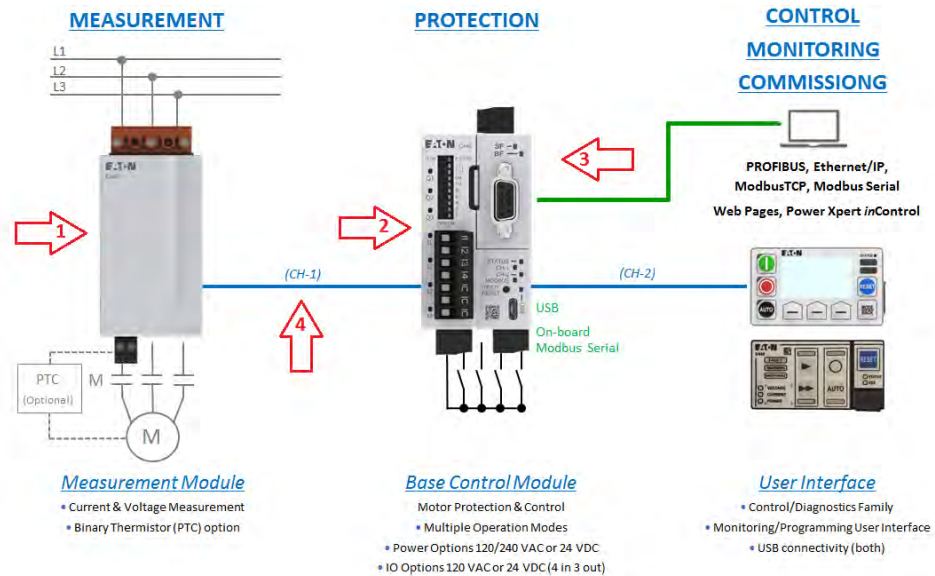


Power Xpert C445 Motor Management Relay **Cheat Sheets**

SYSTEM COMPONENT REQUIREMENTS

To understand the architecture and functionalities of a complete C445 Motor Management Relay system (henceforth referred to as C445), we must understand the individual components that make up the system. At a minimum, the C445 must contain at least (1) of the following components to function properly:



C445 REQUIRED COMPONENTS

- (1) Measurement Module (C445M...)
- (1) Base Control Module (C445B...)
- (1) Communication Module (C445XC... *If Modbus RTU is not specified in the base model)
- (1-2) RJ12 Connection cables (D77E...), required to provide power and comms from the Base Control Module to the Measurement Module and the User Interface if utilized. These must be ordered separately in the length desired.

OPTIONAL ACCESSORIES

- (1) Real-time Clock and Memory Backup Module (C445XO-RTC)
- (1) User Interfaces (C445UM...)
- (1) User Interface (UI) Digital Input Wiring Harnesses (C445XU...) if utilizing optional digital inputs on UI

Accessories

Spare Parts Kits C445XS-TERM – Bag of the most common I/O terminal connectors on C445 for customers who misplace / damage them. C445XS-PMT – Bag of the 45mm Panel Mounting feet for customers who misplace / damage them. C445XS-USBCBL – Cable → USB 2.0 to Micro C445XS-USBMOD – Cable → USB 2.0 to Leads	Communication Modules C445XC-P – Profibus DPV1/DVP0 Communication Card C445XC-E – Ethernet Communication Card (Includes EtherNet/IP & ModbusTCP) * Communication cards plug directly in to the Base Control Module and do not require separate power	Connector Cables RJ-12 Connector Cables used to connect BCM, MM, and User Interface D77E-QPIP13 – 13cm, 600V Rated D77E-QPIP25 – 25cm, 600V Rated D77E-QPIP100 – 100cm, 600V Rated D77E-QPIP200 – 200cm, 600V Rated D77E-QPIP300 – 300cm, 600V Rated D77E-QPIP13-HV – 13cm, 1000V Rated D77E-QPIP25-HV – 25cm, 1000V Rated D77E-QPIP100-HV – 100cm, 1000V Rated D77E-QPIP300-HV – 300cm, 1000V Rated
Current Transformer (CT) Kits XCT300-5 – 300:5 Single Phase CTs XCT600-5 – 600:5 Single Phase CTs XCT800-5 – 800:5 Single Phase CTs * Use CTs and 1-5A Measurement Module (MM). CT kit does not include MM (order separately)	Real Time Clock (RTC) Option Module Accessory board that plugs into Base Control Module. Provides continuous time-stamping when even when power is removed C445XO-RTC – Real Time Clock Option Board	User Interface Inputs Wire Harness Wiring harnesses that allow the user to utilize the (4) 24VDC inputs included on the back of the Control User Interface C445XU-50 – 50cm Inputs Wire Harness C445XU-100 – 100cm Inputs Wire Harness C445XU-200 – 200cm Inputs Wire Harness C445XU-300 – 300cm Inputs Wire Harness

