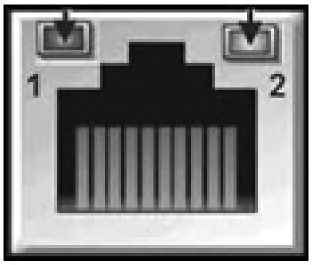


Table 83. Ethernet LED Description

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 84. 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 47** 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 85. 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.
22	0xB2 (178)	BUI	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 86. 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 87. 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 88. 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 89. C445 Assembly Object Instances

Type	Instance	Description
Output	2 (0x02)	Basic Overload
Output	3 (0x03)	Basic Motor Starter
Output	5 (0x05)	Extended Motor Starter
Output	104 (0x68)	Extended Motor Starter 2
Output	105 (0x69)	Basic Starter Relay
Output	106 (0x6A)	Basic Output Control
Input	50 (0x32)	Basic Overload
Input	51 (0x33)	Extended Overload
Input	52 (0x34)	Basic Motor Starter
Input	54 (0x36)	Extended Motor Starter 2
Input	100 (0x64)	Status Current Monitoring
Input	107 (0x64)	Status Current Monitoring
Input	110 (0x6E)	Status, Current Voltage, Trip
Input	116 (0x74)	Full Monitoring
Input	121 (0x79)	Status and Short Measurements
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	DCI_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	DCI_MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current I2	DCI_MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current I3	DCI_MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."

Output Instance 104(0x68): Extended Motor Starter 2

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 Bit3 = Fault Reset Bit 4 to 15 = Reserved

Output Instance 105(0x69): Basic Starter Relay

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): Basic Output Control

Length = 2 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Basic Control Relay	Basic Control Bits: (Byte1: DCI_NETCTRL_CONTROL_WORD) (Byte2: DCI_BCM_FIELD_OUTPUTS) Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: Enable Control From Network Protocol 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

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 110 (0x6E): Status, Current, Voltage, Trip

Length = 22 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	DCI_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	DCI_MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current I2	DCI_MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current I3	DCI_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	DCI_STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - high resistance GF 0x0000 0008 - residual GF 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 - overload 0x0002 0000 - stall 0x0004 0000 - phase rotation 0x0008 0000 - exceeds starts limit 0x0010 0000 - initialization fault 0x0020 0000 - NV memory fault 0x0040 0000 - comm loss 0x0080 0000 - comm msg error
12	2	Current Average	DCI_MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
14	2	Voltage L1-L2	DCI_LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
16	2	Voltage L2-L3	DCI_LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
18	2	Voltage L3-L1	DCI_LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
20	2	Voltage Average	DCI_LINE_V_LN_AVE_RMS: Average RMS Voltage (V)

Input Instance 116 (0x74): Full Monitoring

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	DCI_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	DCI_MOTOR_I_A_SCALED: Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Current I2	DCI_MOTOR_I_B_SCALED: Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor."
6	2	Current I3	DCI_MOTOR_I_C_SCALED: Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor."
8	2	Field inputs	DCI_LOGIC_INPUT_STATE_BITFIELD: Digital Input Status.
10	2	Current Average	DCI_MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
12	2	Voltage L1-L2	DCI_LINE_V_LL_AB_RMS: Phase A RMS Voltage L1-L2 (V)
14	2	Voltage L2-L3	DCI_LINE_V_LL_BC_RMS: Phase B RMS Voltage L2-L3 (V)
16	2	Voltage L3-L1	DCI_LINE_V_LL_CA_RMS: Phase C RMS Voltage L3-L1 (V)
18	2	Voltage Average	DCI_LINE_V_LN_AVE_RMS: Average RMS Voltage (V)

Input Instance 116 (0x74): Full Monitoring, continued

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
20	4	Motor Power	DCI_POWER_WATTS: Motor Power x0.1 kW when external CTs are used x0.01 kW otherwise (scale)
24	1	Voltage Unbalance Percentage	DCI_LINE_V_UNBALANCE_PERC: Max Deviation from Average Voltage Divided by Average Voltage (%).
25	1	Current Unbalance Percentage	DCI_MOTOR_I_UNBALANCE_PERC: Max Deviation from Average Current Divided by Average Current (%)
26	2	Apparent Power Factor	DCI_POWER_PF_APPARENT: cos (phi), (real power)/(apparent power) (%)
28	2	Residual Ground Current	DCI_MOTOR_GF_I_RES_RMS: Residual Ground Current in Amps x 100 (x0.01A)
30	2	Line frequency	DCI_LINE_FREQ Line Frequency (x0.01Hz)

Input Instance 116 (0x74): Full Monitoring, continued

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
32	4	Trip Reason	DCI_STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - high resistance GF 0x0000 0008 - residual GF 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 - overload 0x0002 0000 - stall 0x0004 0000 - phase rotation 0x0008 0000 - exceeds starts limit 0x0010 0000 - initialization fault 0x0020 0000 - NV memory fault 0x0040 0000 - comm loss 0x0080 0000 - comm msg error
36	4	Error Code	DCI_STATUS_WARNING_BITS Warning/Alarm Indications 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - high resistance GF 0x0000 0008 - residual GF 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 - overload 0x0002 0000 - stall 0x0004 0000 - phase rotation 0x0008 0000 - exceeds starts limit 0x0010 0000 - initialization fault 0x0020 0000 - NV memory fault 0x0040 0000 - comm loss 0x0080 0000 - comm msg error

Input Instance 116 (0x74): Full Monitoring, continued

Length = 41 Bytes

Byte Offset	Size (bytes)	Name	Description
40	1	Thermal Pile Percentage	DCI_STATUS_OVLD_THERMAL_MEM_PERCENT: Thermal Capacity 0% Cold Motor 100% Will Cause an Overload Trip (%)

Input Instance 121 (0x79): Status And Short Measurements

Length = 10 Bytes

Byte Offset	Size (bytes)	Name	Description
0	2	Device Status	DCI_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

Input Instance 121 (0x79): Status And Short Measurements, continued

Length = 10 Bytes

Byte Offset	Size (bytes)	Name	Description
2	2	Current Average	DCI_MOTOR_I_AVE_SCALED: Average Motor Current Scaled. Scaled by parameter "I Scale Factor."
4	2	Voltage Average	DCI_LINE_V_LN_AVE_RMS: Average RMS Voltage (V)
6	4	Trip Reason	DCI_STATUS_TRIPPED_BITS 0x0000 0001 - under voltage 0x0000 0002 - over voltage 0x0000 0004 - high resistance GF 0x0000 0008 - residual GF 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 - overload 0x0002 0000 - stall 0x0004 0000 - phase rotation 0x0008 0000 - exceeds starts limit 0x0010 0000 - initialization fault 0x0020 0000 - NV memory fault 0x0040 0000 - comm loss 0x0080 0000 - comm msg error

Table 90. 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 91. 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
5	5 (0x5),	3 (0x3)	Get	BOOL	value	ON/OFF Status of BUI Digital Inputs: 0: OFF, 1: ON Instance 5-BUI Digital i/p-1
6	6(0x6)	3 (0x3)	Get	BOOL	value	ON/OFF Status of BUI Digital Inputs: 0: OFF, 1: ON Instance 6-BUI Digital i/p-2
7	7(0x7)	3 (0x3)	Get	BOOL	value	ON/OFF Status of BUI Digital Inputs: 0: OFF, 1: ON Instance 7-BUI Digital i/p-3
8	8(0x8)	3 (0x3)	Get	BOOL	value	ON/OFF Status of BUI Digital Inputs: 0: OFF, 1: ON Instance 8-BUI 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)

Table 91. Discrete Input Object—Class 0x8 (8), continued

Instance Attributes

Sr. No.	Instance	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
12	4(0x4)	101 (0x65)	Get/Set	UINT	Debounce	BCM Digital i/p-4 debounce time. Applies to both raising & Falling edge. (mSec)
13	5 (0x5),	101 (0x65)	Get/Set	UINT	Debounce	BUI Digital i/p-1 debounce time. Applies to both raising & Falling edge. (mSec)
14	6(0x6)	101 (0x65)	Get/Set	UINT	Debounce	BUI Digital i/p-2 debounce time. Applies to both raising & Falling edge. (mSec)
15	7(0x7)	101 (0x65)	Get/Set	UINT	Debounce	BUI Digital i/p-3 debounce time. Applies to both raising & Falling edge. (mSec)
16	8(0x8)	101 (0x65)	Get/Set	UINT	Debounce	BUI Digital i/p-4 debounce time. Applies to both raising & Falling edge. (mSec)

Table 92. 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 93. 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 93. 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 93. 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: External GF Bit 3: Residual GF 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 Bit 21: PTC Bit 22: Under voltage restart Bit 23: Peak demand
18	107(0x6B)	Get	Array of 4 Bytes	Warning Status Bits	Bit 0: Undervoltage Bit 1: Overvoltage Bit 2: External GF Bit 3: Residual GF 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 Bit 21: PTC Bit 22: Under voltage restart Bit 23: Peak demand

Table 93. 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: External GF 4: Residual GF 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 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

Table 93. 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: External GF 4: Residual GF 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
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

Table 93. 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	
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 93. 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 94. 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	GF Residual - RMS	Motor residual ground fault current RMS

Table 94. 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 95. 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 95. 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	BUI firmware rev	BUI Firmware revision numerical
20	5 (0x05)	3 (0x3)	Get	UDINT	BUI product Serial No.	BUI Device Product Serial Number
21	5 (0x05)	4 (0x4)	Get	UINT	BUI Product code	BUI Product code.
22	5 (0x05)	5 (0x5)	Get	UINT	BUI Product Sub code	BUI Product Subcode.

Table 96. 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 96. 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 97. 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 98. Dynamic Input Assembly Instance Parameters

Value	Parameter Name	Related DCID
0	Assembly Terminator	DCI_D_IN_ASM_TERMINATOR_DCID
1	Packed Device status (See Control Supervisor Object)	DCI_PACKED_C445_DEVICE_STATUS_DCID
2	Motor Current Phase A - Scaled	DCI_MOTOR_I_A_SCALED_DCID
3	Motor Current Phase B - Scaled	DCI_MOTOR_I_B_SCALED_DCID
4	Motor Current Phase C - Scaled	DCI_MOTOR_I_C_SCALED_DCID
5	Motor Current Average - Scaled	DCI_MOTOR_I_AVE_SCALED_DCID
6	Line Voltage LL Phases AB	DCI_LINE_V_LL_AB_RMS_DCID
7	Line Voltage LL Phases BC	DCI_LINE_V_LL_BC_RMS_DCID
8	Line Voltage LL Phases CA	DCI_LINE_V_LL_CA_RMS_DCID
9	Line Voltage LL Average	DCI_LINE_V_LL_AVE_RMS_DCID
10	Total Watts for all three phases	DCI_POWER_WATTS_DCID
11	Line V Unbalance Percent	DCI_LINE_V_UNBALANCE_PERC_DCID
12	Motor Current Average Percent FLA	DCI_MOTOR_I_AVE_PERCENT_FLA_DCID
13	Apparent Power Factor	DCI_POWER_PF_APPARENT_DCID
14	GF High Resistance - RMS	DCI_MOTOR_GF_I_HR_RMS_DCID
15	Line Frequency - Scaled	DCI_LINE_FREQ_DCID
16	Thermal memory Percent	DCI_STATUS_OVLD_THERMAL_MEM_PERCENT_DCID
17	Signal Status Bits	DCI_STATUS_SIGNAL_BITS_DCID
18	Warning Status Bits	DCI_STATUS_WARNING_BITS_DCID
19	BCM Digital Input Status	DCI_LOGIC_INPUT_STATE_BITFIELD_DCID

Table 99. Test Only Object—Class 0xC7 (199)

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 99. Test Only Object—Class 0xC7 (199), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
1	1 (0x1)	Get/Set	USINT	force overload perc	Force Overload Perc
2	2 (0x2)	Get	UINT	idle loop time ave	Amount of time it takes to run through one complete run of all processes inside the idle task. The time to run all items in the idle task loop.
3	3 (0x3)	Get/Set	UINT	idle loop time max	Max amount of time it takes to run through one complete run of all processes inside the idle task. The max time to run all items in the idle task loop. This value can be reset by writing a zero into the location.
4	4 (0x4)	Get/Set	UINT	idle loop time min	Min amount of time it takes to run through one complete run of all processes inside the idle task. The min time to run all items in the idle task loop. This value can be reset.
5	5 (0x5)	Get/Set	USINT	bcm heap used max perc	BCM Maximum heap usage percent (Resettable)
6	6 (0x6)	Get	USINT	bcm heap used perc	BCM Current heap usage percent
7	7 (0x7)	Get	USINT	bcm cstack usage percent	BCM Cstack Usage percent
8	8 (0x8)	Get/Set	UINT	num option card comm crc errors	Provides the number of crc errors that have occurred between the option card and the BCM
9	9 (0x9)	Get/Set	USINT	mm sim enable	Simulation enable
10	10 (0xA)	Get/Set	USINT	mm sim freq	Simulation frequency
11	11 (0xB)	Get/Set	UINT	mm sim i a	Simulation Current A
12	12 (0xC)	Get/Set	UINT	mm sim i b	Simulation Current B
13	13 (0xD)	Get/Set	UINT	mm sim i c	Simulation Current C
14	14 (0xE)	Get/Set	UINT	mm sim v a	Simulation VAN
15	15 (0xF)	Get/Set	UINT	mm sim v b	Simulation VBN
16	16 (0x10)	Get/Set	UINT	mm sim v c	Simulation VCN
17	17 (0x11)	Get/Set	UINT	mm sim phi i1	MM simulator - IA angle
18	18 (0x12)	Get/Set	UINT	mm sim phi i2	MM simulator - IB angle
19	19 (0x13)	Get/Set	UINT	mm sim phi i3	MM simulator - IC angle
20	20 (0x14)	Get/Set	UINT	mm sim phi v1	MM simulator - VAN angle
21	21 (0x15)	Get/Set	UINT	mm sim phi v2	MM simulator - VBN angle
22	22 (0x16)	Get/Set	UINT	mm sim phi v3	MM simulator - VCN angle
23	23 (0x17)	Get/Set	UINT	mm sim vn	simulator - VN RMS
24	24 (0x18)	Get/Set	UINT	mm sim phi vn	simulator - VN angle
25	25 (0x19)	Get/Set	UINT	mm med filt type	RMS filter type bits 0-3: V&I bits 4-7: power bits 8-11: ground fault 0 = off, 1 = on, 2 = cal
26	26 (0x1A)	Get/Set	USINT	bui heap used max perc	BUI Maximum heap usage percent
27	27 (0x1B)	Get	USINT	bui heap used perc	BUI Current heap usage percent
28	28 (0x1C)	Get	USINT	bui cstack usage percent	BUI Cstack Usage percent
29	29 (0x1D)	Get/Set	USINT	bui0 led brightness bank 0	LED Brightness Configuration Bank 0
30	30 (0x1E)	Get/Set	USINT	bui0 led brightness bank 1	LED Brightness Configuration Bank 1
31	31 (0x1F)	Get/Set	USINT	bui0 led brightness bank 2	LED Brightness Configuration Bank 2
32	32 (0x20)	Get/Set	USINT	bui0 led brightness bank 3	LED Brightness Configuration Bank 3
33	33 (0x21)	Get/Set	USINT	bui0 led ctrl 0	LED Control 0 - ON/OFF, color bitfield
34	34 (0x22)	Get/Set	USINT	bui0 led ctrl 1	LED Control 1 - ON/OFF, color bitfield
35	35 (0x23)	Get/Set	USINT	bui0 led ctrl 2	LED Control 2 - ON/OFF, color bitfield
36	36 (0x24)	Get/Set	USINT	bui0 led ctrl 3	LED Control 3 - ON/OFF, color bitfield
37	37 (0x25)	Get/Set	USINT	bui0 led ctrl 4	LED Control 4 - ON/OFF, color bitfield
38	38 (0x26)	Get/Set	USINT	bui0 led ctrl 5	LED Control 5 - ON/OFF, color bitfield

