Operating a Power Xpert C445 Global Motor Management Relay with a Rockwell PLC via Ethernet/IP

Introduction

The purpose of this application note is to demonstrate how to operate a C445 Motor Management Relay via Ethernet/IP and a Rockwell CompactLogix PLC. The C445 has an Ethernet option card that supports both Ethernet/IP and Modbus TCP. The C445 Ethernet card needs to be configured with an IP address for Ethernet communications, but auto senses the protocol and the I/O Assemblies used on Ethernet/IP. In other words, as long as the Ethernet/IP master polls the C445XC-E Ethernet card using valid I/O assemblies, it will respond.

The IP address for the C445XC-E card is set via dip switches on the C445 Base Control Module. This will be described later in this document and a complete description may also be found in Appendix C of the C445 User manual.

While this application example uses a CompactLogix controller with embedded Ethernet/IP scanner port to control and monitor the C445 over Ethernet/IP, any Ethernet/IP scanner may be used for this purpose, including the 1756-ENBT with a ControlLogix PLC. RSLogix5000, version 20 programming software is used to create the CompactLogix project and create the Ethernet/IP network. The CompactLogix PLC will be configured to poll the C445XC-E card to operate and monitor the C445 motor management relay.

Beginning with version 20 of RSLogix5000, Ethernet/IP EDS files can be imported into the software tool allowing Eaton motor control products to be easily added to a project by name. It also allows the I/O assemblies to be chosen from a list for each device, making this process very straight-forward as well. While version 20 of RSLogix5000 was used for this example, the C445 will work with any version of RSLogix5000 that supports Ethernet/IP.

Eaton also has a software tool called EIP-Assist that will be described in more detail later in this document. This software tool creates an I/O tag file for Eaton Ethernet/IP products that can then be imported into RSLogix5000. The tags in this tag file are automatically aliased to the generic I/O tags created by RSLogix5000 for the Eaton motor control products such as the C445. These descriptive tags can then be used directly in the user program for controlling and monitoring the Eaton motor control products. This EIP-Assist software tool can be used to generate tags for up to 100 Eaton motor control products in a single spread sheet file to be imported into an RSLogix5000 project. These devices must already be included in the project prior to importing the tag file.

Configuring the C445XC-E Ethernet Module for the C445 Motor Management Relay

The IP addresses for the devices used in this example will be as follows:

C445XC-E: 192.168.1.8

CompactLogix PLC: 192.168.1.5
Computer: 192.168.1.51
Subnet mask: 255.255.255.0

Connect the C445XC-E card into the Base Control Module of the C445 system.
Connect your computer, PLC and the C445XC-E to an Ethernet switch.

To configure the IP address of the C445XC-E, use the dip switches on the Base Control Module, per the following instructions.

Configuring the IP address of the C445XC-E card via the dip switches on the Base Control Module

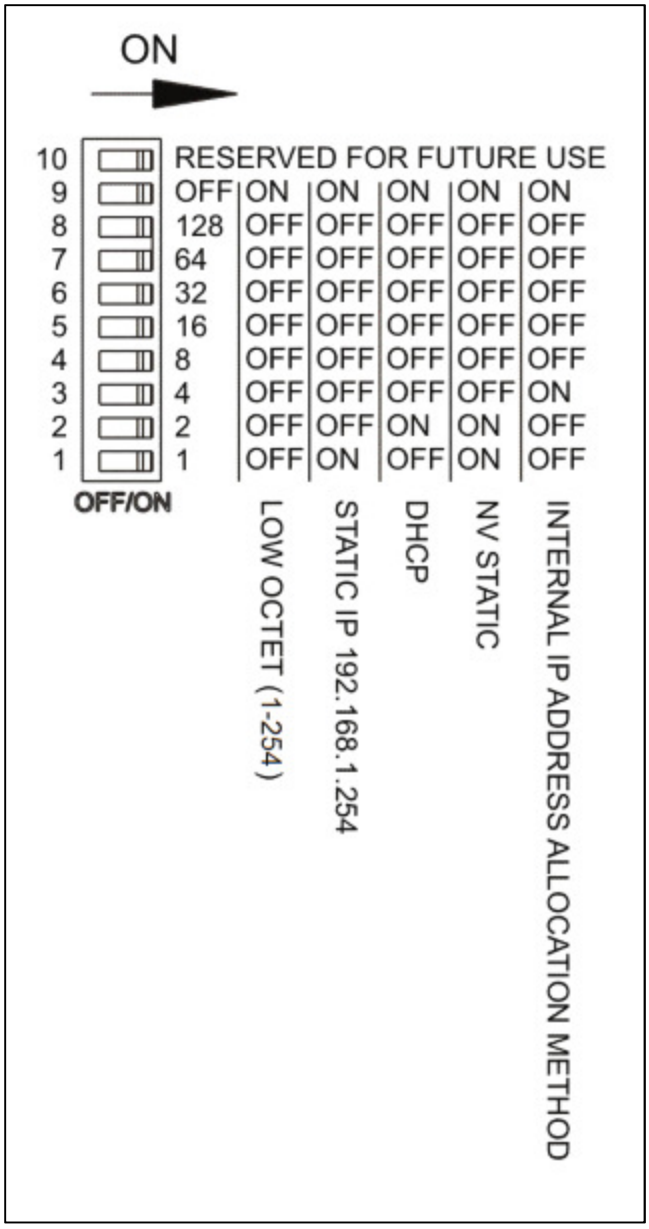
When an optional Ethernet card is inserted into a Base Control Module, the dip switches on the Base Control Module become dedicated to the IP Address for the Ethernet card as follows. As noted above, the IP address for the C445 Ethernet module in this example is 192.168.1.8.

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.



Descriptions

When switch 9 is OFF:

Low Octet: DIP Switch numbers set the low octet of the static IP address 192.168.1.X where X is 1 – 254

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 C445CX-E Ethernet Card.

1. Set DIP Switch 9 to OFF.

2. Set the DIP Switch with a value of 8 ON and leave the others OFF resulting in a value of 8 and an IP address of 192.168.1.8 assigned to the Ethernet Card.

3. Power cycle the C445 system so the new DIP Switch settings will be used.

Refer to the C445 Motor Management Relay User Manual, publication MN042003EN for information concerning all the options for setting the IP Address with the dip switches on the Base Control Module.

The C445XC-E auto senses the Ethernet protocol and the I/O assemblies. No configuration is necessary for it to respond to valid poll commands from an Ethernet/IP master using valid I/O assemblies.