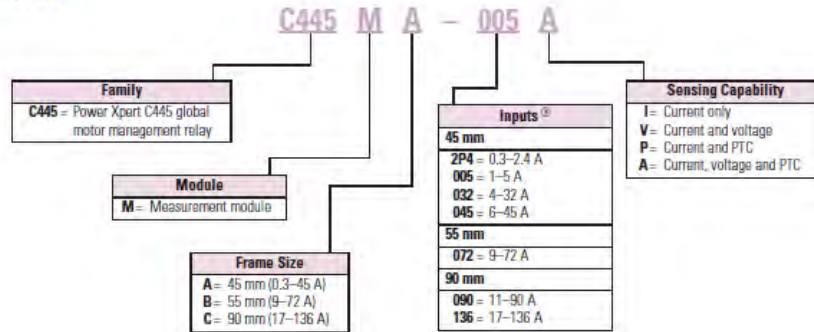


MICROPROCESSOR-BASED PROTECTIVE RELAYS

Power Xpert C445 Global Motor Management Relay

CATALOG NUMBER SELECTION – Measurement Module

Measurement Module



Frame Size	Current Range (A)	Current (I) Sensing	Voltage (V) Sensing	PTC Sensing	Catalog Number
45 mm	0.3–2.4	Yes	—	—	C445MA-2P4I
		Yes	—	Yes	C445MA-2P4P
		Yes	Yes	—	C445MA-2P4V
		Yes	Yes	Yes	C445MA-2P4A
	1–5	Yes	—	—	C445MA-005I
		Yes	—	Yes	C445MA-005P
		Yes	Yes	—	C445MA-005V
		Yes	Yes	Yes	C445MA-005A
	4–32	Yes	—	—	C445MA-032I
		Yes	—	Yes	C445MA-032P
		Yes	Yes	—	C445MA-032V
		Yes	Yes	Yes	C445MA-032A
55 mm	6–45 ^②	Yes	—	—	C445MA-045I
		Yes	—	Yes	C445MA-045P
		Yes	Yes	—	C445MA-045V
		Yes	Yes	Yes	C445MA-045A
	9–72	Yes	—	—	C445MB-072I
		Yes	—	Yes	C445MB-072P
		Yes	Yes	—	C445MB-072V
		Yes	Yes	Yes	C445MB-072A
90 mm	11–90	Yes	—	—	C445MC-090I
		Yes	—	Yes	C445MC-090P
		Yes	Yes	—	C445MC-090V
		Yes	Yes	Yes	C445MC-090A
	17–136	Yes	—	—	C445MC-136I
		Yes	—	Yes	C445MC-136P
		Yes	Yes	—	C445MC-136V
		Yes	Yes	Yes	C445MC-136A



Pass-through device that samples current data (option for voltage/power/energy) consumed by the electric motor and passes that data electronically to the base control module via a cable connection. Various frame sizes are available depending on the application.

^①A measurement module is *always* required when using the C445 system.



0.3 – 45A



9 – 72A



17 – 136A



60 – 800A

Standard:

0.3 – 800A Current Measurement & Protection
2% Accuracy (30–125% of FLA)

Factory Options:

110-690V Voltage Measurement & Protection

- 2% Accuracy (110–690 VAC)
- 4,160VAC with PT Ratios
- Voltage option enables power/energy measurement and protection

Positive Temperature Coefficient (PTC) Protection

- Binary PTC Protection (60947-8)

Line Frequency:

20–80Hz (VFD output capability)

Mounting

DIN or Panel-Mount Option (screw)

Note: C445 Base Control Modules can be attached directly to the 45mm Measurement Module (stacked)