Table 99. Test Only Object—Class 0xC7 (199), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
39	39 (0x27)	Get/Set	USINT	bui0 led ctrl 6	LED Control 6 - ON/OFF, color bitfield
40	40 (0x28)	Get/Set	USINT	bui0 led ctrl 7	LED Control 7 - ON/OFF, color bitfield
41	41 (0x29)	Get/Set	USINT	bui0 led ctrl 8	LED Control 8 - ON/OFF, color bitfield
42	42 (0x2A)	Get/Set	USINT	bui0 led ctrl 9	LED Control 9 - ON/OFF, color bitfield
43	43 (0x2B)	Get	UINT	bcm firmware crc val	BCM Firmware CRC
44	44 (0x2C)	Get	UINT	ps firmware crc val	—
45	45 (0x2D)	Get	UINT	mm firmware crc val	—
46	46 (0x2E)	Get	UINT	option card firmware crc val	—
47	47 (0x2F)	Get	DINT	power energy real frac	Real Energy Fractional
48	48 (0x30)	Get/Set	DINT	power energy real reset frac	Real Energy - Fractional (Resettable)
49	49 (0x31)	Get	DINT	power energy reactive frac	Reactive Energy Fractional
50	50 (0x32)	Get/Set	DINT	power energy reactive reset frac	Reactive Energy - Fractional (Resettable)
51	51 (0x33)	Get	DINT	power energy apparent frac	Apparent Energy Fractional
52	52 (0x34)	Get/Set	DINT	power energy apparent reset frac	Apparent Energy - Fractional (Resettable)
53	53 (0x35)	Get/Set	USINT	KSZ's register no. which want to Read	KSZ's register no. which want to Read
54	54 (0x36)	Get	USINT	Reading of KSZ's register	Reading of KSZ's register
55	55 (0x37)	Get/Set	BOOL	Enable Read Access to KSZ's Register	Enable Read Access to KSZ's Register
56	56 (0x38)	Get/Set	USINT	KSZ's register no. which want to write	KSZ's register no. which want to write
57	57 (0x39)	Get/Set	USINT	Value which want to write into KSZ's register	Value which want to write into KSZ's register
58	58 (0x3A)	Get/Set	BOOL	Enable Write Access to KSZ's Register	Enable Write Access to KSZ's Register

Table 100. 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 100. 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 101. 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 101. 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 102. 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 102. 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 103. 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 103. 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 104. 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 104. 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 - high resistance GF 3 - residual GF 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 - overload 17 - stall 18 - phase rotation 19 - exceeds starts limit 20 - PTC 21 - initialization fault 22 - NV memory fault 23 - comm loss 24 - comm msg error
2	2 (0x2)	Get/Set	BYTE	Warn Enable Bit Field	Enabling bits for warning. Bit location - condition 0 - under voltage 1 - over voltage 2 - high resistance GF 3 - residual GF 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 - overload 17 - stall 18 - phase rotation 19 - exceeds starts limit 20 - PTC 21 - initialization fault 22 - NV memory fault 23 - comm loss 24 - comm msg error
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 104. 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 - high resistance GF 3 - residual GF 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 - overload 17 - stall 18 - phase rotation 19 - exceeds starts limit 20 - PTC 21 - initialization fault 22 - NV memory fault 23 - comm loss 24 - comm msg error
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 104. 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	Residual Ground Fault Threshold - Scaled	Residual Ground Fault Threshold - Scaled
41	41 (0x29)	Get/Set	UINT	Residual Ground Fault Debounce	Residual Ground Fault Debounce
42	42 (0x2A)	Get/Set	UINT	Residual Ground Fault Alarm Threshold - Scaled	Residual Ground Fault Alarm Threshold - Scaled
43	43 (0x2B)	Get/Set	UINT	Residual Ground Fault Start Delay	Residual Ground Fault Start Delay
44	44 (0x2C)	Get/Set	BOOL	Residual Ground Fault Apply Inhibit Current	Residual Ground Fault Apply Inhibit Current
45	45 (0x2D)	Get/Set	UINT	Residual Ground Fault Inhibit Current - Percent	Residual 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 105. 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	12 (0x10)	Get	DINT	Fault Snap Shot Log Real Power (watts)	Fault Snap Shot Log Real Power (watts)
17	13 (0x11)	Get	DINT	Fault Snap Shot Log Apparent Power (VA)	Fault Snap Shot Log Apparent Power (VA)
18	14 (0x12)	Get	INT	Fault Snap Shot Log Power Factor	Fault Snap Shot Log Power Factor
19	15 (0x13)	Get	UINT	Fault Snap Shot Log Ground Fault RMS	Fault Snap Shot Log Ground Fault RMS

Table 106. 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 107. 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 107. 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 108. 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 108. 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 109. BUI Object—Class 0xB2 (178)

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	WORD	User Interface Button States	User Interface Button States
2	2 (0x2)	Get	BYTE	User Interface Input States	User Interface Input States
3	3 (0x3)	Get/Set	UINT	Configuration parameter for the User Interface button LED 0	Configuration parameter for the User Interface button LED 0
4	4 (0x4)	Get/Set	UINT	Configuration parameter for the User Interface button LED 1	Configuration parameter for the User Interface button LED 1
5	5 (0x5)	Get/Set	UINT	Configuration parameter for the User Interface button LED 2	Configuration parameter for the User Interface button LED 2
6	6 (0x6)	Get/Set	UINT	Configuration parameter for the User Interface button LED 3	Configuration parameter for the User Interface button LED 3
7	7 (0x7)	Get/Set	UINT	Configuration parameter for the User Interface status LED 0	Configuration parameter for the User Interface status LED 0
8	8 (0x8)	Get/Set	UINT	Configuration parameter for the User Interface status LED 1	Configuration parameter for the User Interface status LED 1
9	9 (0x9)	Get/Set	UINT	Configuration parameter for the User Interface status LED 2	Configuration parameter for the User Interface status LED 2
10	10 (0xA)	Get/Set	UINT	Configuration parameter for the User Interface user LED 0	Configuration parameter for the User Interface user LED 0
11	11 (0xB)	Get/Set	UINT	Configuration parameter for the User Interface user LED 1	Configuration parameter for the User Interface user LED 1
12	12 (0xC)	Get/Set	UINT	Configuration parameter for the User Interface user LED 2	Configuration parameter for the User Interface user LED 2

Table 109. BUI Object—Class 0xB2 (178), continued

Instance Attributes

Sr. No.	Attribute ID	Access	Data Type	Attribute Name	Attribute Description
13	13 (0xD)	Get/Set	UINT	CFG parameter for the User Interface button 0 function	CFG parameter for the User Interface button 0 function
14	14 (0xE)	Get/Set	UINT	CFG parameter for the User Interface button 1 function	CFG parameter for the User Interface button 1 function
15	15 (0xF)	Get/Set	UINT	CFG parameter for the User Interface button 2 function	CFG parameter for the User Interface button 2 function
16	16 (0x10)	Get/Set	UINT	CFG parameter for the User Interface button 3 function	CFG parameter for the User Interface button 3 function
17	17 (0x11)	Get/Set	UINT	CFG parameter for the User Interface button 4 function	CFG parameter for the User Interface button 4 function
18	18 (0x12)	Get/Set	UINT	User Interface LED 0 Color cfg parameter	User Interface LED 0 Color cfg parameter
19	19 (0x13)	Get/Set	UINT	User Interface LED 1 Color cfg parameter	User Interface LED 1 Color cfg parameter
20	20 (0x14)	Get/Set	UINT	User Interface LED 2 Color cfg parameter	User Interface LED 2 Color cfg parameter
21	21 (0x15)	Get/Set	UINT	User Interface LED 3 Color cfg parameter	User Interface LED 3 Color cfg parameter
22	22 (0x16)	Get/Set	UINT	User Interface LED 4 Color cfg parameter	User Interface LED 4 Color cfg parameter
23	23 (0x17)	Get/Set	UINT	User Interface LED 5 Color cfg parameter	User Interface LED 5 Color cfg parameter
24	24 (0x18)	Get/Set	UINT	User Interface LED 6 Color cfg parameter	User Interface LED 6 Color cfg parameter
25	25 (0x19)	Get/Set	UINT	User Interface LED 7 Color cfg parameter	User Interface LED 7 Color cfg parameter
26	26 (0x20)	Get/Set	UINT	User Interface LED 8 Color cfg parameter	User Interface LED 8 Color cfg parameter

Table 110. 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 110. 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 111. 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 111. 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 112. 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 112. 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 113. 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 113. Ethernet Link Object—Class 0xF6 (246), continued

Class Attributes					
Sr. No.	**ID**	**Description**	**Access Rule**	**Data Type**	**Remarks/Default**
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	A (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 114. 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
2. Locate the communication card slot
3. Plug the PROFIBUS communication card into location

Figure 159. 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 160. Base Control Module DIP Switches with PROFIBUS Card

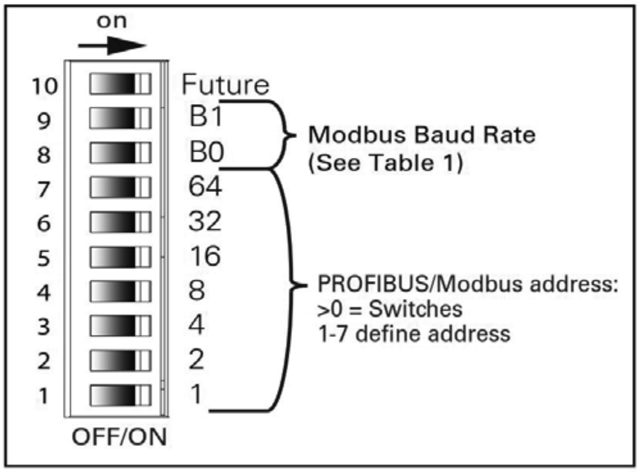


Table 115. Modbus Data Rate

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 116. 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

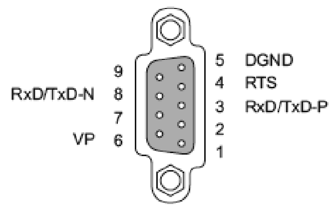


Table 117. DB-9 Connector

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

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 118. 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

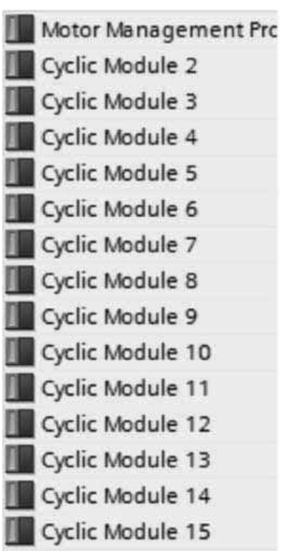
Note

[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:



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

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. Each bit is selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool, under the "Slave" module.

Module 5: Cyclic Module 5

This profile includes 2 output bytes. Each bit is selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool, under the "Slave" module.

Module 6: Cyclic Module 6

This profile includes 2 input bytes and 2 output bytes. Each input bit is selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool. Each output bit is selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool, under the "Slave" module.

Module 7: Cyclic Module 7

This profile includes 8 input bytes and 4 output bytes. 4 word parameters may be selected for the input data and 2 word parameters for the output data. The input data is selectable under the module in the PROFIBUS master's programming software and the output data under the "Slave" module.

Module 8: Cyclic Module 8

This profile includes total 6 output bytes and 10 input bytes. 16 output bits are selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool, under the "Slave" module. 16 input bits are selectable via the C445 GSD file installed in the PROFIBUS master's configuration software tool. 4 word parameters may be selected for the input data and 2 word parameters for the output data.

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. 16 word parameters may be selected for the input data and 2 word parameters for the output data. The input data is selectable under the module in the PROFIBUS master's programming software and the output data under the "Slave" module.

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.

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.