Change the IP Address of your computer

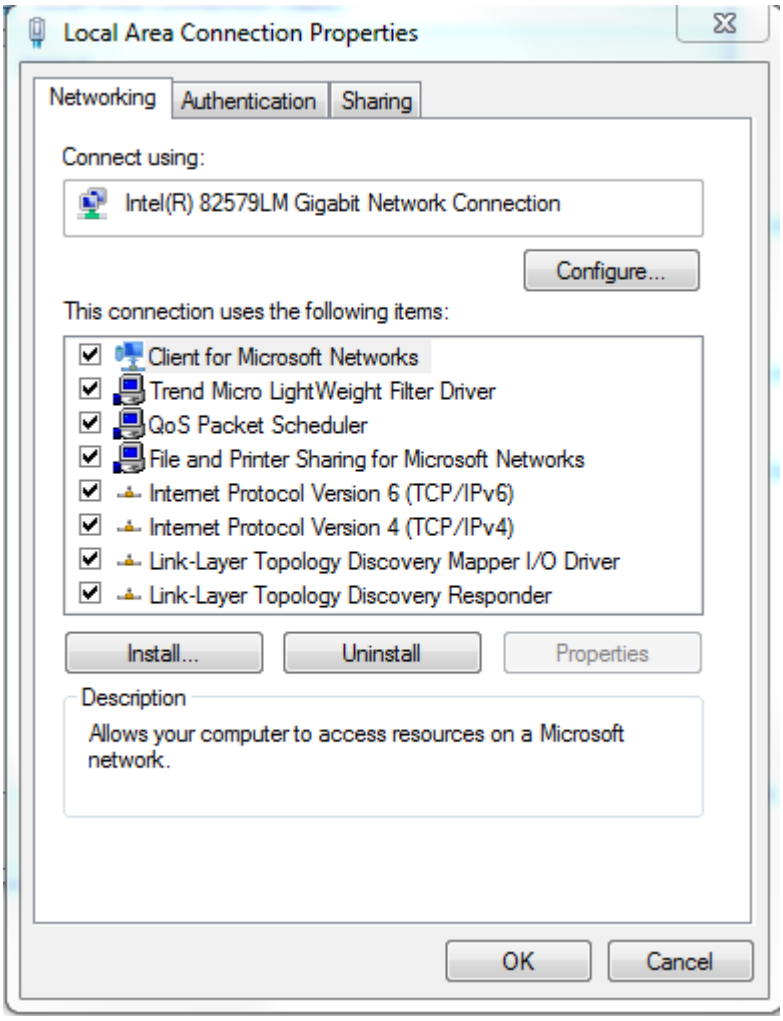
To change the IP address for a computer running Windows 7, follow the procedure below:

1. From the Start menu, choose Control Panel. From the Control Panel, choose Network and Sharing Center.

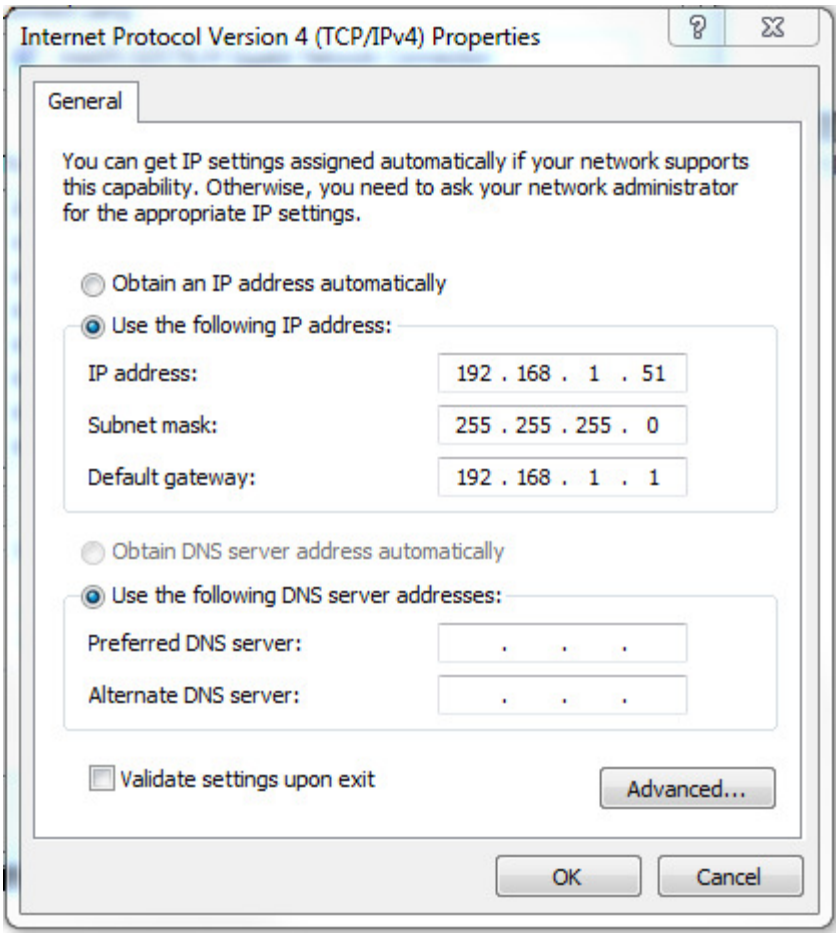
2. With the computer connected to an Ethernet network, select the Local Area Connection. Unless the computer is connected to a network, this Local Area Connection will not be present.