Advanced Monitoring Algorithms

- **Efficiency:** Provides % Value = Shaft Power / Input Power
- **Torque:** Provides estimate of motor torque
- **Speed:** Provides estimate of current motor speed
- **Peak Demand:** Allows user to set a peak demand threshold and provides alarm to user when it increases

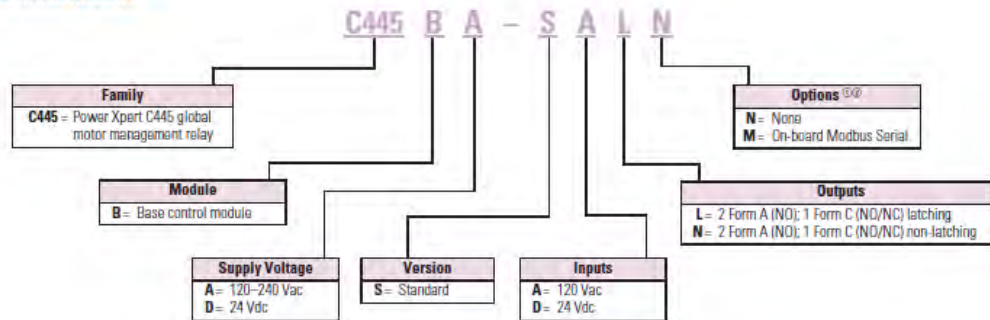


MICROPROCESSOR-BASED PROTECTIVE RELAYS

Power Xpert C445 Global Motor Management Relay

CATALOG NUMBER SELECTION – Base Control Module

Base Control Module



Power Xpert C445 Global Motor Management Relay

C445B

Base Control Module



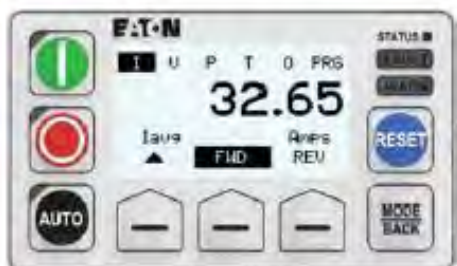
Power Source	Voltage Range ①	Digital Inputs	Relay Outputs	On-board Communications	Catalog Number
120/240 Vac	0-690 Vac	(4) 120 Vac	(2) Form A, (1) Form C (non-latching)	—	C445BA-SANN
			(2) Form A, (1) Form C (latching)	Modbus Serial	C445BA-SANM
			(2) Form A, (1) Form C (non-latching)	Modbus Serial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

CATALOG NUMBER SELECTION –User Interface

Recommended is the C445UM

NEMA - User Interface Nomenclature
(for IEC Type, Replace - “N” with an “I”)

Monitoring User Interface ② Catalog Number: C445UM



User Interface—NEMA Color Scheme (English) ②

Operation Mode	Control Type (Local = UI)	Control Button(s) Action		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	—	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	—	F1 AUTO	RUN	OFF AUTO	FAULT, WARNING, OVERLOAD	C445UC-N9
		TEST	—	—	—	—	—

CATALOG NUMBER SELECTION – CTs & Communication Module

ZEB-XCT



External Current Transformers

Use CTs and 1–5 A C445 measurement module. CT kit does not include measurement module (order separately).

CT Range (A)	Description	Terminal Size	Measurement Module	Catalog Number ⁽³⁾
17–300	300:5 single-phase CT, 1.25 inch dia hole, UL and CSA ANSI/IEEE C57.13, 50–400 Hz, 600 Vac, 10 kV, relay class C50, accuracy 0.3% B0.1	(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 and 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 and 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

C445X



Communication and Option Modules

Description	Catalog Number
EtherNet/IP and Modbus TCP card with 2-port switch	C445XC-E
PROFIBUS DPV0 and DVP1 card	C445XC-P
Real-time clock and memory backup module	C445XO-RTC