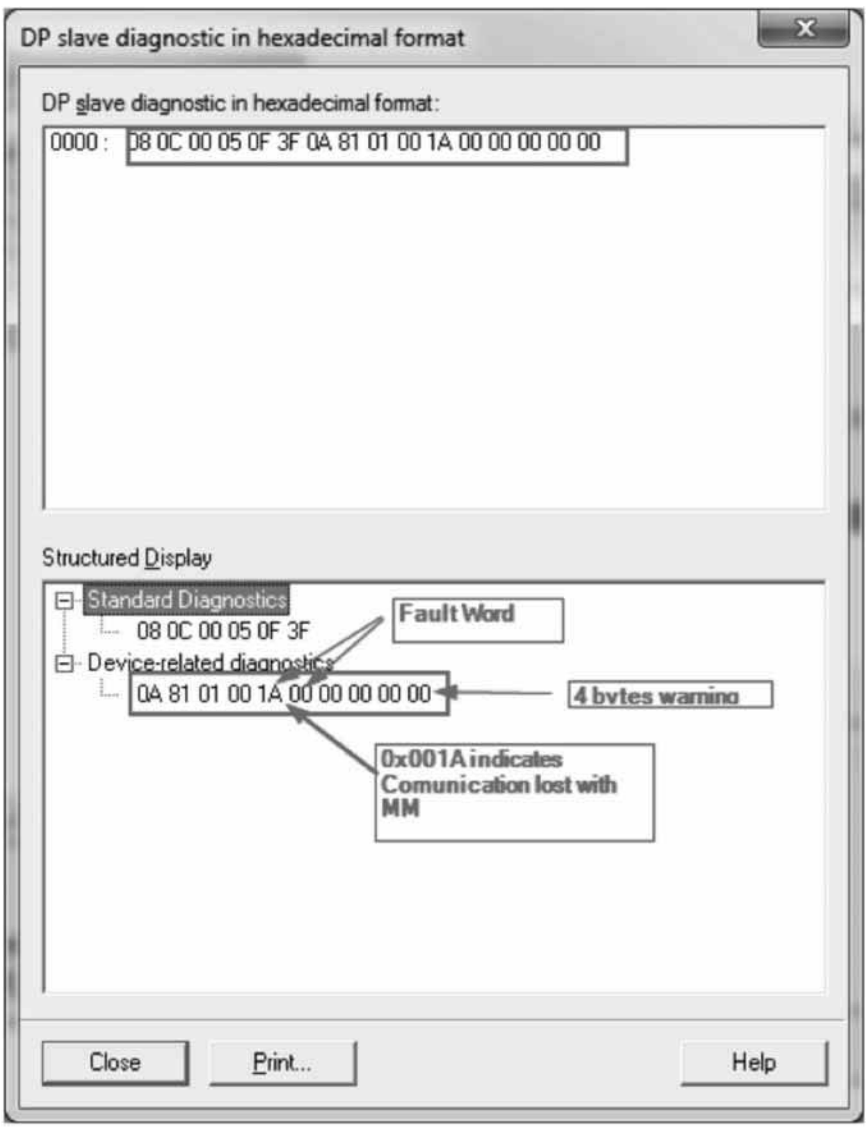
Any time a fault condition is present in the system, the “ext.diag.” bit (bit3 in first diagnostic data byte) will be set high, indicating to the Master, a high level diagnostic message and fault is present. The C445 PROFIBUS communication card will also set the appropriate word/bit/bits in diagnostic 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 119. 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.



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 120. PROFIBUS Configuration File

Operation Mode
Parameterization Download Enable
Active Starter Profile
BCM Remote Source Selector
BCM Local Source Selector
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

Operation Mode
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 121. 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 47** or **Appendix E**.

Table 122. Fieldbus Motor Control Bits

Bit Position	Bit Description
Bit 0	Run 1
Bit 1	Run 2
Bit 2	Reserved
Bit 3	Fault Reset
Bit 4	Reserved
Bit 5	Test Trip
Bit 6	Reserved
Bit 7	Reserved

C445 PROFIBUS Cyclic/Acyclic Readable Parameters

Table 123. Bit Mapping Parameters for Cyclic/Acyclic Readable Parameters

Bit Description	Parameter Description
Running 1	BCM Status Word
Running 2	BCM Status Word
Remote Enabled	BCM Status Word
Faulted	BCM Status Word
Warning	BCM Status Word
Inhibited	BCM Status Word
Ready	BCM Status Word
Up to Speed	BCM Status Word
FIELD INPUT 1	Digital Input Status of BUI
FIELD INPUT 2	Digital Input Status of BUI
FIELD INPUT 3	Digital Input Status of BUI
FIELD INPUT 4	Digital Input Status of BUI

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 124. 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
BUI Input States

Appendix D—Modbus Register Map

C445 Modbus Register Map

Table 125. C445 Modbus Register Map

Register	Name	Attribute	Description		
300	Motor Control Status	BYTE RO Bitfield	Present Motor Control Status Bits		
			Bit	**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
301	IA (L1) Scaled	UINT16 RO Units: scaled A	Phase A (L1) Motor Current Scaled. Scaled by parameter "I Scale Factor"		
302	IB (L2) Scaled	UINT16 RO Units: scaled A	Phase B (L2) Motor Current Scaled. Scaled by parameter "I Scale Factor"		
303	IC (L3) Scaled	UINT16 RO Units: scaled A	Phase C (L3) Motor Current Scaled. Scaled by parameter "I Scale Factor"		
304	I Average Scaled	UINT16 RO Units: scaled A	Average motor Current Scaled. Scaled by parameter "I Scale Factor"		
305	I Scale Factor	UINT16 RO	Motor Current Scale Factor		
306	I Unbalance Percent	UINT8 RO Units: %	Motor Current Unbalance Percent		
307	Motor Residual GF RMS Scaled	UINT16 RO Units: scaled A	Motor Residual Ground Fault current RMS Scaled		
308	Thermal Memory Percent	UINT8 RO Default: 0 Units: %	Thermal Memory in Percent. An overload trip occurs when the Thermal Memory reaches 100%.		
309	Time to Trip Overload	UINT16 RO Units: seconds	Time for Overload to Reach Trip Threshold (100%)		
310	Remaining Thermal Capacity	UINT8 RO Units: %	Thermal Capacity (Percent) Remaining to Trip		
311	Time to Reset Overload	UINT16 RO Units: seconds	Time for overload to reach reset threshold. The Thermal Memory must drop below 75% before a reset is allowed.		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
312	Active Fault	UINT16 RO Default: 0 Enum	Active Fault	
			Value	**Description**
			0	No Faults
			1	Under voltage
			2	Over voltage
			3	External GF
			4	Residual GF
			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 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
312	Active Fault	UINT16 RO Default: 0 Enum	Active Fault, continued	
			Value	**Description**
			36	Ethernet Option Card firmware is incompatible
			37	Profi Option Card firmware is incompatible
			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—CUI NV memory error
			510	Internal—Option card NV memory error
313	Active Warning	UINT16 RO Enum	Active Warning	
			Value	**Description**
			0	No Warnings
			1	Under voltage
			2	Over voltage
			3	External GF
			4	Residual GF
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
313	Active Warning	UINT16 RO Enum	Active Warning, continued	
			Value	**Description**
			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	CUI high ambient temperature
			30	Option card high ambient temperature
314	Active Inhibit	UINT16 RO Enum	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
315	Config Inhibit Reason	UINT8 RO Enum	Config Inhibit Reason	
			Value	**Description**
			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 operational mode is incompatible with 3-wire CFG fieldwire as local control
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
315	Config Inhibit Reason	UINT8 RO Enum	Config Inhibit Reason, continued		
			Value	**Description**	
			8	UI Custom Overlay—Multiple button LEDs assigned to the same function	
			9	UI Custom Overlay—Multiple status LEDs assigned to the same function	
			10	Selected operational mode is incompatible with the connected UI	
			11	The General Purpose I/O operational mode does not use fieldwire as a control source	
316	Tripped Status Bits	BYTE RO Array size: 4 Bitfield	Trip Status Bits Indicate the Trip Reason		
			Bit	**Description**	**Coil**
			0	Under voltage	5041
			1	Over voltage	5042
			2	External ground fault	5043
			3	Residual ground 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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
318	Warning Status Bits	BYTE RO Array size: 4 Bitfield	Warning Status Bits Indicate the Reason for a Warning		
			Bit	**Description**	**Coil**
			0	Under voltage	5073
			1	Over voltage	5074
			2	External ground fault	5075
			3	Residual ground fault	5076
			4	Current phase loss	5077
			5	Current unbalance	5078
			6	Instantaneous over current	5079
			7	Jam	5080
			8	Power factor deviation	5081
			9	Voltage phase loss	5082
			10	Voltage unbalance	5083
			11	Frequency deviation fast	5084
			12	Frequency deviation slow	5085
			13	Under current	5086
			14	High power	5087
			15	Low power	5088
			16	Reserved	5089
			17	Starts limit exceeded	5090
			18	Overload	5091
			19	Stall	5092
			20	Phase rotation mismatch	5093
			21	PTC	5094
			22	Under voltage restart	5095
			23	Peak demand	5096
320	Base Control Module Control Voltage	UINT16 RO Units: mV	Base Control Module Control voltage measured		
321	Voltage AB (L1-L2)	UINT16 RO Units: V	Supply Line-to-Line Voltage AB (L1-L2)		
322	Voltage BC (L2-L3)	UINT16 RO Units: V	Supply Line-to-Line Voltage BC (L2-L3)		
323	Voltage CA (L3-L1)	UINT16 RO Units: V	Supply Line-to-Line Voltage CA (L3-L1)		
324	Average Line-to-Line Voltage	UINT16 RO Units: V	Supply Line-to-Line Voltage Average		
325	Voltage Unbalance Percent	UINT8 RO Units: %	Supply Voltage Unbalance Percentage		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
326	Voltage Phase Order	UINT8 RO Enum	Supply Phase Order. 0: unknown; 1: ABC (L1-L2-L3); 2: ACB (L1-L3-L2) **Value** / **Description** 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)
327	Total Watts	SINT32 RO Units: W	Total Real Power
329	Total VA	SINT32 RO Units: VA	Total Apparent Power
331	Total VARS	SINT32 RO Units: VAR	Total Reactive Power
333	Power Factor Scaled	SINT16 RO Units: 0.01%	Apparent Power Factor in Percent (Scaled). A parameter value of 8512 is equal to 85.12% or 8512.
334	Real Energy Scaled	SINT32 RO Default: 0 Units: 0.1 kWh Backup Mem	Real Energy Scaled
336	Reactive Energy Scaled	SINT32 RO Default: 0 Units: 0.1kVARh Backup Mem	Reactive Energy Scaled
338	Apparent Energy Scaled	SINT32 RO Default: 0 Units: 0.1kVAh Backup Mem	Apparent Energy Scaled
340	Real Energy (Resettable) Scaled	SINT32 RW NV Default: 0 Units: 0.1 kWh Admin Lock USB Lock Backup Mem	Real Energy, User Resettable Scaled
342	Reactive Energy (Resettable) Scaled	SINT32 RW NV Default: 0 Units: 0.1kVARh Admin Lock USB Lock Backup Mem	Reactive Energy, User Resettable Scaled

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
344	Apparent Energy (Resettable) Scaled	SINT32 RW NV	Apparent Energy, User Resettable Scaled
		Default: 0	
		Units: 0.1kVAh	
		Admin Lock	
		USB Lock	
		Backup Mem	
346	Total Motor Run Time	UINT32 RO	Total motor run time in seconds
		Units: seconds	
		Backup Mem	
348	Number of Starts	UINT32 RO	Total Number of Motor Starts
		Manufacturing Lock	
		Backup Mem	
350	Number of Operating Seconds	UINT32 RO	Number of Operating Seconds
		Units: seconds	
		Backup Mem	
352	Total Motor Run Time (Resettable)	UINT32 RW NV	Total run time user (Resettable)
		Default: 0	
		Units: seconds	
		Admin Lock	
		USB Lock	
		Backup Mem	
354	Number of Starts (Resettable)	UINT32 RW NV	Number of Starts (Resettable)
		Default: 0	
		Admin Lock	
		USB Lock	
		Backup Mem	
356	Operating Seconds (Resettable)	UINT32 RW NV	Number of Operating Seconds (Resettable)
		Default: 0	
		Units: seconds	
		Backup Mem	
358	Number of Contactor Operations Last Hour	UINT16 RO	Number of Contactor Operations During the Last Hour
		Backup Mem	
359	Latest Run Time	UINT32 RO	Duration in Seconds of the Last Start-to-Stop Motor Run Time
		Default: 0	
		Units: seconds	
361	Last Measured Starting Time	UINT16 RO	The amount of time the motor took to reach up to speed on the last start.
		Default: 0	
		Units: seconds	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
362	I Average % of FLA (Nominal Current)	UINT16 RO Units: %	Average Motor Current as Percentage of FLA (Nominal Current)
363	Current Demand Value	UINT32 RO Units: W	Latest estimate of the Demand
365	Demand (Resettable)	UINT32 RW NV Default: 0 Range: 0 to 0 Units: W Admin Lock USB Lock Backup Mem	Peak Demand, User Resettable
367	Peak Demand Time Stamp	UINT32 RO Default: 0 Units: seconds Admin Lock USB Lock Backup Mem	Peak Demand Time Stamp (in Unix time)
369	Maximum Start Current Floating Point	FLOAT RW NV Default: 0 Units: A Admin Lock USB Lock	Maximum Motor Starting Current Floating Point Format. This value can be set (typically to 0).
371	Maximum Start Current Scaled	UINT16 RW NV Default: 0 Units: scaled A Admin Lock USB Lock	Max Motor Starting Current Scaled. Scaled by parameter “I Scale Factor.” This value can be set (typically to 0).
372	Motor State (Current Based)	UINT8 RO Enum	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. **Value** — **Description** 0 — Motor current indicates a stop 1 — Motor current indicates motor is accelerating 2 — Motor current indicates a running or at speed condition
373	Motor Speed RPM	UINT16 RO Units: 0.1 RPM	Motor Speed in RPM
374	Motor Torque	SINT16 RO Units: 0.01 Nm	Motor torque
375	Motor Efficiency Percent Scaled	UINT16 RO Units: 0.01%	Motor Efficiency in Percentage scaled by 0.01%

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
376	PTC Status	UINT8 RO Enum	PTC Status Bits **Value** / **Description** 0 — PTC ok—No fault 1 — PTC over temperature fault 2 — PTC shorted fault 3 — PTC open fault
377	IA (L1) Float	FLOAT RO Units: A	Phase A (L1) Motor Current in Floating Point Format
379	IB (L2) Float	FLOAT RO Units: A	Phase B (L2) Motor Current in Floating Point Format
381	IC (L3) Float	FLOAT RO Units: A	Phase C (L3) Motor Current in Floating Point Format
383	I Average Float	FLOAT RO Units: A	Average Motor Current in Floating Point Format
385	I Positive Sequence Real	SINT16 RO	Current positive sequence real
386	I Positive Sequence Imaginary	SINT16 RO	Current positive sequence imaginary
387	I Negative Sequence Real	SINT16 RO	Current negative sequence real
388	I Negative Sequence Imaginary	SINT16 RO	Current negative sequence imaginary
389	V Positive Sequence Real	SINT16 RO	Voltage Positive Sequence Real
390	V Positive Sequence Imaginary	SINT16 RO	Voltage Positive Sequence Imaginary
391	V Negative Sequence Real	SINT16 RO	Voltage Negative Sequence Real
392	V Negative Sequence Imaginary	SINT16 RO	Voltage Negative Sequence Imaginary
393	Line Frequency x100	UINT16 RO Units: 0.01 Hz	Supply Frequency in centi-Hz
394	Digital Input Status	BYTE RO Array size: 2 Bitfield	ON/OFF status of digital inputs. **Bit** / **Description** / **Coil** 0 — Base Control Module Input I1 — 6289 1 — Base Control Module Input I2 — 6290 2 — Base Control Module Input I3 — 6291 3 — Base Control Module Input I4 — 6292 4 — User Interface Input I1 — 6293 5 — User Interface Input I2 — 6294 6 — User Interface Input I3 — 6295 7 — User Interface Input I4 — 6296