3. The Local Area Connection Status window will be displayed. Select Properties.

4. From the window shown below, select Internet Protocol Version 4 (TCP/IPv4) to highlight it, then select Properties.



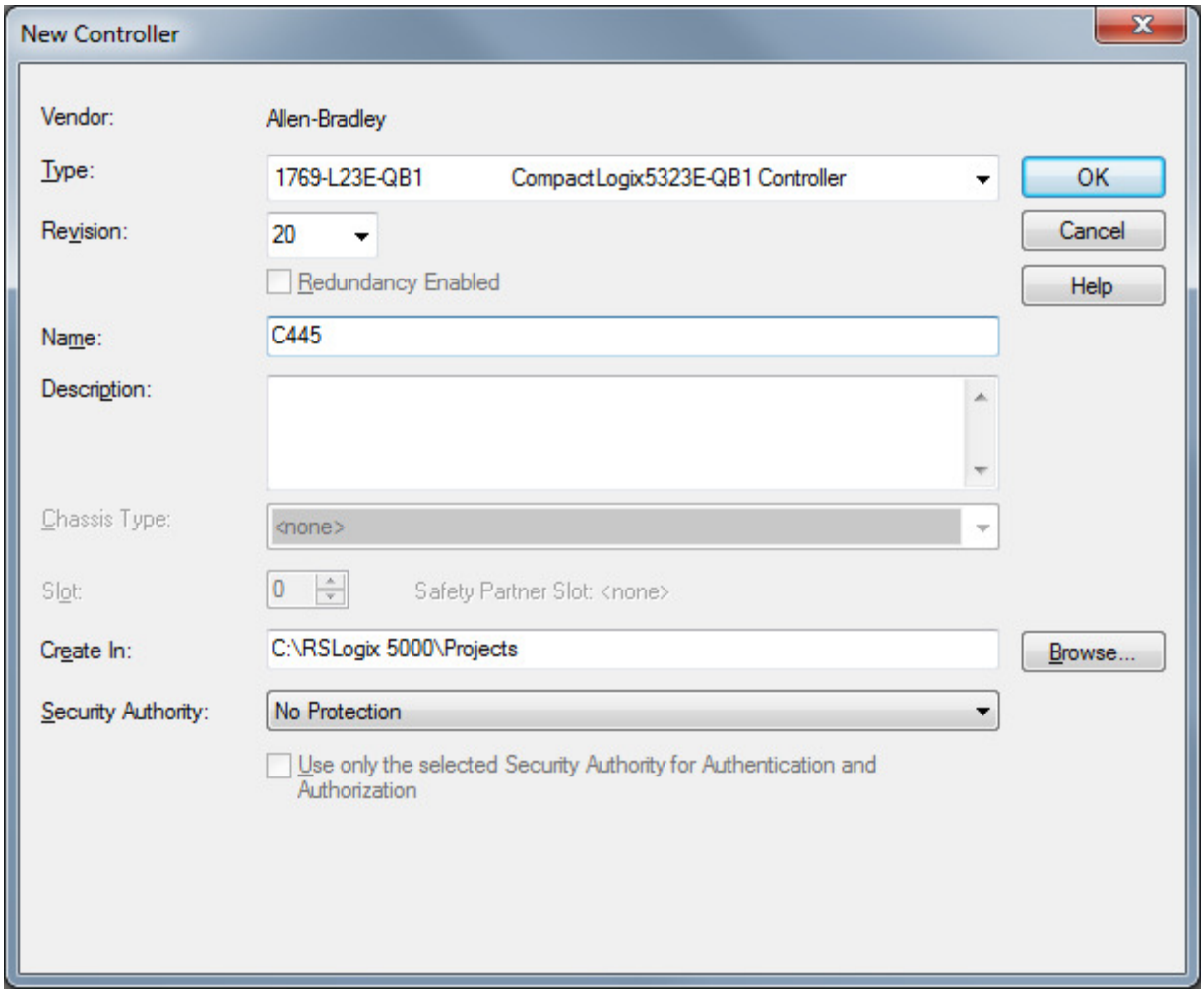
5. Per the following window, select Use the following IP Address, then enter an IP address, Subnet mask and a Default gateway if it applies.



6. When finished, select OK and close all the windows used along the way to get to this window. Your computer's Ethernet port will now be actively using the IP address and Subnet mask you just entered.

Creating a Project in RSLogix5000

Create a project in RSLogix5000. Give the project a name and select the controller type, per the following:



Select OK to create the project.

Install EDS Files for Eaton Products into RSLogix5000

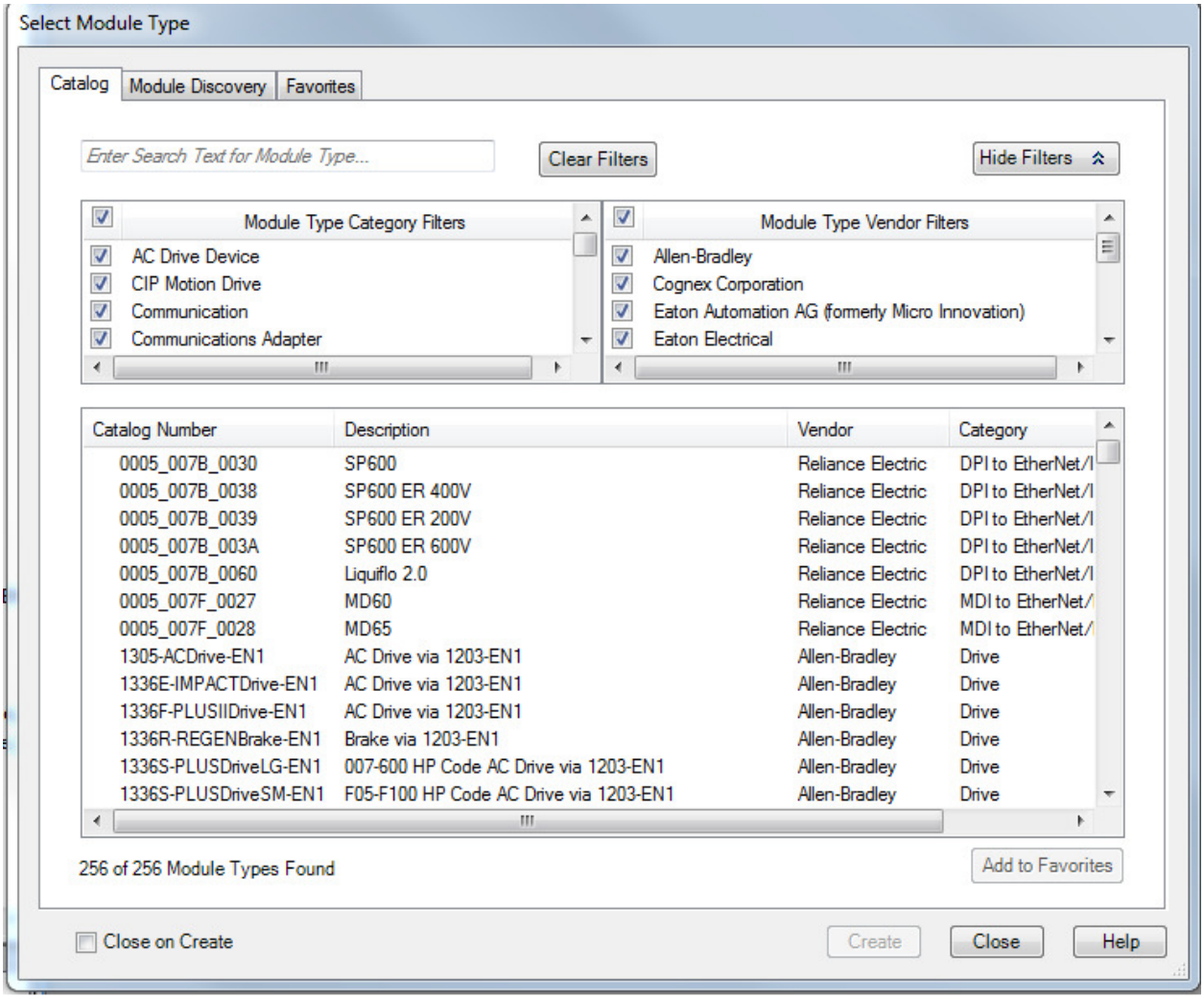
There is an Ethernet/IP EDS file for all Eaton Ethernet/IP motor control products, compatible with RSLogix5000, version 20 or later. These files can be installed into the RSLogix5000 software via the following:

1. Download the EDS files for Eaton Ethernet/IP products from the following link www.eaton.com/software and store them on your hard drive.
2. Select the Tools drop down menu in RSLogix5000
3. Select EDS Hardware Installation Tool
4. Follow the installation wizard, browsing for the EDS files previously saved to your hard drive.