Cables, Wiring Harnesses and Spare Parts

Connection Cables and Accessories

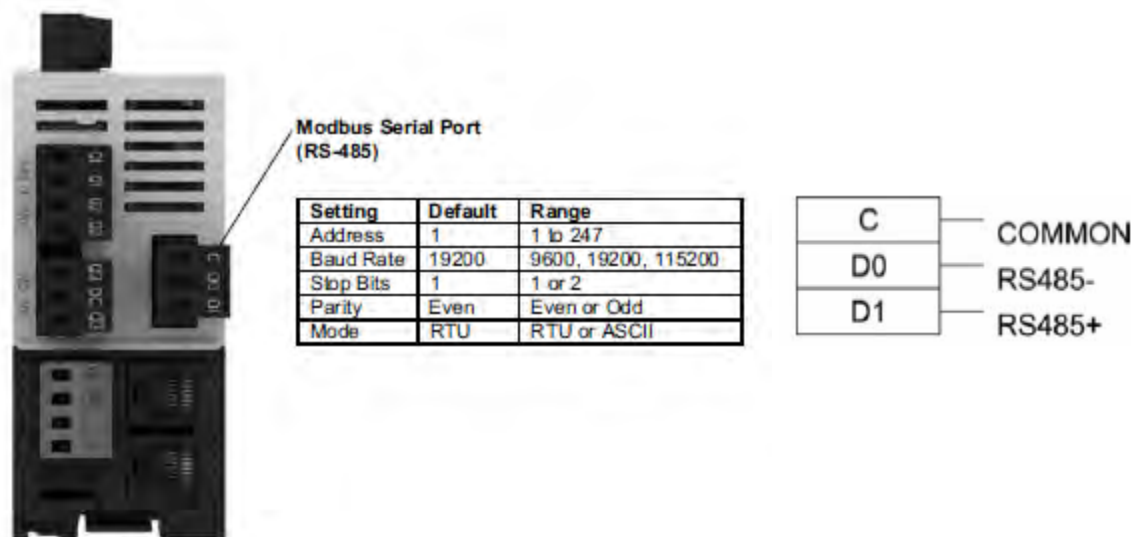
D77E connection cables are required to connect the base control module to the measurement module and to the user interface. Order the appropriate lengths for each connection.

User interface wiring harnesses are required to utilize the digital inputs on the user interface. Order one wiring harness per user interface to connect to these inputs. C445XS-USBMICRO and C445XS-USBLEADS are used to connect the Power Xpert *inControl* tool (see next page for details). C445XS-USBRJ12 is used for firmware upgrades.

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 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
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 loose leads cable (for use with Modbus Serial terminals)	C445XS-USBLEADS
Standard USB A male to RJ-12 cable (for firmware upgrades)	C445XS-USBRJ12

COMMUNICATION – Modbus Serial Port; 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.
- 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 inControl Software or via Modbus commands from a Modbus master.
- 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.

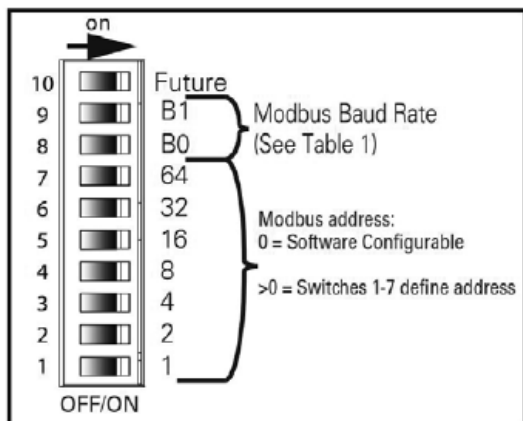

RS-485 Port - Notes

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

COMMUNICATION - Base Control Module Dip Switches – (Modbus RTU & PROFIBUS)

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

Base Control Module DIP Switches with Built-In Modbus

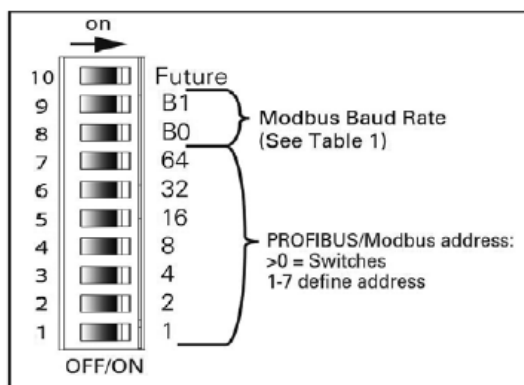


*** If multiple C445 devices are being utilized on the same serial network (Modbus RTU or PROFIBUS), ensure that each device has its own address and the comms parameters are consistent***