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
395	Base Control Module Relay Status	BYTE RO Default: 0 Bitfield	Base Control Module Relay Status **Bit** / **Description** / **Coil** 0 / Q1 state: (0) Open not energized / (1) Closed energized / 6305 1 / Q2 state: (0) Open not energized / (1) Closed energized / 6306 2 / Q3 State: (0) Open (latching: relay reset) / (1) Closed (latching: relay set) / 6307
396	Base Control Module Dip Switches	WORD RO Bitfield	Base Control Module Dip Switch Settings **Bit** / **Description** / **Coil** 0 / Switch 1 (close to connector) / 6321 1 / Switch 2 / 6322 2 / Switch 3 / 6323 3 / Switch 4 / 6324 4 / Switch 5 / 6325 5 / Switch 6 / 6326 6 / Switch 7 / 6327 7 / Switch 8 / 6328 8 / Switch 9 / 6329 9 / Switch 10 (USB—close to top) / 6330
397	Base Control Module Control Bd Amb Temp	SINT16 RO Units: ∫C	Base Control Module Option board—ambient temperature measured on the PCB.
398	Base Control Module Max Bd Amb Temp	SINT16 RW NV Default: –40 Units: ∫C	Base Control Module Maximum ambient temperature measured on the PCB. This value can be set (typically to –40).
400	Proof Test Status	UINT8 RO Default: 0 Enum	Proof Test Status **Value** / **Description** 0 / Proof test is idle (not triggered) 1 / Proof test is running 2 / Proof test passed 3 / Proof test failed
500	Active Overload Trip FLA (Nominal Current) Scaled	UINT16 RO Default: 101 (RW) Range: 1 to 65535 (RW) Units: scaled A	Active Overload Trip FLA (Nominal Current) Scaled is a read only parameter indicating the active FLA. 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."
501	Motor Rated Speed RPM active	UINT16 RO Default: 1750 Range: 300 to 3600 Units: RPM	RPM nameplate rating of the active motor winding.
502	Motor Rated HP Active Scaled	UINT32 RO Units: HPx100	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.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
504	Motor Rated Watts Active	UINT32 RO Default: 14914 Range: 10 to 3728500 Units: W	Watts nameplate rating of the active motor winding.		
506	Active Control Source	UINT8 RO Enum	Active Control Source		
			Value	**Description**	
			0	No active control source	
			1	User Interface is the active control source	
			2	FieldBus is the active control source	
			3	FieldWire is the active control source	
600	Fieldbus Motor Control	BYTE RW Bitfield USB Lock	Fieldbus Motor Control Run 1 Command Bit: This bit is Profile dependant. 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 dependant. 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.		
			Bit	**Description**	**Coil**
			0	Run1 command bit	9585
			1	Run2 command bit	9586
			2	Reserved bit	9587
			3	Reset fault bit	9588
			4	Reserved bit	9589
			5	Test trip the device bit	9590
601	Base Control Module Field Output control word	BYTE RW Bitfield	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.		
			Bit	**Description**	**Coil**
			0	Bit 0	9601
			1	Bit 1	9602
			2	Bit 2	9603
			3	Bit 3	9604

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
602	Remote Feedback Signal Parameter	BYTE RW Bitfield	Parameter to write status of Controller input feedback.		
			Bit	**Description**	**Coil**
			0	Network feedback input I1	9617
			1	Network feedback input I2	9618
			2	Network feedback input I3	9619
			3	Network feedback input I4	9620
			4	Network feedback input I5	9621
			5	Network feedback input I6	9622
			6	Network feedback input I7	9623
			7	Network feedback input I8	9624
603	System Services	UINT8 RW Enum	System services are used to execute device level commands. The command is automatically cleared after being processed.		
			Value	**Description**	
			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	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
700	Active Operation Mode	UINT8 RW NV	Active Operation Mode is a read/write parameter used to configure the C445 for the application profile. 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 Reverser is FVR Motor Control Star/Delta or Wye/Delta applications use all three Base Control Module Outputs. Two Speed Poll Changing is for Fast/Slow Motor Control applications. 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. Auto Transformer is for starting a motor at the voltage reduced by the transformer, with a correspondingly smaller current.	
		Default: 1	**Value**	**Description**
		Enum	0	Overload only
		Config CRC	1	Direct online
		Run Lock	2	Reverser
		Admin Lock	3	Star/Delta
		USB Lock	4	Two speed pole changing
		Backup Mem	5	Two speed Dahlander
			6	Auto transformer
			7	Solenoid valve
			8	HMCP/MCCP actuation
			9	Contactor feeder
			10	General purpose input / output
701	Delay before control fault (in 10ms)	UINT16 RW NV	Delay Before a Control Fault is Issued after a Change of Control State (in 10ms). This is meant as a delay in case the Fault clears itself a short time after a change of control state.	
		Default: 200		
		Range: 0 to 2000		
		Units: 10ms		
		Config CRC		
		Run Lock		
		Admin Lock		
		USB Lock		
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
702	Control Interlocking Time	UINT16 RW NV	Time delay between "forward to reverse" or "reverse to forward" direction change (in 0.1sec)
		Default: 10	
		Range: 0 to 60000	
		Units: 10ms	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
703	Control Switching Time	UINT16 RW NV	Time delay between switching from fast to slow which allows the motor time to slow down. (in 0.1 sec)
		Default: 10	
		Range: 0 to 60000	
		Units: 10ms	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
704	Network contactor delay	UINT16 RW NV	Settling time for network contactor before RUN contactor engages (in 10 ms)
		Default: 5	
		Range: 0 to 2000	
		Units: 10ms	
705	Max Star Winding Time	UINT16 RW NV	The time after which the controller will transition to delta wiring when "up to speed" is NOT detected in the star winding
		Default: 100	
		Range: 1 to 6000	
		Units: 100ms	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
706	Enable HMCP Actuation	BOOL RW NV	Enable HMCP Actuation Control
		Default: 0	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
707	HMCP actuation pulse width	UINT16 RW NV	HMCP actuation pulse width to trigger motor operator (in 1.0 ms)	
		Default: 500		
		Range: 100 to 60000		
		Units: ms		
		Config CRC		
		Run Lock		
		Admin Lock		
		USB Lock		
		Backup Mem		
708	Solenoid open delay time	UINT16 RW NV	Delay time for solenoid valve to open (in 10 ms)	
		Default: 0		
		Units: 10ms		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
709	Solenoid close delay time	UINT16 RW NV	Delay time for solenoid valve to close (in 10 ms)	
		Default: 0		
		Units: 10ms		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
710	Non-energized state	UINT8 RW NV	Non energized state of solenoid valve	
		Default: 0	**Value**	**Description**
		Enum	0	Solenoid Valve normally closed—energize to open
		Config CRC	1	Solenoid Valve normally open—energize to close
		Admin Lock		
		USB Lock		
		Backup Mem		
711	Local motor control source	UINT8 RW NV	Selects local motor control source	
		Default: 0	**Value**	**Description**
		Enum	0	Auto detect User Interface
		Config CRC	1	No local control
		Run Lock	2	User Interface local control
		Admin Lock	3	Fieldwire local control
		USB Lock		
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Value	Description
712	Remote Control Source Select	UINT8 RW NV		Remote Control Source Select. Selects the control source when in "Auto".
		Default: 1	**Value**	**Description**
		Enum	0	No remote control source
		Config CRC	1	Fieldbus is remote control source
		Run Lock	2	Fieldwire is remote control source
		Admin Lock		
		USB Lock		
		Backup Mem		
713	Feedback Signal Source Select	UINT8 RW NV		Feedback Signal Source Select. Selects the inputs for the needed feedback signals for certain control profiles. (used in Feeder & Solenoid valve profiles)
		Default: 1	**Value**	**Description**
		Enum	0	No feedback signals
		Config CRC	1	Feedback signals connected to User Interface inputs
		Run Lock	2	Feedback signals connected to Base Control Module field wiring inputs
		Admin Lock	3	Feedback signals provided by network
		USB Lock		
		Backup Mem		
714	Local/Remote power up mode	UINT8 RW NV		Base Control Module local/remote power up mode
		Default: 2	**Value**	**Description**
		Enum	0	Local control is active control on power-up
		Config CRC	1	Remote control is active control on power-up
		Admin Lock	2	Hold last control state on power up
		USB Lock		
		Backup Mem		
715	Output 1 Function Select	UINT16 RW NV		Output Function Select for General Purpose Output 1. Available when this output is not used by the Application Mode. Default = none, If used by the Application Mode = Reserved.
		Default: 0	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Run Lock	2	Fault Reason Type—Supply fault (Voltage based)
		Admin Lock	3	Fault Reason Type—Motor fault (Current based)
		USB Lock	4	Tripped Status Bits—PTC
		Backup Mem	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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
715	Output 1 Function Select	UINT16 RW NV	Output Function Select for General Purpose Output 1, continued	
			Value	**Description**
			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—Residual ground fault
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Value	Description
715	Output 1 Function Select	UINT16 RW NV		Output Function Select for General Purpose Output 1, continued
			Value	**Description**
			47	Warning Status Bits—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			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
			65535	Reserved
716	Output 2 Function Select	UINT16 RW NV		Output Function Select for General Purpose Output 2. Available when this output is not used by the Application Mode. Default = none, If used by the Application Mode = Reserved.
		Default: 0	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Run Lock	2	Fault Reason Type—Supply fault (Voltage based)
		Admin Lock	3	Fault Reason Type—Motor fault (Current based)
		USB Lock	4	Tripped Status Bits—PTC
		Backup Mem	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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
716	Output 2 Function Select	UINT16 RW NV	Output Function Select for General Purpose Output 2, continued	
			Value	**Description**
			21	Tripped Status Bits—Residual ground fault
			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—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			54	Base Control Module Field Output control word—Bit 0
			55	Base Control Module Field Output control word—Bit 1

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
716	Output 2 Function Select	UINT16 RW NV	Output Function Select for General Purpose Output 2, continued	
			Value	**Description**
			56	Base Control Module Field Output control word—Bit 2
			57	Base Control Module Field Output control word—Bit 3
			65535	Reserved
717	Output 3 Function Select	UINT16 RW NV	Output Function Select for General Purpose Output 3. Available when this output is not used by the Application 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).	
		Default: 0	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Run Lock	2	Fault Reason Type—Supply fault (Voltage based)
		Admin Lock	3	Fault Reason Type—Motor fault (Current based)
		USB Lock	4	Tripped Status Bits—PTC
		Backup Mem	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—Residual ground fault
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
717	Output 3 Function Select	UINT16 RW NV	Output Function Select for General Purpose Output 3, continued	
			Value	**Description**
			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—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			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
			65535	Reserved

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
718	Output 3 Function Select reset	UINT16 RW NV	Output Reset Function Select for General Purpose Output 3. Available when this output is not used by the Application 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).	
		Default: 57	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Run Lock	2	Fault Reason Type—Supply fault (Voltage based)
		Admin Lock	3	Fault Reason Type—Motor fault (Current based)
		USB Lock	4	Tripped Status Bits—PTC
		Backup Mem	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—Residual ground fault
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
718	Output 3 Function Select reset	UINT16 RW NV	Output Reset Function Select for General Purpose Output 3, continued	
			Value	**Description**
			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—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			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
			65535	Reserved
719	Base Control Module Relay 3 Behavior	UINT8 RW NV	Base Control Module Relay 3 Behavior	
		Default: 1	**Value**	**Description**
		Enum	0	Behave like a non-latching relay
		Config CRC	1	Behave like a latching relay
		Admin Lock		
		USB Lock		
		Backup Mem		
720	Motor Control Communication Loss Behavior	UINT8 RW NV	Defines the behavior of the motor control when communication times out.	
		Default: 0	**Value**	**Description**
		Enum	0	Stop (clear Run1/Run2) on communication loss event—no fault
		Config CRC	1	Ignore communication loss and keep present state
		Admin Lock	2	Set network motor control Run1 on comloss event
		USB Lock	3	Set network motor control Run2 on comloss event
		Backup Mem	4	Stop (clear Run1/Run2) on communication loss event and generate fault

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
721	Motor Control Network Idle Behavior	UINT8 RW NV	Motor control network idle behavior.		
		Default: 0	**Value**	**Description**	
		Enum	0	Stop on idle event	
		Config CRC	1	Ignore idle and keep present state	
		Admin Lock	2	Send RUN1 command on idle event	
		USB Lock	3	Send RUN2 command on idle event	
		Backup Mem			
722	Field Output Communication Fault Action	BYTE RW NV	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 Motor Control Communication Loss Behavior parameter to set the behavior of outputs used in the control profile.		
		Default: 0	**Bit**	**Description**	**Coil**
		Bitfield	0	Communication loss action for Field Output Control Word. Bit 0: (0)Use fault state (1) Hold Last	11537
		Config CRC	1	Communication loss action for Field Output Control Word. Bit 1: (0) Use fault state (1) Hold Last	11538
		Admin Lock	2	Communication loss action for Field Output Control Word. Bit 2: (0) Use fault state (1) Hold Last	11539
		USB Lock	3	Communication loss action for Field Output Control Word. Bit 3: (0) Use fault state (1) Hold Last	11540
		Backup Mem			
723	Field Output Communication Fault State	BYTE RW NV	Communication Fault Value to be Applied. A bitfield where each bit defines an output point.		
		Default: 0	**Bit**	**Description**	**Coil**
		Bitfield	0	Communication loss action for Field Output Control Word. Bit 0: (0) Off (1) On	11553
		Config CRC	1	Communication loss action for Field Output Control Word. Bit 1: (0) Off (1) On	11554
		Admin Lock	2	Communication loss action for Field Output Control Word. Bit 2: (0) Off (1) On	11555
		USB Lock	3	Communication loss action for Field Output Control Word. Bit 3: (0) Off (1) On	11556
		Backup Mem			
724	Field Output Communication Idle Action	BYTE RW NV	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.		
		Default: 0	**Bit**	**Description**	**Coil**
		Bitfield	0	Communication idle action for Field Output Control Word. Bit 0: (0) Use idle state (1) Hold Last	11569
		Config CRC	1	Communication idle action for Field Output Control Word. Bit 1: (0) Use idle state (1) Hold Last	11570
		Admin Lock	2	Communication idle action for Field Output Control Word. Bit 2: (0) Use idle state (1) Hold Last	11571
		USB Lock	3	Communication idle action for Field Output Control Word. Bit 3: (0) Use idle state (1) Hold Last	11572
		Backup Mem			