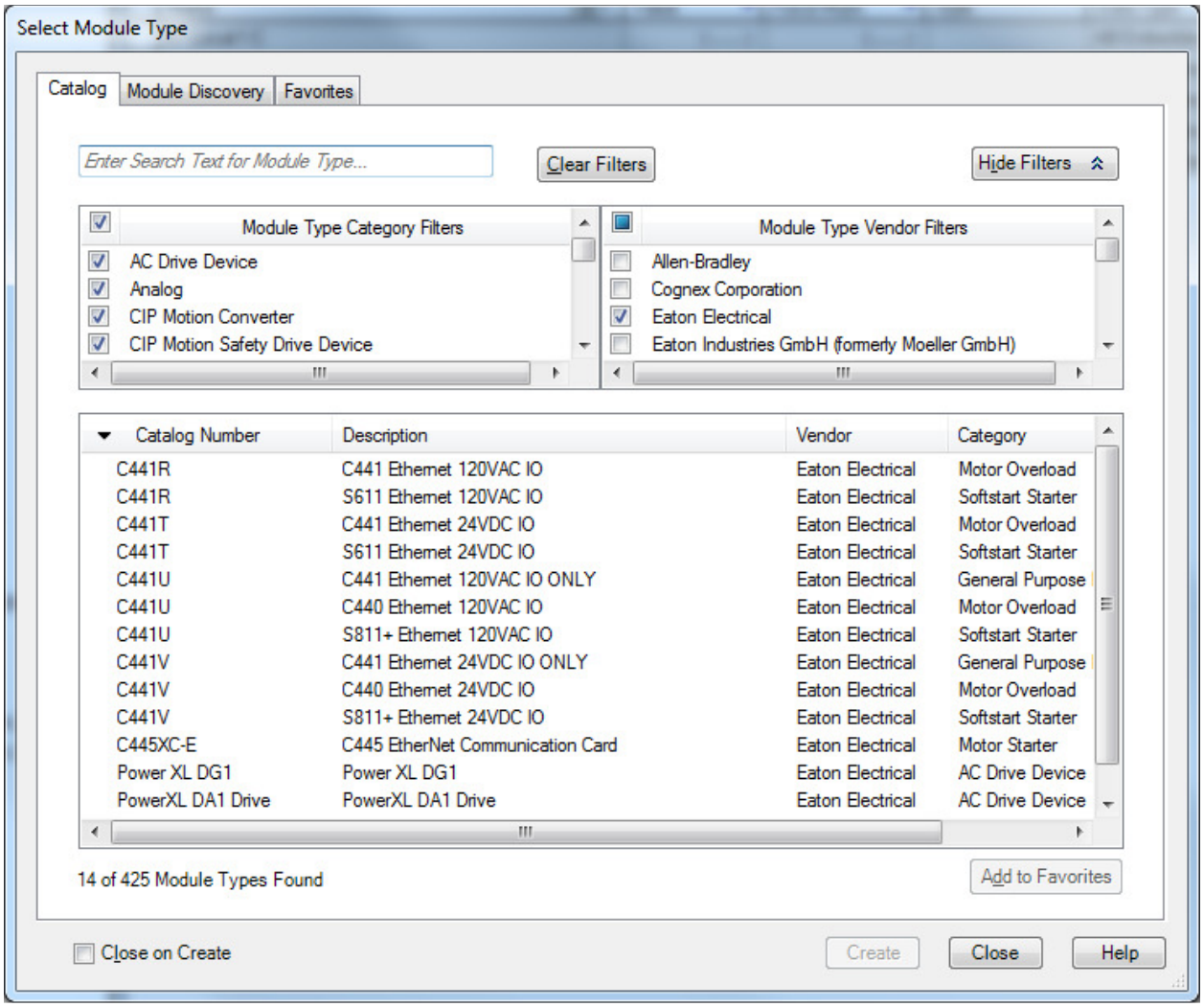
Once the EDS files have been installed into RSLogix5000, the C445XC-E card can be added to an Ethernet/IP network, per the following.

Creating an Ethernet/IP Network in RSLogix5000

On the left portion of the project screen in RSLogix5000, under I/O Configuration right click on Ethernet and select New Module. The following screen will open:

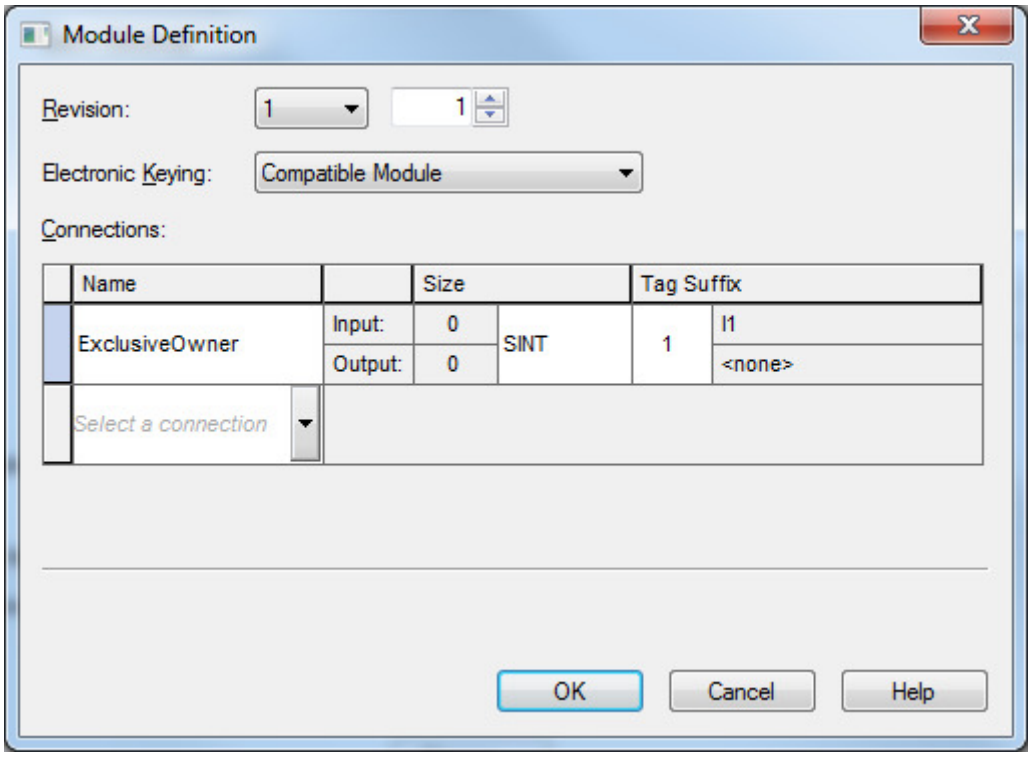


Select the check mark to the left of Module Type Vendor Filters to remove the check mark. Then select the box to the left of Eaton Electrical in the top right section to add a check mark and the Select Module Type screen should now look like the following. Notice it is now displaying only the Eaton motor control products with EDS files installed in this software.