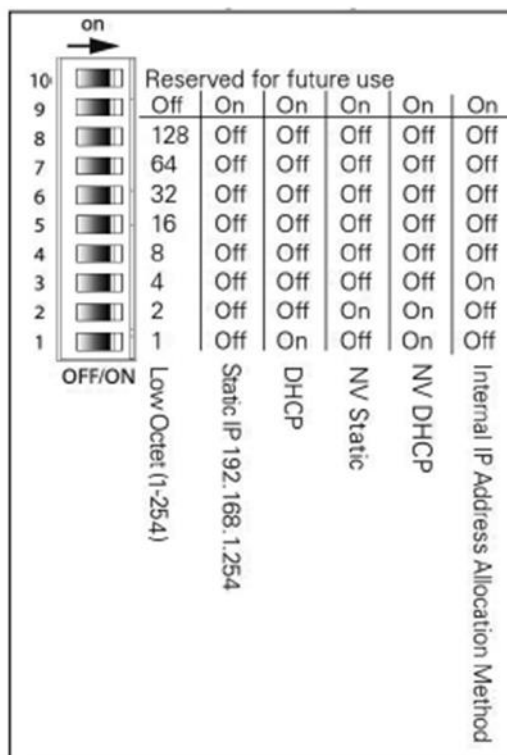
Modbus Data Rate

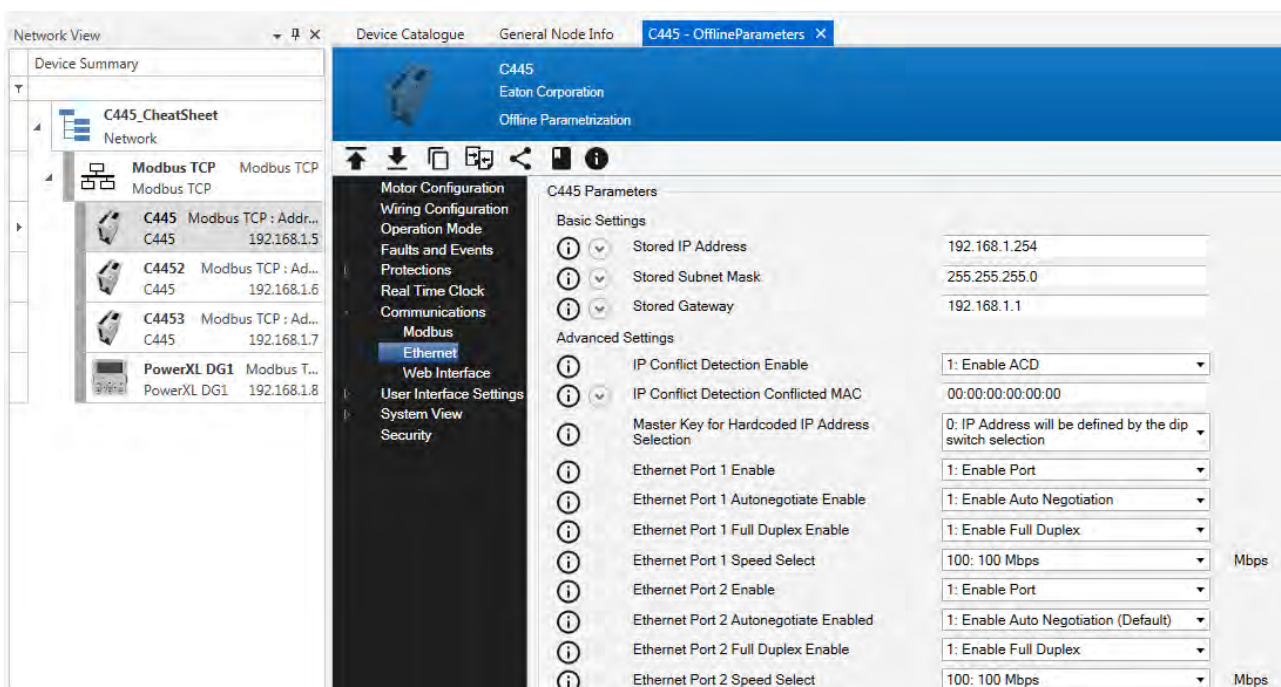
B1	B0	Rate
0	0	Software Configurable
0	1	9600
1	0	115200
1	1	19200