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
725	Field Output Communication Idle State	BYTE RW NV	Communication Idle Value to be Applied. A bitfield where each bit defines an output point.		
		Default: 0	**Bit**	**Description**	**Coil**
		Bitfield	0	Communication idle state for Field Output Control Word. Bit 0: (0) Off (1) On	11585
		Config CRC	1	Communication idle state for Field Output Control Word. Bit 1: (0) Off (1) On	11586
		Admin Lock	2	Communication idle state for Field Output Control Word. Bit 2: (0) Off (1) On	11587
		USB Lock	3	Communication idle state for Field Output Control Word. Bit 3: (0) Off (1) On	11588
		Backup Mem			
726	Output 3 Latching Relay Behavior at Power-down	UINT8 RW NV	Latching Relay Behavior Setting at Power Up		
		Default: 0	**Value**	**Description**	
		Enum	0	Turn off (emulate a non-latching relay [reset]) (default)	
		Config CRC	1	Turn on (set)	
		Admin Lock	2	Do nothing (maintain present state)	
		USB Lock	3	Toggle	
		Backup Mem			
727	Measurement Module Wire Config	UINT8 RW NV	Measurement Module Wire configuration		
		Default: 0	**Value**	**Description**	
		Enum	0	Three-phase wire configuration	
		Config CRC	1	Single-phase wire configuration (two wire)	
		Run Lock			
		Admin Lock			
		USB Lock			
		Backup Mem			
728	Base Control Module Field Wiring Configuration Selector	UINT8 RW NV	Base Control Module Field Wiring Configuration Selector; selects 2 or 3 wire control.		
		Default: 0	**Value**	**Description**	
		Enum	0	Two-wire field wiring configuration	
		Config CRC	1	Three-wire field wiring configuration	
		Run Lock			
		Admin Lock			
		USB Lock			
		Backup Mem			

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
729	Digital Input Debounce	UINT16 RW NV	Digital Input Debounce. One 16-bit value for each of the 4 inputs. The same value is used for both rising and falling edges. The default is 20 milliseconds, range is 1~5,000 ms.	
		Array size: 4	Array of 4 registers	
		Default: 20		
		Range: 5 to 5000		
		Units: ms		
		Backup Mem		
737	User Interface Button LED 1 Purpose	UINT16 RW NV	Configuration parameter for the User Interface button LED 1	
		Default: 1	**Value**	**Description**
		Enum	0	No LED function
		Config CRC	1	Stop LED function
		Admin Lock	2	Auto LED function
		USB Lock	3	Run1 LED function
		Backup Mem	4	Run2 LED function
			5	Reset LED function
738	User Interface Button LED 2 Purpose	UINT16 RW NV	Configuration parameter for the User Interface button LED 2	
		Default: 2	**Value**	**Description**
		Enum	0	No LED function
		Config CRC	1	Stop LED function
		Admin Lock	2	Auto LED function
		USB Lock	3	Run1 LED function
		Backup Mem	4	Run2 LED function
			5	Reset LED function
739	User Interface Button LED 3 Purpose	UINT16 RW NV	Configuration parameter for the User Interface button LED 3	
		Default: 3	**Value**	**Description**
		Enum	0	No LED function
		Config CRC	1	Stop LED function
		Admin Lock	2	Auto LED function
		USB Lock	3	Run1 LED function
		Backup Mem	4	Run2 LED function
			5	Reset LED function

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
740	User Interface Button LED 4 Purpose	UINT16 RW NV	Configuration parameter for the User Interface button LED 4	
		Default: 4	**Value**	**Description**
		Enum	0	No LED function
		Config CRC	1	Stop LED function
		Admin Lock	2	Auto LED function
		USB Lock	3	Run1 LED function
		Backup Mem	4	Run2 LED function
			5	Reset LED function
741	User Interface Status LED 1 Purpose	UINT16 RW NV	Configuration parameter for the User Interface status LED 1	
		Default: 6	**Value**	**Description**
		Enum	0	No status LED function
		Config CRC	1	Fault status LED function
		Admin Lock	2	Warning status LED function
		USB Lock	3	Ready status LED function
		Backup Mem	4	Up to speed status LED function
			5	Overload fault status LED function
			6	Ground fault status LED function
742	User Interface Status LED 2 Purpose	UINT16 RW NV	Configuration parameter for the User Interface status LED 2	
		Default: 1	**Value**	**Description**
		Enum	0	No status LED function
		Config CRC	1	Fault status LED function
		Admin Lock	2	Warning status LED function
		USB Lock	3	Ready status LED function
		Backup Mem	4	Up to speed status LED function
			5	Overload fault status LED function
			6	Ground fault status LED function
743	User Interface Status LED 3 Purpose	UINT16 RW NV	Configuration parameter for the User Interface status LED 3	
		Default: 2	**Value**	**Description**
		Enum	0	No status LED function
		Config CRC	1	Fault status LED function
		Admin Lock	2	Warning status LED function
		USB Lock	3	Ready status LED function
		Backup Mem	4	Up to speed status LED function
			5	Overload fault status LED function
			6	Ground fault status LED function

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
744	User Interface User LED 1 Purpose	UINT16 RW NV	User Interface, User Defined LED 1 Function Selection	
		Default: 2	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Admin Lock	2	Fault Reason Type—Supply fault (Voltage based)
		USB Lock	3	Fault Reason Type—Motor fault (Current based)
		Backup Mem	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—Residual ground fault
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
744	User Interface User LED 1 Purpose	UINT16 RW NV	User Interface, User Defined LED 1 Function Selection, continued	
			Value	**Description**
			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—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			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
			65535	Reserved

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
745	User Interface User LED 2 Purpose	UINT16 RW NV	User Interface, User Defined LED 2 Function Selection	
		Default: 3	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Admin Lock	2	Fault Reason Type—Supply fault (Voltage based)
		USB Lock	3	Fault Reason Type—Motor fault (Current based)
		Backup Mem	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—Residual ground fault
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
745	User Interface User LED 2 Purpose	UINT16 RW NV	User Interface, User Defined LED 2 Function Selection, continued	
			Value	**Description**
			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—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			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
			65535	Reserved

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
746	User Interface User LED 3 Purpose	UINT16 RW NV	User Interface, User Defined LED 3 Function Selection	
		Default: 1	**Value**	**Description**
		Enum	0	None
		Config CRC	1	Fault Reason Type—Load fault (Power based)
		Admin Lock	2	Fault Reason Type—Supply fault (Voltage based)
		USB Lock	3	Fault Reason Type—Motor fault (Current based)
		Backup Mem	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—Residual ground fault
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
746	User Interface User LED 3 Purpose	UINT16 RW NV	User Interface, User Defined LED 3 Function Selection, continued	
			Value	**Description**
			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—Residual ground fault
			48	Warning Status Bits—External ground fault
			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—External ground fault
			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
			65535	Reserved
747	User Interface Button 1 CFG	UINT16 RW NV	CFG parameter for the User Interface button 1 function	
		Default: 1	**Value**	**Description**
		Enum	0	No User Interface button present
		Config CRC	1	User Interface button configured as STOP
		Admin Lock	2	User Interface button configured as AUTO
		USB Lock	3	User Interface button configured as RUN1
		Backup Mem	4	User Interface button configured as RUN2
			5	User Interface button configured as RESET

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
748	User Interface Button 2 CFG	UINT16 RW NV	CFG parameter for the User Interface button 2 function	
		Default: 2	**Value**	**Description**
		Enum	0	No User Interface button present
		Config CRC	1	User Interface button configured as STOP
		Admin Lock	2	User Interface button configured as AUTO
		USB Lock	3	User Interface button configured as RUN1
		Backup Mem	4	User Interface button configured as RUN2
			5	User Interface button configured as RESET
749	User Interface Button 3 CFG	UINT16 RW NV	CFG parameter for the User Interface button 3 function	
		Default: 3	**Value**	**Description**
		Enum	0	No User Interface button present
		Config CRC	1	User Interface button configured as STOP
		Admin Lock	2	User Interface button configured as AUTO
		USB Lock	3	User Interface button configured as RUN1
		Backup Mem	4	User Interface button configured as RUN2
			5	User Interface button configured as RESET
750	User Interface Button 4 CFG	UINT16 RW NV	CFG parameter for the User Interface button 4 function	
		Default: 4	**Value**	**Description**
		Enum	0	No User Interface button present
		Config CRC	1	User Interface button configured as STOP
		Admin Lock	2	User Interface button configured as AUTO
		USB Lock	3	User Interface button configured as RUN1
		Backup Mem	4	User Interface button configured as RUN2
			5	User Interface button configured as RESET
751	User Interface Button 5 CFG	UINT16 RW NV	CFG parameter for the User Interface button 5 function	
		Default: 5	**Value**	**Description**
		Enum	0	No User Interface button present
		Config CRC	1	User Interface button configured as STOP
		Admin Lock	2	User Interface button configured as AUTO
		USB Lock	3	User Interface button configured as RUN1
		Backup Mem	4	User Interface button configured as RUN2
			5	User Interface button configured as RESET

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
752	User Interface LED 1 color CFG	UINT16 RW NV	User Interface LED 1 Color CFG parameter	
		Default: 3	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock	3	Sets LED color to white
		Backup Mem		
753	User Interface LED 2 color CFG	UINT16 RW NV	User Interface LED 2 Color CFG parameter	
		Default: 3	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock	3	Sets LED color to white
		Backup Mem		
754	User Interface LED 3 color CFG	UINT16 RW NV	User Interface LED 3 Color CFG parameter	
		Default: 3	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock	3	Sets LED color to white
		Backup Mem		
755	User Interface LED 4 color CFG	UINT16 RW NV	User Interface LED 4 Color CFG parameter	
		Default: 3	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock	3	Sets LED color to white
		Backup Mem		
756	User Interface LED 5 color CFG	UINT16 RW NV	User Interface LED 5 Color CFG parameter	
		Default: 1	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock	3	Sets LED color to white
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
757	User Interface LED 6 color CFG	UINT16 RW NV	User Interface LED 6 Color CFG parameter	
		Default: 1	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock		
		Backup Mem		
758	User Interface LED 7 color CFG	UINT16 RW NV	User Interface LED 7 Color CFG parameter	
		Default: 2	**Value**	**Description**
		Enum	0	Sets LED color to green
		Config CRC	1	Sets LED color to red
		Admin Lock	2	Sets LED color to amber
		USB Lock		
		Backup Mem		
759	User Interface User LED 1 color CFG	UINT16 RW NV	User Interface, User Defined LED 1 Color Selection	
		Default: 1	**Value**	**Description**
		Enum	0	Sets LED color to green
			1	Sets LED color to red
			2	Sets LED color to amber
760	User Interface User LED 2 color CFG	UINT16 RW NV	User Interface, User Defined LED 2 Color Selection	
		Default: 1	**Value**	**Description**
		Enum	0	Sets LED color to green
			1	Sets LED color to red
			2	Sets LED color to amber
761	User Interface User LED 3 color CFG	UINT16 RW NV	User Interface, User Defined LED 3 Color Selection	
		Default: 1	**Value**	**Description**
		Enum	0	Sets LED color to green
			1	Sets LED color to red
			2	Sets LED color to amber
900	Motor1 Overload FLA (Nominal Current) Scaled	UINT16 RW NV	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”	
		Default: 101		
		Range: 1 to 65535 (RW)		
		Units: scaled A		
		Config CRC		
		Run Lock		
		Admin Lock		
		USB Lock		
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
901	Motor2 Overload FLA (Nominal Current) Scaled	UINT16 RW NV	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"
		Default: 101	
		Range: 1 to 65535 (RW)	
		Units: scaled A	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
902	Motor Rated Service Factor	UINT8 RW NV	Motor Rated Service Factor
		Default: 115	
		Range: 100 to 255	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
903	Motor Rated Voltage	UINT16 RW NV	Motor Rated Voltage
		Default: 480	
		Range: 100 to 5000	
		Units: V	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
904	Motor Rated Frequency	UINT16 RW NV	Motor Rated Frequency in Hz
		Default: 60	
		Range: 50 to 60	
		Units: Hz	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
905	Motor Rated Watts Motor1	UINT32 RW NV	Watts nameplate rating for motor winding #1 (Used in all control profiles)
		Default: 14914 (RW)	
		Range: 10 to 3728500	
		Units: W	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
907	Motor Rated Watts Motor2	UINT32 RW NV	Watts nameplate rating for motor winding #2 (Used in star/delta, two speed and dahlander profiles)
		Default: 14914 (RW)	
		Range: 10 to 3728500	
		Units: W	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
909	Motor Rated hp Motor1 Scaled	UINT32 RW NV	hp nameplate rating for motor winding #1 (Used in all control profiles). This value is scaled by 0.01. For example, if the motor is rated at 123.25 hp then this parameter should contain 12325.
		Default: 2000 (RW)	
		Range: 1 to 500000	
		Units: HPx100	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
911	Motor Rated hp Motor2 Scaled	UINT32 RW NV	hp nameplate rating for motor winding #2 (Used in star/delta, two speed and dahlander profiles). This value is scaled by 0.01. For example, if the motor is rated at 123.25 hp then this parameter should contain 12325.
		Default: 2000	
		Range: 1 to 500000	
		Units: HPx100	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
913	Motor Rated PF (Scaled)	SINT16 RW NV	Motor Rated Power Factor in Percent (Scaled). A parameter value of 8512 is equal to 85.12% or.8512.
		Default: 8350	
		Range: 5000 to 10000	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
914	Motor Rated Speed Motor1	UINT16 RW NV	RPM nameplate rating for motor winding #1 (Used in all control profiles)
		Default: 1750 (RW)	
		Range: 300 to 3600 (RW)	
		Units: RPM	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
915	Motor Rated Speed Motor2	UINT16 RW NV	RPM nameplate rating for motor winding #2 (Used in star/delta, two speed and dahlander profiles)
		Default: 1750 (RW)	
		Range: 300 to 3600 (RW)	
		Units: RPM	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
916	Motor Rated Efficiency	UINT16 RW NV	Motor rated efficiency in percent
		Default: 8500	
		Range: 5000 to 10000	
		Units: 0.01%	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
917	Motor Rated Stator Resistance	UINT16 RW NV	Motor Rated Stator Resistance
		Default: 280	
		Units: mOhms	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
918	CT Ratio—Primary	UINT16 RW NV	CT Ratio—Primary
		Default: 1	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
919	CT Ratio—Secondary	UINT16 RW NV	CT Ratio—Secondary
		Default: 1	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
920	PT Ratio Primary	UINT16 RW NV	PT Ratio—Primary (Only available with external PT)
		Default: 1	
		Run Lock	
921	PT Ratio Secondary	UINT16 RW NV	PT Ratio—Secondary (Only available with external PT)
		Default: 1	
		Run Lock	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
1000	Trip Enable Bits	BYTE RW NV	Enabling bits for tripping. This is a bit field for enabling those protections the unit will trip on.		
		Array size: 4	**Bit**	**Description**	**Coil**
		Default: 0x38, 0x00, 0x04, 0x00	0	Under voltage	15985
		Bitfield	1	Over voltage	15986
		Config CRC	2	External ground fault	15987
		Run Lock	3	Residual ground fault	15988
		Admin Lock	4	Current phase loss	15989
		USB Lock	5	Current unbalance	15990
		Backup Mem	6	Instantaneous over current	15991
			7	Jam	15992
			8	Power factor deviation	15993
			9	Voltage phase loss	15994
			10	Voltage unbalance	15995
			11	Frequency deviation fast	15996
			12	Frequency deviation slow	15997
			13	Under current	15998
			14	High power	15999
			15	Low power	16000
			16	Reserved	16001
			17	Starts limit exceeded	16002
			18	Overload	16003
			19	Stall	16004
			20	Phase rotation mismatch	16005
			21	PTC	16006
			22	Under voltage restart	16007
			23	Peak demand	16008