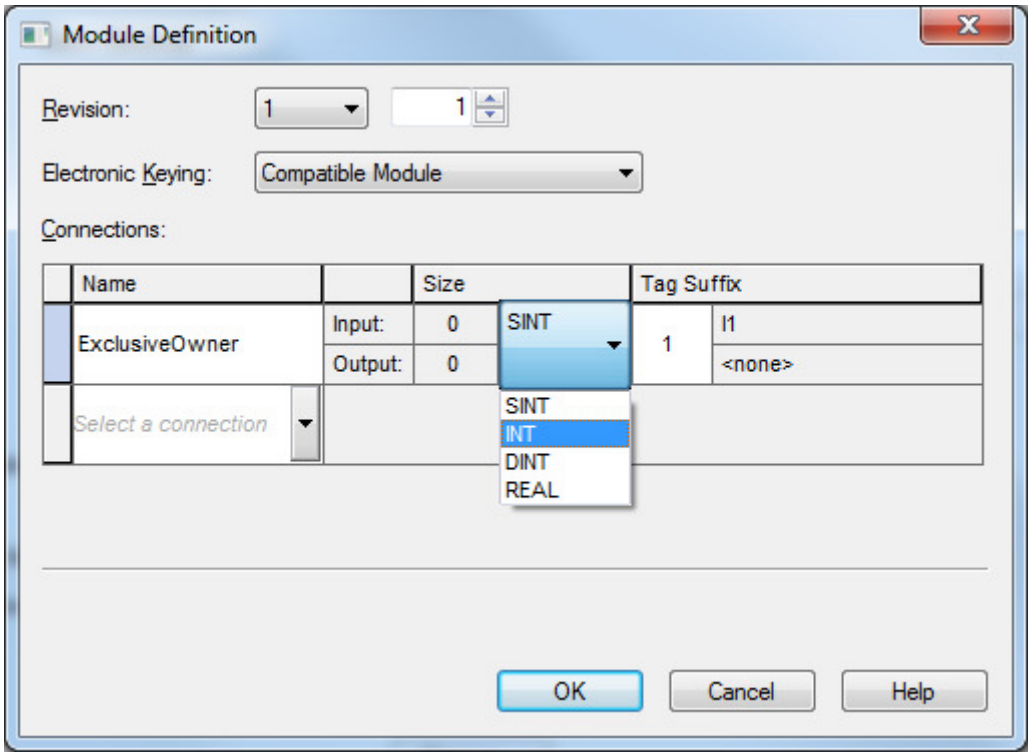


For this example, we will select the C445XC-E card, then select the Create button. Give the C445 a name and an IP address. The Name must not exceed 10 characters to work with EIP-Assist later. This name is used in EIP-Assist for this particular device. It must be entered exactly the same in EIP-Assist as it is entered here. The name used for this example is C445.

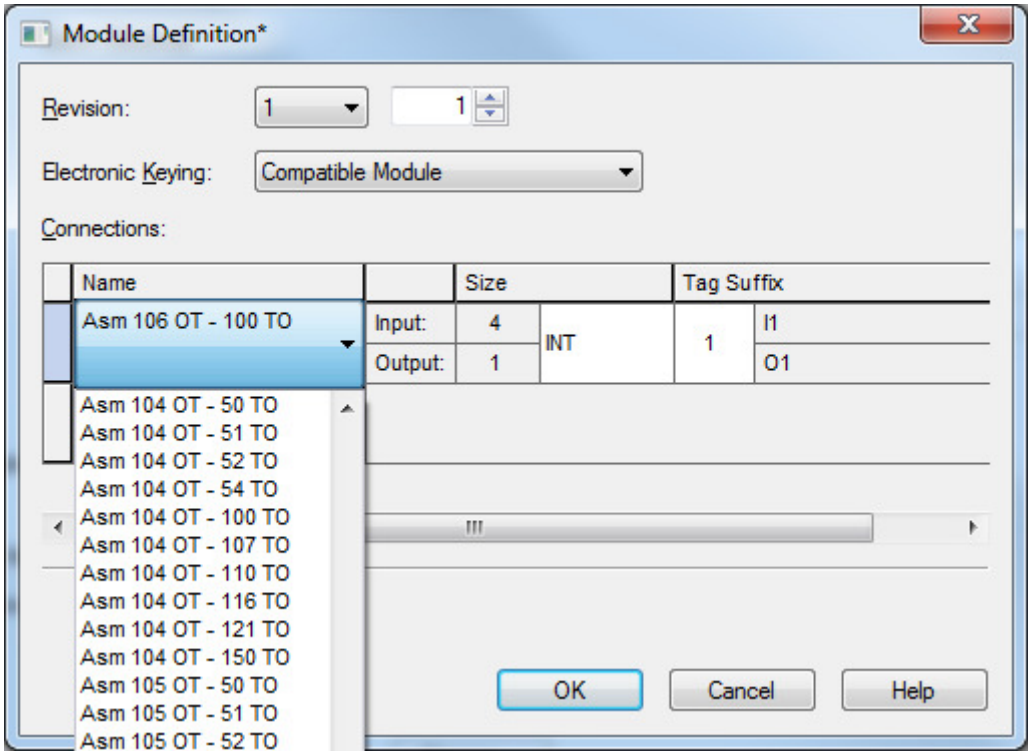
Next, select the Change… button on this Module Properties screen to open the Module Definition screen as follows:



The C445 does support I/O assemblies with an even number of bytes. This allows the INT (word) data type to be used so analog values such a currents, voltages, power and so on will be 16-bit integer values in the PLC program, making it much more straight forward to view and use for display purposes. Select the INT data type as shown below.



Select the white space to the right of Exclusive Owner under Name to display the I/O assembly pairs available for the C445. Every combination of I/O assembly pairs are available. For this example, select Asm 106 OT – 100 TO as follows.



The Input Assembly size is 4 integer words and the Output Assembly is 1 integer word, which is actually an array of bits. The data layout for the Input Assembly is as follows:

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."

The data layout for the Output Assembly is as follows:

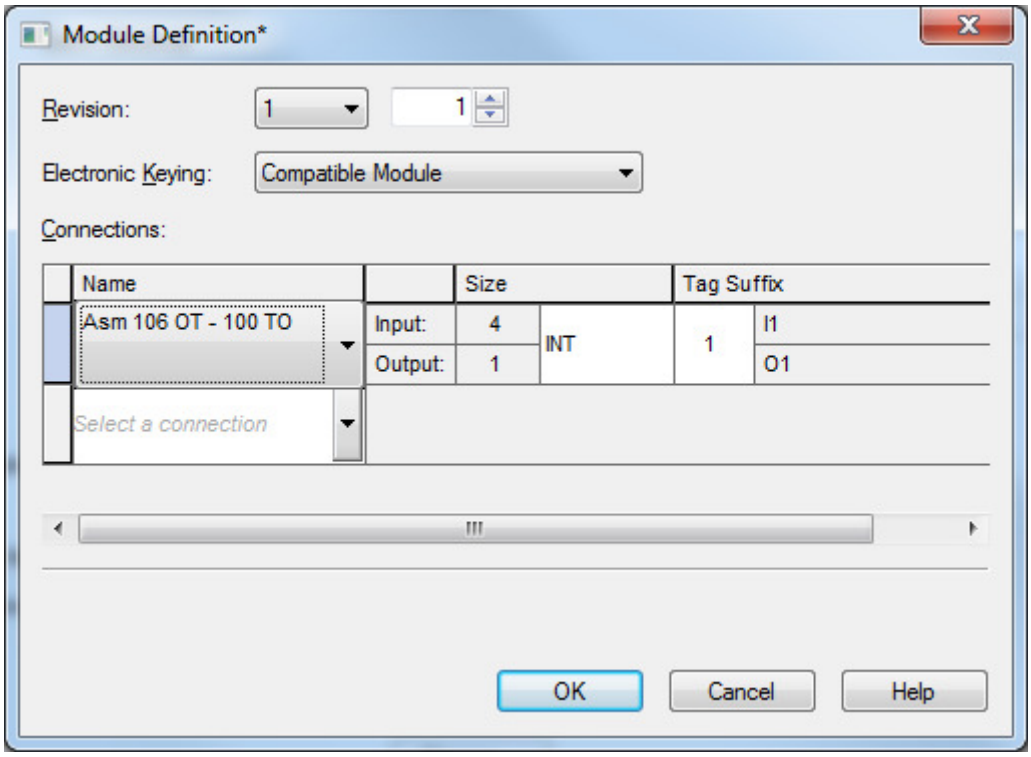
Output Instance 106(0x6A): Basic Output Control

Length = 2 Bytes

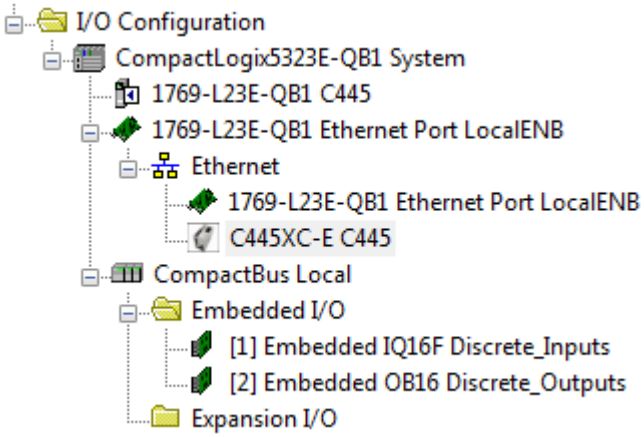
Byte Offset	Size (bytes)	Name	Description
0	2	Basic Control Relay	Basic Control Bits: (Byte1: DCI_NETCTRL_CONTROL_WORD) (Byte2: DCI_BCM_FIELD_OUTPUTS) Bit 0: Run1 Bit 1: Run2 Bit 2: Reserved Bit 3: Fault Reset Bit 4: Enable Control From Network Protocol Bit 5: Test Trip Bit 6: Reserved Bit 7: Reserved 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

The tags imported from the EIP-Assist Tool will be bits aliased to the generic tags created for the first word of the input assembly data and output assembly data word, with the same tag names as shown above. The Current values in the Input Assembly data will be represented as 3 integer word tags. Tags with these names will also be created then imported from the EIP-Assist Tool and aliased to the generic tags created by RSLogix5000. This will be more apparent later in this application note when the CSV file is imported into the RSLogix5000 project.

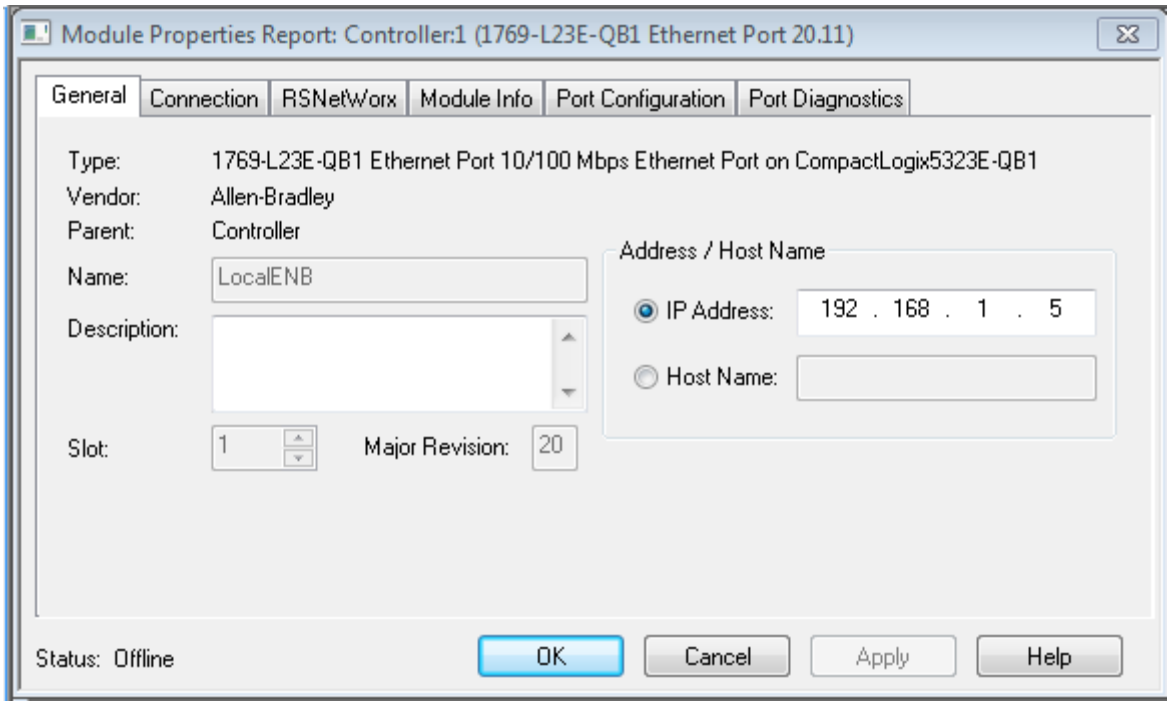
The Module Definition window will look like the following:



Select OK, then Yes for the information screen. Then select OK for the Module Properties screen for the C445 Module. It will then appear under the Ethernet/IP master on the lower left portion of the project as follows:



Next double click the 1769-L23E-QB1 Ethernet Port LocalENB located directly above the C445 Module. Set the IP address for this port from its Properties screen as shown below.



Click OK to save and close this screen.