Base Control Module DIP Switches with PROFIBUS Card



Base Control Module DIP Switches with Ethernet Card

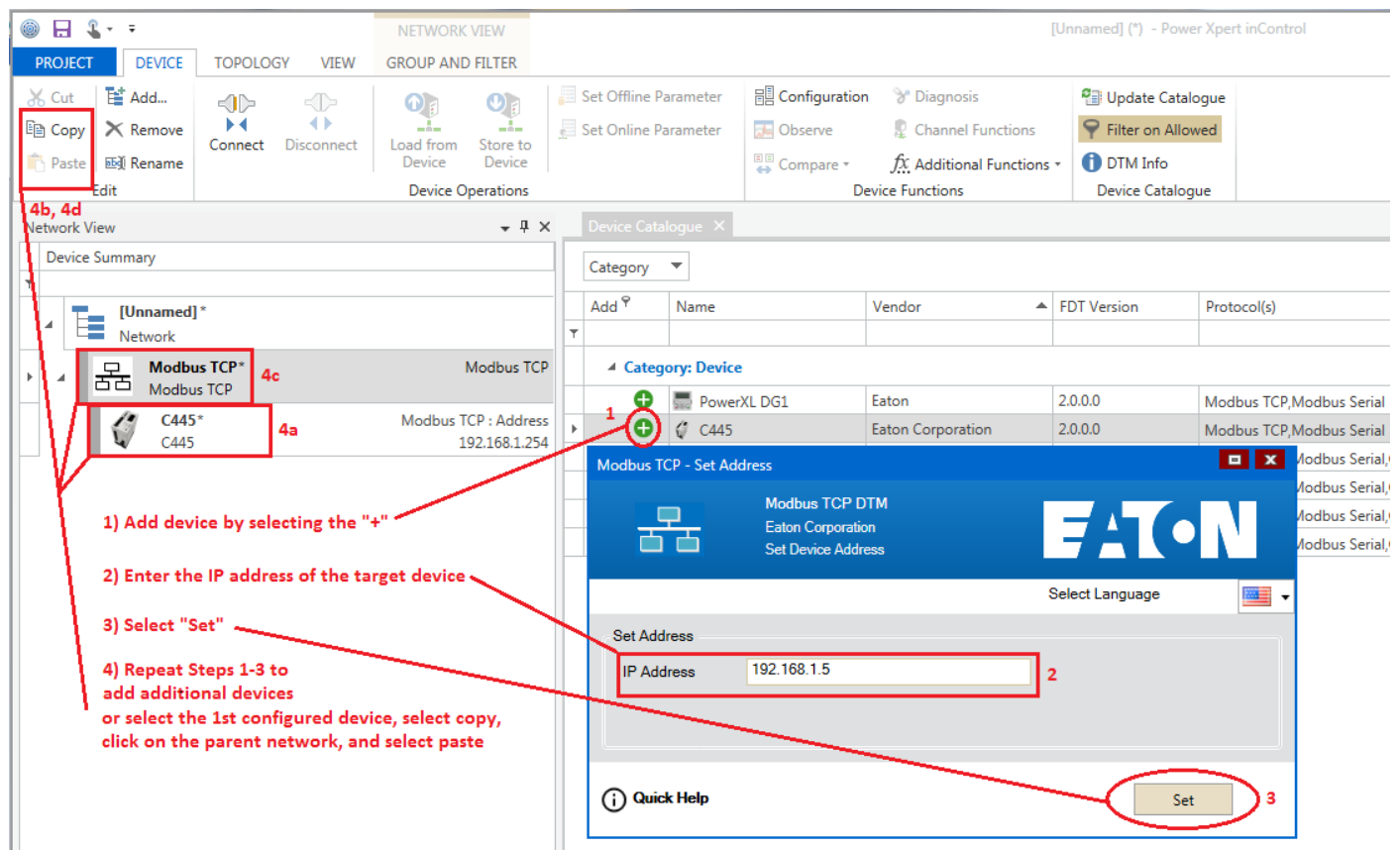




COMMISSIONING TOOLS - Power Xpert inControl - Creating a new project

The default IP Address for the C445 is typically 192.168.1.254. The PC 's IPv4 Address must be set to the same subnet i.e. 192.168.1.xxx to be able to communicate when utilizing Modbus TCP or EtherNet/IP and configurations will be performed within the Power Xpert inControl environment. As previously mentioned, set DIP 9 to off and DIP 1-8 for the last Octet (1-254) per device to ensure that there will not be an IP Address conflict.