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
1002	Warning Enable Bits	BYTE RW NV	Only those protections that are enabled by checking the associated box will provide a warning when that condition occurs.		
		Array size: 4	**Bit**	**Description**	**Coil**
		Default: 0	0	Under voltage	16017
		Bitfield	1	Over voltage	16018
		Config CRC	2	External ground fault	16019
		Admin Lock	3	Residual ground fault	16020
		USB Lock	4	Current phase loss	16021
		Backup Mem	5	Current unbalance	16022
			6	Instantaneous over current	16023
			7	Jam	16024
			8	Power factor deviation	16025
			9	Voltage phase loss	16026
			10	Voltage unbalance	16027
			11	Frequency deviation fast	16028
			12	Frequency deviation slow	16029
			13	Under current	16030
			14	High power	16031
			15	Low power	16032
			16	Reserved	16033
			17	Starts limit exceeded	16034
			18	Overload	16035
			19	Stall	16036
			20	Phase rotation mismatch	16037
			21	PTC	16038
			22	Under voltage restart	16039
			23	Peak demand	16040
1004	Overload Trip Class	UINT8 RW NV	Overload Trip Class		
		Default: 5			
		Range: 5 to 40			
		Config CRC			
		Run Lock			
		Admin Lock			
		USB Lock			
		Backup Mem			

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1005	Overload Alarm Level	UINT8 RW NV	Overload alarm level, generates a warning when the thermal capacity reaches this percent.
		Default: 90	
		Range: 1 to 100	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1006	Overload Reset Threshold	UINT8 RW NV	Thermal Overload Reset Threshold. Level where reset is possible.
		Default: 75	
		Range: 1 to 99	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
1007	Stall Trip Level	UINT16 RW NV	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.
		Default: 200	
		Range: 50 to 400	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1008	Jam Trip Level	UINT16 RW NV	Jam Trip Level, when exceeded and following the Jam Debounce time will generate a trip.
		Default: 400	
		Range: 50 to 400	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
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 Debounce Time in the Protections/General category, will generate a warning.
1010	Jam Debounce	UINT16 RW NV Default: 10 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Jam Debounce is the time delay following the trip level being exceeded until a trip occurs.
1011	Allowed Starts Per Hour	UINT16 RW NV Default: 4 Range: 1 to 60 Config CRC Admin Lock USB Lock Backup Mem	The starts 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 Debounce 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 Debounce Time in the Protections/General category, will generate a warning.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1014	Instantaneous Overcurrent Start Delay	UINT16 RW NV	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.
		Default: 0	
		Range: 0 to 180	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1015	Instantaneous Overcurrent Debounce	UINT16 RW NV	Instantaneous Overcurrent Debounce is the time delay following the trip level being exceeded until a trip occurs.
		Default: 2000	
		Range: 1 to 2000	
		Units: ms	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1018	I Unbalance Trip Level Percent	UINT8 RW NV	Current Unbalance Trip Level Percent, when exceeded and following the I Unbalance Debounce time will generate a trip.
		Default: 15	
		Range: 1 to 60	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1019	I Unbalance Alarm Level Percent	UINT8 RW NV	Current Unbalance Alarm Level Percent, when exceeded and after the Alarm Debounce Time in the Protections/General category expires will cause a warning to occur.
		Default: 15	
		Range: 1 to 60	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1020	I Unbalance Debounce	UINT16 RW NV Default: 15 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Current Unbalance Debounce is the time delay following the trip level being exceeded until 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 Debounce 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 Debounce Time in the Protections/General category, will generate a warning.
1023	Undercurrent Debounce	UINT16 RW NV Default: 20 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Undercurrent Debounce is the time delay following the trip level being exceeded until a trip occurs.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
1024	Phase Rotation Protection	UINT8 RW NV	Bits 0–2 determine the phase rotation protection. 0=No Fault 1=ABC Rotation 2=ACB Rotation	
		Default: 0	**Value**	**Description**
		Enum	0	Ignore phase order
		Config CRC	1	ABC (L1-L2-L3) phase order
		Run Lock	2	ACB (L1-L3-L2) phase order
		Admin Lock		
		USB Lock		
		Backup Mem		
1025	Overvoltage Trip Level	UINT16 RW NV	Overvoltage Trip Level, when exceeded and following the Overvoltage Debounce time will generate a trip.	
		Default: 110		
		Range: 90 to 150		
		Units: %		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
1026	Overvoltage Alarm Level	UINT16 RW NV	Overvoltage Alarm Level, when exceeded and following the Alarm Debounce Time in the Protections/General category, will generate a warning.	
		Default: 110		
		Range: 90 to 150		
		Units: %		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
1027	Overvoltage Debounce	UINT16 RW NV	Overvoltage Debounce is the time delay following the trip level being exceeded until a trip occurs.	
		Default: 20		
		Range: 1 to 60		
		Units: seconds		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1028	Undervoltage Trip Level	UINT8 RW NV	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 Deboune time.
		Default: 90	
		Range: 10 to 100	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1029	Undervoltage Alarm Level	UINT8 RW NV	Undervoltage Alarm Level when exceeded and following the Alarm Debounce Time in the Protections/General category, will generate a warning.
		Default: 90	
		Range: 10 to 100	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1030	Undervoltage Start Delay	UINT16 RW NV	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 if this condition were still present following the Undervoltage Debounce time.
		Default: 20	
		Range: 0 to 60	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1031	Undervoltage Debounce	UINT16 RW NV	Undervoltage Debounce is the time delay following the trip level being exceeded until a trip occurs.
		Default: 20	
		Range: 1 to 60	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1032	Under Voltage Restart Fault Level	UINT8 RW NV	Under Voltage Restart Fault Level is the level set where the C445 will be allowed to restart following an Under Voltage fault, provide Under Voltage fault is enabled.
		Default: 70	
		Range: 65 to 90	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
1033	Under Voltage Restart Restoration Level	UINT8 RW NV	Under Voltage Restart Restoration Level
		Default: 90	
		Range: 80 to 100	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
1034	Voltage Loss Auto Time	UINT16 RW NV	Voltage Loss Restart Maximum Time for Automatic Restart
		Default: 200	
		Range: 100 to 400	
		Units: ms	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
1035	Voltage Loss Short Delay	UINT32 RW NV	Voltage Loss Restart Delay Time—Short
		Default: 1000	
		Range: 100 to 500000	
		Units: ms	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1037	Voltage Loss 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 Maximum Time for Short Delayed Restart
1039	Voltage Loss Long Delay	UINT16 RW NV Default: 10 Range: 1 to 3600 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Voltage Loss Restart Delay Time—Long
1040	Voltage Loss 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 Maximum Time for Long Delayed Restart
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 Debounce time.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1044	Voltage Unbalance Alarm Level	UINT8 RW NV	Voltage Unbalance Alarm Level when exceeded and following the Alarm Debounce Time in the Protections/General category, will generate a warning.
		Default: 6	
		Range: 1 to 20	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1045	Voltage Unbalance Debounce	UINT16 RW NV	Voltage Unbalance Debounce is the time delay following the trip level being exceeded until a trip occurs.
		Default: 20	
		Range: 1 to 60	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1046	High kW Trip Level	SINT16 RW NV	High kW Trip Level protection will trip the motor if the calculated High kW Trip Level exceeds this threshold, following the Voltage Unbalance Debounce time.
		Default: 110	
		Range: -200 to 200	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1047	High kW Alarm Level	SINT16 RW NV	High kW Alarm Level when exceeded and following the Alarm Debounce Time in the Protections/ General category, will generate a warning.
		Default: 110	
		Range: -200 to 200	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1048	High kW Debounce	UINT16 RW NV	High kW Debounce is the time delay following the trip level being exceeded until a trip occurs.
		Default: 20	
		Range: 1 to 60	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1049	Low kW Trip Level	SINT16 RW NV	Low kW Trip Level protection will trip the motor if the calculated Low kW Trip Level exceeds this threshold, following the Voltage Unbalance Debounce time.
		Default: 50	
		Range: -200 to 200	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1050	Low kW Alarm Level	SINT16 RW NV	Low kW Alarm Level when exceeded and following the Alarm Debounce Time in the Protections/ General category, will generate a warning.
		Default: 50	
		Range: -200 to 200	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1051	Low kW Debounce	UINT16 RW NV	Low kW Debounce is the time delay following the trip level being exceeded until a trip occurs.
		Default: 20	
		Range: 1 to 60	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1052	Peak Demand Warning Threshold	UINT32 RW NV	Generate an alarm if the peak demand exceeds this threshold.
		Default: 0	
		Units: W	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1054	Demand Window Duration	UINT16 RW NV	Demand Window Duration
		Default: 15	
		Range: 1 to 240	
		Units: minutes	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1055	Power Factor Deviation Trip Level High	SINT16 RW NV	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.
		Default: 10000	
		Range: –10000 to 10000	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1056	Power Factor Deviation Trip Level Low	SINT16 RW NV	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.
		Default: 0	
		Range: –10000 to 10000	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1057	Power Factor Deviation Alarm Level High	SINT16 RW NV	Power Factor Deviation Alarm Level High—If the Power Factor rises above this level, following the Alarm Debounce Time in the Protections/General category, a warning is generated.
		Default: 10000	
		Range: –10000 to 10000	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1058	Power Factor Deviation Alarm Level Low	SINT16 RW NV	Power Factor Deviation Alarm Level Low—If the Power Factor drops below this level, and following the Alarm Debounce Time in the Protections/General category, a warning is generated.
		Default: 0	
		Range: -10000 to 10000	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1059	Power Factor Deviation Debounce	UINT16 RW NV	PF Deviation Debounce time is the time delay from when a Power Factor trip condition exists to when the motor is tripped.
		Default: 20	
		Range: 1 to 60	
		Units: seconds	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1060	Residual GF Threshold Scaled	UINT16 RW NV	Residual Ground Fault Threshold Scaled is the value that will generate a trip of the motor following the Residual Ground Fault Debounce time. Scaled by parameter "I Scale Factor."
		Default: 101	
		Range: 1 to 65535 (RW)	
		Units: scaled A	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1061	Residual GF Alarm Threshold Scaled	UINT16 RW NV	Residual Ground Fault Alarm Threshold Scaled is a value if exceeded that will generate a warning following the Alarm Debounce Time in the Protections/General category. Scaled by parameter "I Scale Factor."
		Default: 101	
		Range: 1 to 65535 (RW)	
		Units: scaled A	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1062	Residual GF Start Delay	UINT16 RW NV Default: 0 Range: 0 to 5000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	Residual Ground Fault 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	Residual GF Debounce	UINT16 RW NV Default: 5 Range: 1 to 60 Units: seconds Config CRC Admin Lock USB Lock Backup Mem	Residual Ground Fault Debounce is the time delay before a trip occurs
1064	Residual GF Use Inhibit Current	BOOL RW NV Default: FALSE Config CRC Admin Lock USB Lock Backup Mem	Residual Ground Fault Use Inhibit Current, if selected the Residual GF Inhibit Current will be used.
1065	Residual GF Inhibit Current Percent	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.
1066	Frequency Deviation Fast Trip Level Scaled	UINT16 RW NV Default: 10 Range: 2 to 200 Units: 0.01 Hz 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. This parameter is scaled by 0.01%.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1067	Frequency Deviation Fast Alarm Level Scaled	UINT16 RW NV Default: 10 Range: 2 to 200 Units: 0.01 Hz 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 Debounce 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 by 0.01%.
1068	Frequency Deviation Fast Debounce	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 Debounce time, the decision to trip the motor is made. This debounce time delay only applies to the trip level.
1069	Frequency Deviation Slow Trip Level Scaled	UINT16 RW NV Default: 10 Range: 10 to 500 Units: 0.01 Hz 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 Debounce time, it will trip the motor. The frequency deviation protection is active when the motor is in the energized state. This parameter is scaled by 0.01%.
1070	Frequency Deviation Slow Alarm Level Scaled	UINT16 RW NV Default: 10 Range: 10 to 500 Units: 0.01 Hz 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 Debounce 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 by 0.01%.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
1071	Frequency Deviation Slow Debounce	UINT16 RW NV	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 Debounce time, the decision to trip the motor is made. This debounce time delay only applies to the trip level.		
		Default: 20			
		Range: 1 to 60			
		Units: seconds			
		Config CRC			
		Admin Lock			
		USB Lock			
		Backup Mem			
1072	Global Auto Reset Enable	BOOL RW NV	If disabled, no auto reset; if enabled, auto reset is based on trip auto-reset bit selections		
		Default: FALSE			
		Config CRC			
		Run Lock			
		Admin Lock			
		USB Lock			
		Backup Mem			
1073	Trip Auto Reset Enable Bits	BYTE RW NV	Trip Auto Reset Enable Bits select the protections that are to auto-reset.		
		Array size: 4	**Bit**	**Description**	**Coil**
		Default: 0	0	Under voltage	17153
		Bitfield	1	Over voltage	17154
		Config CRC	2	External ground fault	17155
		Run Lock	3	Residual ground fault	17156
		Admin Lock	4	Current phase loss	17157
		USB Lock	5	Current unbalance	17158
		Backup Mem	6	Instantaneous over current	17159
			7	Jam	17160
			8	Power factor deviation	17161
			9	Voltage phase loss	17162
			10	Voltage unbalance	17163
			11	Frequency deviation fast	17164
			12	Frequency deviation slow	17165
			13	Under current	17166
			14	High power	17167
			15	Low power	17168
			16	Reserved	17169
			17	Starts limit exceeded	17170