Double click Controller Tags near the top of the Controller Organizer to open the Controller Tags window on the right portion of the screen. There will be 4 INT tags of input and 1 INT output word created for the C445 per the following:

Name	Value	Force Mask	Style	Data Type	Description
Local:1:C	{...}	{...}		AB:Embedded_IQ16F:C:0	
Local:1:I	{...}	{...}		AB:Embedded_IQ16F:I:0	
Local:2:C	{...}	{...}		AB:Embedded_OB16:C:0	
Local:2:I	{...}	{...}		AB:Embedded_OB16:I:0	
Local:2:O	{...}	{...}		AB:Embedded_OB16:O:0	
C445:I1	{...}	{...}		_0044:C445XC_E_A07EED95:I:0	
C445:I1.ConnectionFaulted	0		Decimal	BOOL	
C445:I1.Data	{...}	{...}	Decimal	INT[4]	
C445:I1.Data[0]	0		Decimal	INT	
C445:I1.Data[1]	0		Decimal	INT	
C445:I1.Data[2]	0		Decimal	INT	
C445:I1.Data[3]	0		Decimal	INT	
C445:O1	{...}	{...}		_0044:C445XC_E_F5E3CF1A:O:0	
C445:O1.Data	{...}	{...}	Decimal	INT[1]	
C445:O1.Data[0]	0		Decimal	INT	

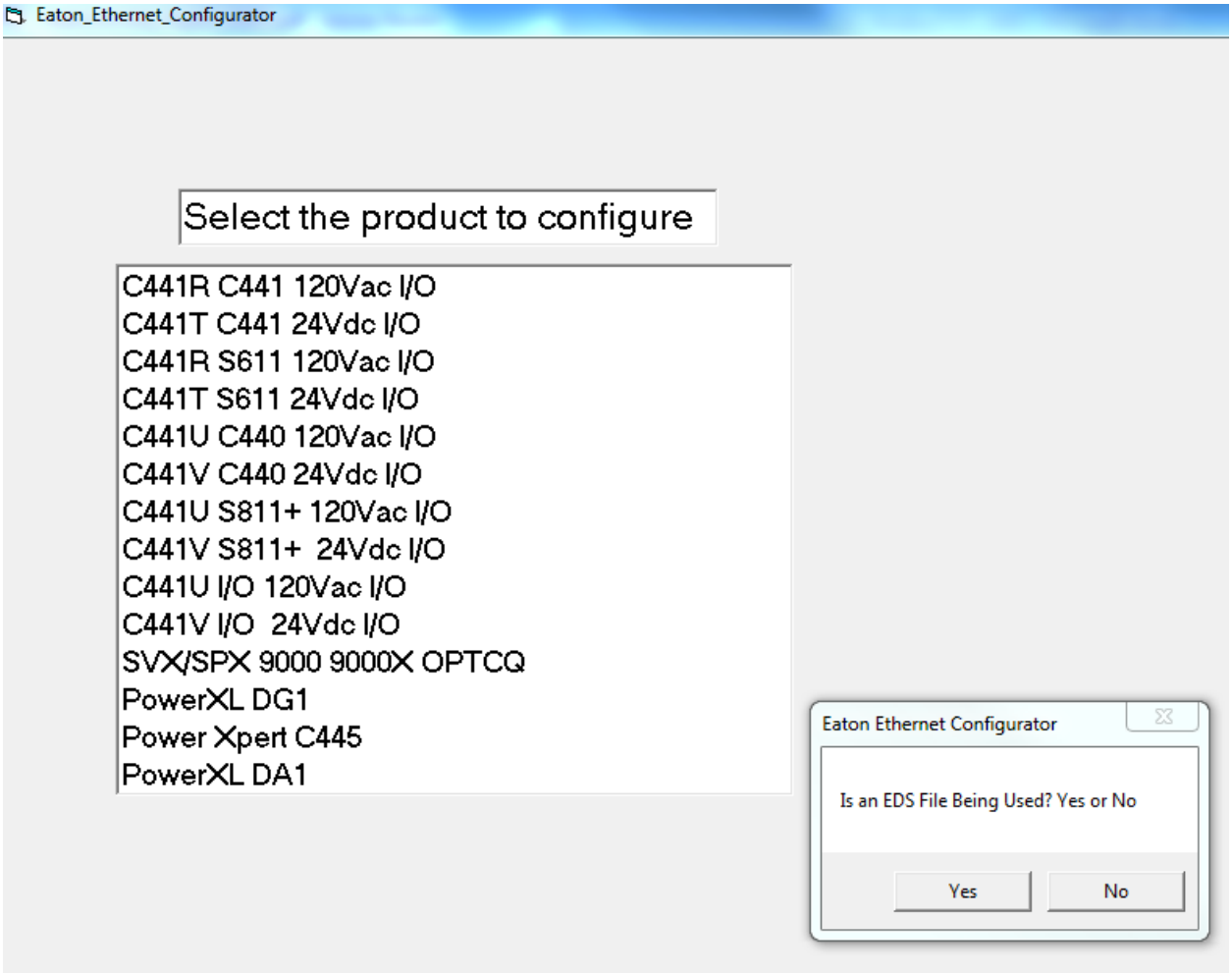
These are generic tags with the name previously entered into its Ethernet/IP Properties used to identify the tags. This same name, in this case C445 must also be used for this device in EIP-Assist to uniquely identify it.

Creating a CSV file for the C445 I/O Tags in Eaton's EIP-Assist Software

The EIP-Assist Tool and a user manual for it can be found at the following link:

www.eaton.com/software

Once downloaded, double click its icon. The splash screen will open for a few seconds, then the following window will be displayed.



Ethernet/IP slave devices can be added to a network in RSLogix5000 by importing and using EDS files for each device or by using the Generic Ethernet Device selection. Since all Eaton Ethernet/IP products have a current EDS file and since we installed the EDS file for the C445XC-E card earlier and used it, we will select Yes to the question: Is an EDS File Being Used?.

Then select the Power Xpert C445 from the list and enter a quantity of 1 when the next window appears. Then select the I/O pair of your choice, 106/100 is used for this example. The software will then prompt for the selection of using the INT or SINT data type. We selected the INT data type in RSLogix5000, so we must also say Yes to this question in EIP-Assist.

A Browse for Folder window will then be displayed. Browse for a folder where you want to save the CSV Tag file this tool will generate. Also, provide a name for that file when the next window appears.