Once the IP Address is configured, the device may be accessed via built-in web page or through inControl. With inControl, easy device configuration can be accomplished over local USB or a ModbusTCP network. The free user interface software can be downloaded from Eaton's website. As of writing this document, only the DG1 VFD and C445 devices are supported.



The screenshot displays the Power Xpert inControl software interface. The top menu bar includes PROJECT, DEVICE, TOPOLOGY, VIEW, and GROUP AND FILTER. The left sidebar shows a tree view of the project structure, including a network and a list of devices. The main window displays a table of devices, with a 'Modbus TCP' device selected. A 'Modbus TCP - Set Address' dialog box is open, showing the 'Set Address' tab with the IP Address field set to 192.168.1.5. The 'Set' button is highlighted.

4b, 4d Network View

4c Modbus TCP*

4a C445*

1 Add device by selecting the "+"

2 Enter the IP address of the target device

3 Select "Set"

4 Repeat Steps 1-3 to add additional devices or select the 1st configured device, select copy, click on the parent network, and select paste

Add	Name	Vendor	FDT Version	Protocol(s)
+	PowerXL DG1	Eaton	2.0.0.0	Modbus TCP, Modbus Serial
+	C445	Eaton Corporation	2.0.0.0	Modbus TCP, Modbus Serial

Modbus TCP - Set Address

Modbus TCP DTM
Eaton Corporation
Set Device Address

Select Language

Set Address

IP Address 192.168.1.5

Quick Help

Set



MICROPROCESSOR-BASED PROTECTIVE RELAYS

Power Xpert C445 Global Motor Management Relay

Once the device[s] is connected, it may be programmed and monitored from any work station over the network connection within inControl or can be accessed on a Web Browser by simple entering the IP Address.

The screenshot shows the inControl software interface. On the left, a sidebar lists devices connected via Modbus TCP. A red arrow points to the 'Connect' button in the top menu bar. Another red arrow points to the 'Control/Monitor (Dashboard)' option in the sidebar. A third red arrow points to the 'C445' device entry in the device list. Below the device list, a red box contains the following instructions:

- 1) Select device to connect
- 2) Select "Connect" in the menu bar
- 3) Select Control/Monitor (Dashboard)

* Notice green blocks indicating that comms has been established

The main window displays the 'C445 - OnlineParameters' tab. It shows various parameters for the C445 device, including Basic Settings, Advanced Settings, and a list of parameters with their current values and units. The status bar at the bottom indicates 'Connected' and 'Ready'.

The screenshot shows a web browser window displaying the C445 device configuration and monitoring parameters. The address bar shows the IP address 192.168.14.6. A red arrow points to the IP address in the address bar. Below the browser window, a red box contains the following instruction:

Enter IP Address and categories will populate

The main window displays the 'Eaton' logo and a list of parameters for the C445 device. The parameters are organized into groups, including 'Group #1: Monitor'. The parameters are listed in a table with columns for PID, Param Name, Access, Read/Write Parameters, and Unit.

PID	Param Name	Access	Read/Write Parameters	Unit
300	Motor Control Status	Read Only	0x54	
304	Average Speed	Read Only	0	
306	Unbalance Percent	Read Only	0	%
308	Thermal Memory Percent	Read Only	0	%
309	Time to Trip Overload	Read Only	9999	seconds
311	Time to Reset Overload	Read Only	0	seconds
324	Average Line to Line Voltage	Read Only	497	V
325	Voltage Unbalance Percent	Read Only	0	%
326	Voltage Phase Order	Read Only	1	
327	Total Watts	Read Only	0	W
333	Power Factor Scaled	Read Only	0	%
350	Number of Operating Seconds	Read Only	4294967295	seconds
356	Operating Seconds (Resettable)	Writable	4294967295	seconds
362	Average % of FLA (Nominal Current)	Read Only	0	%
372	Motor State (Current Based)	Read Only	0	
373	Motor Speed RPM	Read Only	0	RPM
374	Motor Torque	Read Only	0	Nm