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1073	Trip Auto Reset Enable Bits	BYTE RW NV	Trip Auto Reset Enable Bits select the protections that are to auto-reset, continued **Bit** / **Description** / **Coil** 18 / Overload / 17171 19 / Stall / 17172 20 / Phase rotation mismatch / 17173 21 / PTC / 17174 22 / Under voltage restart / 17175 23 / Peak demand / 17176
1075	Auto Reset Delay	UINT16 RW NV Default: 180 Range: 0 to 3600 Units: seconds Config CRC Run Lock Admin Lock USB Lock Backup Mem	The time delay following a fault before attempting to auto-reset that fault condition
1076	Fault Reset on Power Up	BOOL RW NV Default: FALSE Config CRC Admin Lock USB Lock Backup Mem	If enabled, perform a fault reset on power up
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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1078	Motor State Transition to run delay from Start	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. The default is 10 seconds.
1079	Alarm Debounce Time	UINT16 RW NV Default: 2000 Range: 200 to 5000 Units: ms Config CRC Admin Lock USB Lock Backup Mem	Alarm Debounce Time—applies to all protection functions
1080	If Protection Start Inhibit Enable	BOOL RW NV Default: 1 Config CRC Run Lock Admin Lock USB Lock Backup Mem	If this parameter is enabled and a 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	Undervoltage Start Inhibit Threshold	UINT8 RW NV Default: 90 Range: 10 to 100 Config CRC Admin Lock USB Lock Backup Mem	If Protection Start Inhibit Enable is enabled, this Under Voltage threshold value is used to inhibit the motor from being started.
1082	Voltage Unbalance Start Inhibit Threshold	UINT8 RW NV Default: 6 Range: 1 to 20 Units: % Config CRC Admin Lock USB Lock Backup Mem	If Protection Start Inhibit Enable is enabled, this Voltage Unbalance threshold value is used to inhibit the motor from being started.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1083	Overvoltage Start Inhibit Threshold	UINT8 RW NV	If Protection Start Inhibit Enable is enabled, this Over Voltage threshold value is used to inhibit the motor from being started.
		Default: 110	
		Range: 90 to 150	
		Units: %	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
1084	Motor Start Threshold	UINT8 RW NV	Motor Start Threshold Percent
		Default: 30	
		Range: 1 to 100	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
1085	Motor Stop Threshold	UINT8 RW NV	Motor Stop Threshold Percent
		Default: 5	
		Range: 1 to 50	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	
1086	Motor Transition Threshold Percent	UINT8 RW NV	Motor Transition to Run Threshold Percent
		Default: 115	
		Range: 25 to 200	
		Units: %	
		Config CRC	
		Run Lock	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
1200	Fault Queue—Event Order	UINT16 RO	A List of the Last 10 Faults Shown in the Order They Occurred. Duplicates are allowed and the most recent is at the top.	
		Array size: 10	**Value**	**Description**
		Enum	0	No Faults
			1	Under voltage
			2	Over voltage
			3	External GF
			4	Residual GF
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
1200	Fault Queue—Event Order	UINT16 RO	A List of the Last 10 Faults, continued	
			Value	**Description**
			35	User Interface firmware is incompatible
			36	Ethernet Option Card firmware is incompatible
			37	Profi Option Card firmware is incompatible
			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)
1300	Fault Snap Shot Log Year	UINT16 RO Default: 0 Backup Mem	Fault Snap Shot Log Year	
1301	Fault Snap Shot Log Month	UINT8 RO Default: 0 Backup Mem	Fault Snap Shot Log Month	
1302	Fault Snap Shot Log Day	UINT8 RO Default: 0 Backup Mem	Fault Snap Shot Log Day	
1303	Fault Snap Shot Log Hour	UINT8 RO Default: 0 Backup Mem	Fault Snap Shot Log Hour	
1304	Fault Snap Shot Log Minute	UINT8 RO Default: 0 Backup Mem	Fault Snap Shot Log Minute	
1305	Fault Snap Shot Log Second	UINT8 RO Default: 0 Backup Mem	Fault Snap Shot Log Second	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
1306	Fault Snap Shot Trip Reason	UINT16 RO	The fault that caused the trip	
		Default: 0	**Value**	**Description**
		Enum	0	No Faults
		Backup Mem	1	Under voltage
			2	Over voltage
			3	External GF
			4	Residual GF
			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

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
1306	Fault Snap Shot Trip Reason	UINT16 RO	The fault that caused the trip, continued	
			Value	**Description**
			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
			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)
1307	Snap Shot Thermal Memory	UINT8 RO Default: 0 Backup Mem	Overload Thermal Memory Percent at time of trip	
1308	Snap Shot Phase A (L1) Current 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 Phase B (L2) Current 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 Phase C (L3) Current 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 AB (L1-L2)	UINT16 RO Default: 0 Units: V Backup Mem	Voltage AB (L1-L2) RMS volts at time of trip	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
1312	Snap Shot Voltage BC (L2-L3)	UINT16 RO	Voltage BC (L2-L3) RMS volts at time of trip
		Default: 0	
		Units: V	
		Backup Mem	
1313	Snap Shot Voltage CA (L3-L1)	UINT16 RO	Voltage CA (L3-L1) RMS volts at time of trip
		Default: 0	
		Units: V	
		Backup Mem	
1314	Snap Shot Frequency Scaled	UINT16 RO	Line Frequency at time of trip scaled by 0.01 Hz
		Default: 0	
		Units: 0.01 Hz	
		Backup Mem	
1315	Snap Shot Watts	SINT32 RO	Real Power at time of trip
		Default: 0	
		Units: W	
		Backup Mem	
1317	Snap Shot VA	SINT32 RO	Apparent Power at time of trip
		Default: 0	
		Units: VA	
		Backup Mem	
1319	Snap Shot Power Factor Scaled	SINT16 RO	Power Factor at time of trip scaled by 0.01%
		Default: 0	
		Units: 0.01%	
		Backup Mem	
1320	Snap Shot Ground Current	UINT16 RO	Ground Fault Current RMS at time of trip (See motor current scale factor for scaling)
		Default: 0	
		Units: scaled A	
		Backup Mem	
3000	Modbus Scan Data	UINT16 RW	Data used for Modbus Scan List
		Array size: 32	Array of 32 registers
3032	Modbus Scan List	UINT16 RW NV	The Modbus scan registers can be used to create custom Modbus interface ranges. 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 is the "Modbus Scan Data" registers.
		Array size: 32	Array of 32 registers
		Default: 0	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
4000	RTC Time	UINT8 RO	Real Time Clock Time in hh:mm:ss format (24 hour format)	
		Array size: 3	Array of 2 registers	
4002	RTC Year	UINT16 RW	Real Time Clock—year	
		Range: 2000 to 2099		
4003	RTC Month	UINT8 RW	Real Time Clock Month	
		Enum	**Value**	**Description**
			1	January
			2	February
			3	March
			4	April
			5	May
			6	June
			7	July
			8	August
			9	September
			10	October
			11	November
			12	December
4004	RTC Day of Month	UINT8 RW	Real Time Clock Day of Month	
4005	RTC Time hours	UINT8 RW	Real Time Clock Time hours	
4006	RTC Time minutes	UINT8 RW	Real Time Clock Time minutes	
4007	RTC Time seconds	UINT8 RW	Real Time Clock Time seconds	
4008	RTC Time (milliseconds)	UINT16 RO	Real Time Clock Time milliseconds	
4009	RTC Power Interrupted	UINT8 RO	Real Time Clock backup power has been interrupted	
		Default: 0	**Value**	**Description**
		Enum	0	Power not interrupted
		Backup Mem	1	Power interrupted
4010	RTC Time In UNIX format	UINT32 RO	Real Time Clock time in seconds from UNIX epoch	
		Units: seconds		
4012	RTC Status	UINT8 RO	Real Time Clock Status Enum	
		Enum	**Value**	**Description**
			0	Running
			1	Initializing
			2	Real time clock not present
			3	Internal error

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
4013	RTC Time Set Status	UINT8 RO	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	
		Enum	**Value**	**Description**
			0	Initial value
			1	Successful
			2	Set in progress
			3	Wrong data
			4	Conversion out of range
			5	Internal error
4014	RTC Time Zone DST Setting Status	UINT8 RO	Real Time Clock Time Zone DST Setting Status	
		Enum	**Value**	**Description**
		Config CRC	0	Okay
		Admin Lock	1	Manual rule error
		USB Lock	2	Time zone error
			3	Conversion out of range
			4	Internal error
4015	RTC DST Rule	UINT8 RW NV	Real Time Clock DST Rule Selection	
		Default: 0	**Value**	**Description**
		Enum	0	No daylight savings time
		Config CRC	1	Manually set DST start and end
		Admin Lock	2	Europe
		USB Lock	3	United States of America
		Backup Mem	4	Australia
			5	Brazil
			6	New Zealand
			7	United States before 2007
4016	RTC Manual DST Rule End	UINT8 RW NV	Real Time Clock Manual Daylight Savings Time Rule End date/time (month, week, weekday, hour, minute)	
		Array size: 5	Array of 3 registers	
		Default: 11, 1, 7, 2, 0		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
4019	RTC Manual DST Rule Start	UINT8 RW NV	Real Time Clock Manual Daylight Savings Time Rule Start date/time (month, week, weekday, hour, minute)	
		Array size: 5	Array of 3 registers	
		Default: 3, 2, 7, 2, 0		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
4022	RTC Month and Date	UINT8 RO	Real Time Clock Month and Date	
		Array size: 2	Array of 1 registers	
4023	RTC Time Zone Ahead of UTC	UINT8 RW NV	Real Time Clock calculation for Time Zone ahead of UTC. If true, UTC+hh:mm; otherwise UTC-hh:mm	
		Default: 0	**Value**	**Description**
		Enum	0	UTC –hh: mm
		Config CRC	1	UTC + hh: mm
		Admin Lock		
		USB Lock		
		Backup Mem		
4024	RTC Time Zone hh mm	UINT8 RW NV	Time zone assignment (UTC+/–hh:mm). Where 0xhhmm. Element [0] = Minutes Element [1] = Hours	
		Array size: 2	Array of 1 registers	
		Default: 0		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
5000	Set Admin Password	UINT32 RW	Set administrator password (0x00000000 means no password)	
		Default: 0x00000000		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
5002	Administrator Login	UINT32 RW	Log in with administrator password	
5004	Set USB Port Password	UINT32 RW	Set USB port password (0x00000000 means no password)	
		Default: 0x00000000		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
5006	USB Login	UINT32 RW	Log in with USB Port administrator password	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
5008	Motor Run Parameter Lock Override	BOOL RW NV	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, set this parameter to 1. To restrict access during run time, set this parameter to 0.	
		Default: 0		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
6000	Base Control Module Modbus Port Address	UINT8 RW NV	Modbus Address for the Base Control Module's port. The address is loaded at startup. A power cycle is required for change in address to take effect.	
		Default: 1		
		Range: 1 to 247		
		Config CRC		
		Admin Lock		
		USB Lock		
		Backup Mem		
6001	Base Control Module Modbus port Baud Rate	UINT8 RW NV	Selects the Modbus Baud Rate for the Base Control Module's Modbus port. A power cycle is required for change in baud rate to take effect.	
		Default: 0	**Value**	**Description**
		Enum	0	19200
		Config CRC	1	9600
		Admin Lock	2	38400
		USB Lock	3	57600
		Backup Mem	4	115200
6002	Base Control Module Modbus port Parity and Stop Bits	UINT8 RW NV	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 MODBUS_PARITY_NONE_1_STOP_BIT is not valid when in MODBUS_ASCII_TX_MODE mode.	
		Default: 0	**Value**	**Description**
		Enum	0	Even parity—1 Stop bit
		Config CRC	1	Odd parity—1 Stop bit
		Admin Lock	2	No parity—2 Stop bits
		USB Lock	3	Even parity—2 Stop bits
		Backup Mem	4	Odd parity—2 Stop bits
			5	No parity—1 Stop bits
6003	Base Control Module Modbus port TX mode	UINT8 RW NV	Selects the RTU/ASCII Modbus Mode for the Base Control Module's Modbus port.	
		Default: 0	**Value**	**Description**
		Enum	0	RTU Tx Mode (8 data bits)
		Config CRC	1	ASCII Tx Mode (7 data bits)
		Admin Lock		
		USB Lock		
		Backup Mem		

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
6004	Base Control Module RS485 Modbus Timeout	UINT16 RW NV	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.
		Default: 2000	
		Units: ms	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
6005	Base Control Module USB Modbus Timeout	UINT16 RW NV	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.
		Default: 10000	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
6006	User Interface USB Modbus Timeout	UINT16 RW NV	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.
		Default: 0	
		Units: ms	
		Backup Mem	
6007	Modbus TCP Com Timeout	UINT16 RW NV	The time before Modbus TCP 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.
		Default: 2000	
		Units: ms	
		Config CRC	
		Admin Lock	
		USB Lock	
6008	REST Web services Communication Timeout	UINT16 RW NV	The time before HTTP REST communications are considered lost. Every valid poll assembly 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.
		Default: 0	
		Units: ms	
		Config CRC	
		Admin Lock	
		USB Lock	
6010	Present Ethernet IP Address	UINT8 RO	The Active IP Address Being used on the Network.
		Array size: 4	Array of 2 registers
6012	Present Ethernet Subnet Mask	UINT8 RO	The Active Subnet Mask IP Address Being used on the Network.
		Array size: 4	Array of 2 registers
6014	Present Ethernet Default Gateway	UINT8 RO	The Active Default Gateway IP Address Being used on the Network.
		Array size: 4	Array of 2 registers

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
6016	Stored Ethernet IP Address	UINT8 RW NV	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 size: 4	Array of 2 registers
		Default: 0xFE, 0x01, 0xA8, 0xC0	
		Config CRC	
		Admin Lock	
		USB Lock	
6018	Stored Ethernet Subnet Mask	UINT8 RW NV	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 size: 4	Array of 2 registers
		Default: 0x00, 0xFF, 0xFF, 0xFF	
		Config CRC	
		Admin Lock	
		USB Lock	
6020	Stored Ethernet Default Gateway	UINT8 RW NV	The IP default gateway used in the NV address select configuration.
		Array size: 4	Array of 2 registers
		Default: 0x01, 0x01, 0xA8, 0xC0	
		Config CRC	
		Admin Lock	
		USB Lock	
6022	Ethernet Port 1 Speed Select	UINT16 RW NV	Select the Ethernet link speed. Only used when Auto-Negotiate is disabled.
		Default: 100	**Value** — **Description**
		Enum	10 — 10 Mbps
		Units: Mbs	100 — 100 Mbps
		Config CRC	
		Admin Lock	
		USB Lock	
6023	Ethernet Port 1 Speed Actual	UINT16 RO	Actual Ethernet link speed. This parameter is used to verify the data rate being used on the Ethernet network. It is read only.
		Enum	**Value** — **Description**
		Units: Mbs	10 — 10 Mbps
			100 — 100 Mbps

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
6024	Ethernet Port 1 Full Duplex Enable	BOOL RW NV	Selects the duplex mode. Only used when Auto-Negotiate is disabled. True = Full Duplex False = Half Duplex	
		Default: 1		
		Config CRC		
		Admin Lock		
		USB Lock		
6025	Ethernet Port 1 Full Duplex Enabled	BOOL RO	Actual duplex mode. This is a read only parameter, indicating the actual duplex mode on the Ethernet network. True = Full Duplex False = Half Duplex	
6026	Ethernet Port 1 Autonegotiate Enable	BOOL RW NV	Selects Auto-Negotiation of link speed and duplex. False = Disabled True = Enabled	
		Default: 1		
		Config CRC		
		Admin Lock		
		USB Lock		
6027	Ethernet Port 1 Autonegotiate State	UINT8 RO	Active state of the Auto-Negotiation behavior. This parameter indicates the status of auto negotiate on the Ethernet network. This is read only.	
		Enum	**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
6028	Ethernet Port 1 Enabled	BOOL RW NV	This parameter is used to disable the Ethernet port. True = Enable Port False = Disable Port	
		Default: 1		
		Config CRC		
		Admin Lock		
		USB Lock		
6029	Ethernet Port 2 Speed Select	UINT16 RW NV	Select the Ethernet link speed. Only used when Auto-Negotiate is disabled.	
		Default: 100	**Value**	**Description**
		Enum	10	10 Mbps
		Units: Mbs	100	100 Mbps
		Config CRC		
		Admin Lock		
		USB Lock		
6030	Ethernet Port 2 Speed Actual	UINT16 RO	Actual Ethernet link speed. This is a read only parameter.	
		Enum	**Value**	**Description**
		Units: Mbs	10	10 Mbps
			100	100 Mbps

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
6031	Ethernet Port 2 Full Duplex Enable	BOOL RW NV Default: 1 Config CRC Admin Lock USB Lock	Selects the duplex mode. Only used when Auto-Negotiate is disabled. True = Full Duplex False = Half Duplex
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 Enabled	BOOL RW NV Default: 1 Config CRC Admin Lock USB Lock	This parameter Indicates whether an Ethernet port is enabled. True = Port Enabled (default) False = Port Disabled
6036	Address 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.
6037	Address Conflict Detection Status	UINT8 RO Enum	Address Conflict Detection State. This is read only. **Value** **Description** 0 No conflict detected 1 Conflict detected—defending 2 Conflict detected—retreated
6038	Address 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.

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description	
6039	Address Conflict Detection Conflicted MAC	UINT8 RW NV	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 size: 6	Array of 3 registers	
		Default: 0		
		Range: 0 to 0		
6048	Ethernet MAC Address	UINT8 RO	Unique MAC Address assigned to this device.	
		Array size: 6	Array of 3 registers	
6052	Profibus Modbus Timeout	UINT16 RW NV	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.	
		Default: 2000		
		Units: ms		
		Backup Mem		
7000	Minimum FLA (Nominal Current)	UINT16 RO	Minimum Full Load Amperes Scaled (Nominal Current). See motor current scale factor for scaling.	
		Default: 1		
		Units: scaled A		
7001	Maximum FLA (Nominal Current)	UINT16 RO	Maximum Full Load Amperes Scaled (Nominal Current). See motor current scale factor for scaling.	
		Default: 65535		
		Units: scaled A		
7002	Overlay type	UINT8 RO	Overlay type	
		Default: 255	**Value**	**Description**
		Enum	0	No predefined User Interface overlay selected
			1	30-46625-101 IEC User Interface Overlay
			2	30-46625-102 IEC User Interface Overlay
			3	30-46625-103 IEC User Interface Overlay
			4	30-46625-104 IEC User Interface Overlay
			5	30-46625-105 IEC User Interface Overlay
			6	30-46625-106 IEC User Interface Overlay
			7	30-46625-107 IEC User Interface Overlay
			8	30-46625-108 IEC User Interface Overlay
			9	30-46625-109 IEC User Interface Overlay
			10	30-46625-110 IEC User Interface Overlay
			11	30-46625-201 NEMA User Interface Overlay
			12	30-46625-202 NEMA User Interface Overlay
			13	30-46625-203 NEMA User Interface Overlay
			14	30-46625-204 NEMA User Interface Overlay
			15	30-46625-205 NEMA User Interface Overlay
			16	30-46625-206 NEMA User Interface Overlay

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description
7002	Overlay type	UINT8 RO	Overlay type, continued
			Value — **Description**
			17 — 30-46625-207 NEMA User Interface Overlay
			18 — 30-46625-208 NEMA User Interface Overlay
			19 — 30-46625-209 NEMA User Interface Overlay
			20 — 30-46625-210 NEMA User Interface Overlay
			255 — Out of box or factory reset state. No User Interface was ever connected
			Write-protected by manufacturing lock service. Preserved on WipeNV.
7003	Base Control Module Product Name	STRING8 RO	Base Control Module Product Name
		Array size: 32	Array of 16 registers
7025	Base Control Module Assigned Name	STRING8 RW NV	Base Control Module User Assigned Name
		Array size: 32	Array of 16 registers
		Default: "Power Xpert C445"	
		Config CRC	
		Admin Lock	
		USB Lock	
		Backup Mem	
7041	Base Control Module Serial Number	UINT32 RO	Base Control Module 32bit Device Serial Number.
			Write-protected by manufacturing lock service. Preserved on WipeNV.
7043	Base Control Module Product Code	UINT16 RO	Base Control Module Product Code numerical
7044	Base Control Module Product Sub Code	UINT16 RO	Base Control Module Product Sub Code
			Write-protected by manufacturing lock service. Preserved on WipeNV.
7045	Base Control Module Firmware Version	UINT16 RO	Base Control Module Firmware Version
		Array size: 2	Array of 2 registers
7048	Base Control Module Hardware Version	UINT16 RO	Base Control Module Product hardware version numerical
			Write-protected by manufacturing lock service. Preserved on WipeNV.
7049	Base Control Module Config CRC	UINT16 RO	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).†
7050	Base Control Module Bootloader Version	UINT16 RO	Base Control Module Bootloader Version
		Array size: 2	Array of 2 registers
7053	Measurement Module Serial Number	UINT32 RO	Measurement Module Product Serial Number
7055	Measurement Module Product Code	UINT16 RO	Measurement Module Product Code
7056	Measurement Module Product Sub Code	UINT16 RO	Measurement Module Product Sub Code
		Default: 65535	

Table 125. C445 Modbus Register Map, continued

Register	Name	Attribute	Description		
7057	Measurement Module Firmware Version	UINT16 RO	Measurement Module Product Firmware Version		
		Array size: 2	Array of 2 registers		
7060	Measurement Module Hardware Version	UINT16 RO	Measurement Module Product Hardware Version		
7061	Measurement Module Option Board Type	BYTE RO	Measurement Module Option board type.		
		Bitfield	**Bit**	**Description**	**Coil**
			0	Voltage option board present in Measurement Module	N/A
			1	PTC option board present in Measurement Module	N/A
7062	Measurement Module Bootloader Version	UINT16 RO	Measurement Module Bootloader Version		
		Array size: 2	Array of 2 registers		
7065	User Interface Serial Number	UINT32 RO	User Interface Module 32 bit Device Serial Number.		
7067	User Interface Product Code	UINT16 RO	User Interface Module Product code numerical		
7068	User Interface Product Sub Code	UINT16 RO	User Interface Product Sub Code		
7069	User Interface Firmware Version	UINT16 RO	User Interface Module Firmware version numerical		
		Array size: 2	Array of 2 registers		
7072	User Interface Hardware Version	UINT16 RO	User Interface Module Product hardware version numerical		
7073	User Interface Bootloader Version	UINT16 RO	User Interface Bootloader Version		
		Array size: 2	Array of 2 registers		
7076	Option Card Serial Number	UINT32 RO	Option Card 32 bit Device Serial Number.		
7078	Option Card Product Code	UINT16 RO	Option Card Product Code		
		Default: 0			
7079	Option Card Product Sub Code	UINT16 RO	Option Card Product Sub Code		
7080	Option Card Product Firmware Version	UINT16 RO	Option Card Product Firmware Version		
		Array size: 2	Array of 2 registers		
7083	Option Card Hardware Version	UINT16 RO	Option Card Product hardware Version		
7084	Option Card Bootloader Version	UINT16 RO	Option Card Bootloader Version		
		Array size: 2	Array of 2 registers		
7087	Power Board Serial Number	UINT32 RO	Power Board 32 bit Device Serial Number.		
7089	Power Board Firmware Version	UINT16 RO	The Firmware version of the power board processor.		
		Array size: 2	Array of 2 registers		
7092	Power Board Hardware Version	UINT16 RO	Power Board Product hardware version numerical		

Table 125. C445 Modbus Register Map, continued

<table>
<tr><th>Register</th><th>Name</th><th>Attribute</th><th colspan="3">Description</th></tr>
<tr><td>8004</td><td>Input Debounce Time</td><td>UINT16 RW NV</td><td colspan="3">Array of debounce values. A debounce value exists for each input. The debounce applies to both rising and falling edge.</td></tr>
<tr><td></td><td></td><td>Array size: 4</td><td colspan="3">Array of 4 registers</td></tr>
<tr><td></td><td></td><td>Default: 20</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>Range: 5 to 5000</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>Units: ms</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>Config CRC</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>Admin Lock</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>USB Lock</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>Backup Mem</td><td colspan="3"></td></tr>
<tr><td>8027</td><td>Measurement Module Board Ambient Temp</td><td>SINT16 RO</td><td colspan="3">Measurement Module Ambient temperature measured on the PCB.</td></tr>
<tr><td></td><td></td><td>Units: ∫C</td><td colspan="3"></td></tr>
<tr><td>8028</td><td>Measurement Module Max Board Ambient Temp</td><td>SINT16 RW NV</td><td colspan="3">Measurement Module Maximum ambient temperature measured on the PCB. This value can be set (typically to –40).</td></tr>
<tr><td></td><td></td><td>Default: –40</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td>Units: ∫C</td><td colspan="3"></td></tr>
<tr><td>8145</td><td>Low relay control V flag</td><td>BOOL RO</td><td colspan="3">Flag indicates power supply voltage is too low to pull in relays</td></tr>
<tr><td>8502</td><td>Control Word with NetCtrl bit</td><td>BYTE RW</td><td colspan="3">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</td></tr>
<tr><td></td><td></td><td>Bitfield</td><td>Bit</td><td>Description</td><td>Coil</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>Run1 command</td><td>N/A</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>Run2 command</td><td>N/A</td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>Reserved</td><td>N/A</td></tr>
<tr><td></td><td></td><td></td><td>3</td><td>Reset fault</td><td>N/A</td></tr>
<tr><td></td><td></td><td></td><td>4</td><td>Remote control enable (Allow control commands from this control word)</td><td>N/A</td></tr>
<tr><td></td><td></td><td></td><td>5</td><td>Test trip the device</td><td>N/A</td></tr>
</table>

Appendix E—Safety Manual

"Increased safety" type of protection EEx e according to ATEX directive 94/9/EC.

The C445 global motor management relay provides EEx e protection to motor installed in explosive areas.

EEx e Types of Protection

The overload protection and the thermistor motor protection of C445 global motor management relay comply with requirements for overload protection of explosion-protected motors of the type of protection.

EEx e "increased safety" e.g., according to EN 60079-7.

EC Type Certificate: DEMKO 15 ATEX 1286.

User shall refer C445 safety manual MN042004EN.pdf before installing C445 to protect the motors installed in Hazardous Area.

ATEX Approval for Operation in Areas Subject to Explosion Hazard

The C445 global motor management relay is certified according to ATEX Ex II (2) G and GD for gases and dust.

The C445 global motor management relay is certified for the protection of motors in areas subject to explosion hazard according to:

- ATEX Ex I (M2); equipment group I, category M2 (mining)
- ATEX Ex II (2) GD; equipment group II, category 2 in area GD

Licenses

This product includes embedded software that incorporates or interfaces with the following third party software:

lwIP is licensed under the BSD license:

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. The name of the author may not be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDER "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

www.FreeRTOS.org

At Eaton, we're energized by the challenge of powering a world that demands more. With over 100 years experience in electrical power management, we have the expertise to see beyond today. From ground-breaking products to turnkey design and engineering services, critical industries around the globe count on Eaton.

We power businesses with reliable, efficient and safe electrical power management solutions. Combined with our personal service, support and bold thinking, we are answering tomorrow's needs today. Follow the charge with Eaton. Visit eaton.com/electrical.

Powering Business Worldwide

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
Publication No. MN042003EN / Z17179
September 2015