**EATON POWER XPRT C445 GLOBAL MOTOR MANAGEMENT RELAY - USER MANUAL - [MN042003EN](#)****CIP GENERIC COMMUNICATION****Table 88. EtherNet/IP Object Model for the C445 Motor Management Relay**

Page 182	Table 91. Assembly Object—Class 0x4 (4)	
Page 184	Appendix C—Optional Communication Cards	
	Input Instance 100 (0x64): Status, Current	Length = 8 Bytes
	Output Instance 104 (0x68): Extended Motor Starter 2	Length = 2 Bytes
Page 185	Output Instance 105 (0x69): Basic Starter Relay	Length = 2 Bytes
	Output Instance 106 (0x6A): Basic Output Control	Length = 2 Bytes
Page 186-187	Input Instance 107 (0x6B): Extended Overload Input w/IO	Length = 2 Bytes
	Input Instance 110 (0x6E): Status, Current, Voltage, Trip	Length = 2 Bytes
Page 188-191	Input Instance 116 (0x74): Full Monitoring	Length = 41 Bytes
Page 191-192	Input Instance 121 (0x79): Status And Short Measurements	Length = 10 Bytes
Page 224	Table 116. Modbus TCP Function Codes	
Page 235-301	Table 127. C445 Modbus Register Map	

User Inhibit Start/Stop (Enable Cntrl Buttons)

Write "0" to Disable & "3" to Enable Local Start/Stop/Reset – Data Type - DCI_DTYPE_BYTE (SINT)

Line #7327 in the EDS files; Param 462

Attribute No.	Class - Hex (Decimal)	Object	No. of Instances	Description
22	0xB2 (178)	BUI	1	Vendor Specific Object

Number of Starts per Hour allowed before trip

Write Integer to specify Allowed Starts Per Hour, RTC required – Data Type - DCI_DTYPE_UINT16 (INT)

Line #5871 in the EDS files; Param 371

Attribute No.	Class - Hex (Decimal)	Object	No. of Instances	Description
34	0xA2 (52)	Motor Protection	1	Allowed Starts Per Hour

System Services

Write "6" to send a Soft Reset CMD – Data Type - DCI_DTYPE_UINT8 (SINT)

Line #2047 in the EDS files; Param 132

Attribute No.	Class - Hex (Decimal)	Object	No. of Instances	Description
72	0x29 (41)	Control Sup. Object	1	Soft Reset Command

**MICROPROCESSOR-BASED
PROTECTIVE RELAYS****Power Xpert C445
Global Motor
Management Relay****Read – Last Fault Snap Shot Log**

Year, Month, Day, Minute, Hour, Second, Trip Reason, TP, Ia, Ib, Ic, Vba, Vbc, Vca, Hz, w, VA, PF, & Ground Fault RMS
Line #5951-6239 in the EDS files; Param 376-394 Data Type - DCI_DTYPE_UINT8, UINT16, SINT16, & SINT32

Class: 0xA5

Instance: 0x01

Attribute: (0x1, 0x2, 0x3, 0x4, 0x5, 0x6, 0x7, 0x8, 0x9, 0xA, 0xB, 0xC, 0xD, 0xE, 0xF, 0x10, 0x11, 0x12, 0x13)

Attribute No.	Class - Hex (Decimal)	Object	No. of Instances	Description
See Above	0xA5 (165)	Snap Shot Object	1	Fault Snap Shots

Commissioning Notes!!!

Eaton buckets containing a C445 User Inter & a 3-Position Switch: Local HOA MUST be in HAND (else jumper 3 to 3A) and Remote Display Unit in AUTO for Fieldbus Control. While in HAND, the Remote Display Unit can start the motor manually by deselecting the AUTO button and pressing RUN. The STOP button will stop the device in any mode.

C445 Web Page & Interactive Demo may be found with the following links:

[Power Xpert C445 Intelligent Motor Management & Protection Relay](#)

[C445 Interactive Demo 1](#)

[C445 Interactive Demo 2](#)