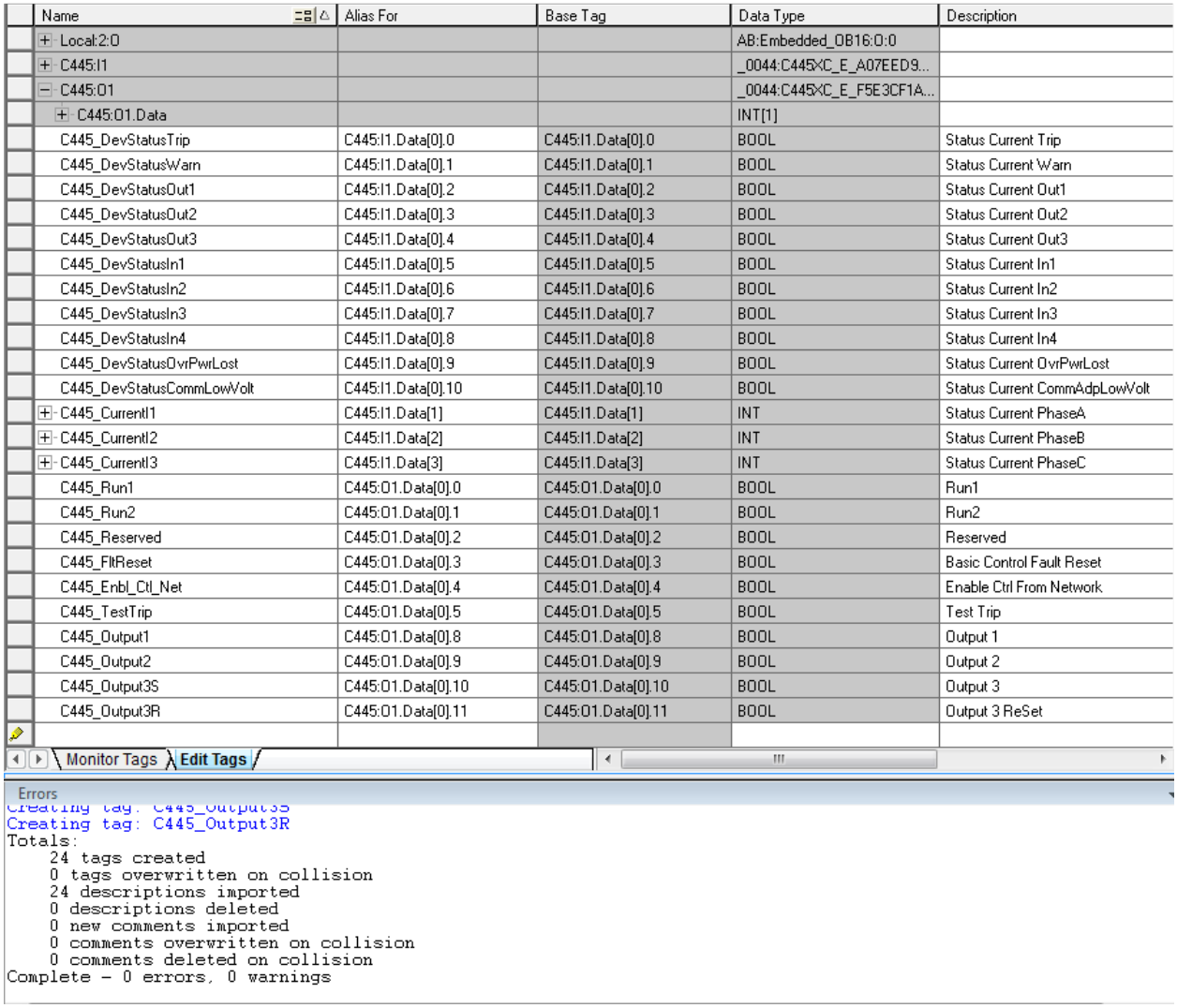
You will then be prompted for a Module Device Name. It is very important that the name you provided for this device in RSLogix5000 is entered here. The name cannot exceed 10 characters. If the name you provided for this device in RSLogix5000 was longer than 10 characters, you must go back and change it before continuing with this tool. The name used for this example is C445.

You will then be prompted if you wish to add additional products. Select No for this example, but this tool supports up to 100 Eaton Ethernet/IP slave devices per CSV file. If more are needed, the tool may be

executed again to include those devices in another CSV file, which can also be imported into the same RSLogix5000 project. The final window displays the path the CSV file will be stored in, based on the path provided earlier.

Importing the CSV File created for the C445 using the EIP-Assist Tool

While viewing the Controller Tags in RSLogix5000, select the Tools drop down menu, then select Import/Tags and Logic Comments. Browse for the CSV file previously created with EIP-Assist, then select the Import button. The descriptive tags for the C445 will be imported and aliased to the generic I/O tags. The tags are linked by the name given the C445 in both software tools. The descriptive tags shown below for the C445 can now be used in the PLC program. No tags need to be manually entered into RSLogix5000 for any Eaton Ethernet/IP products, saving a lot of time, effort and typing errors.



Name	Alias For	Base Tag	Data Type	Description
Local:2:O			AB:Embedded_OB16:O:0	
C445:I1			_0044:C445XC_E_A07EED9...	
C445:O1			_0044:C445XC_E_F5E3CF1A...	
C445:O1.Data			INT[1]	
C445_DevStatusTrip	C445:I1.Data[0].0	C445:I1.Data[0].0	BOOL	Status Current Trip
C445_DevStatusWarn	C445:I1.Data[0].1	C445:I1.Data[0].1	BOOL	Status Current Warn
C445_DevStatusOut1	C445:I1.Data[0].2	C445:I1.Data[0].2	BOOL	Status Current Out1
C445_DevStatusOut2	C445:I1.Data[0].3	C445:I1.Data[0].3	BOOL	Status Current Out2
C445_DevStatusOut3	C445:I1.Data[0].4	C445:I1.Data[0].4	BOOL	Status Current Out3
C445_DevStatusIn1	C445:I1.Data[0].5	C445:I1.Data[0].5	BOOL	Status Current In1
C445_DevStatusIn2	C445:I1.Data[0].6	C445:I1.Data[0].6	BOOL	Status Current In2
C445_DevStatusIn3	C445:I1.Data[0].7	C445:I1.Data[0].7	BOOL	Status Current In3
C445_DevStatusIn4	C445:I1.Data[0].8	C445:I1.Data[0].8	BOOL	Status Current In4
C445_DevStatusOvrPwrLost	C445:I1.Data[0].9	C445:I1.Data[0].9	BOOL	Status Current OvrPwrLost
C445_DevStatusCommLowVolt	C445:I1.Data[0].10	C445:I1.Data[0].10	BOOL	Status Current CommAdpLowVolt
C445_CurrentI1	C445:I1.Data[1]	C445:I1.Data[1]	INT	Status Current PhaseA
C445_CurrentI2	C445:I1.Data[2]	C445:I1.Data[2]	INT	Status Current PhaseB
C445_CurrentI3	C445:I1.Data[3]	C445:I1.Data[3]	INT	Status Current PhaseC
C445_Run1	C445:O1.Data[0].0	C445:O1.Data[0].0	BOOL	Run1
C445_Run2	C445:O1.Data[0].1	C445:O1.Data[0].1	BOOL	Run2
C445_Reserved	C445:O1.Data[0].2	C445:O1.Data[0].2	BOOL	Reserved
C445_FltReset	C445:O1.Data[0].3	C445:O1.Data[0].3	BOOL	Basic Control Fault Reset
C445_Enbl_Ctl_Net	C445:O1.Data[0].4	C445:O1.Data[0].4	BOOL	Enable Ctrl From Network
C445_TestTrip	C445:O1.Data[0].5	C445:O1.Data[0].5	BOOL	Test Trip
C445_Output1	C445:O1.Data[0].8	C445:O1.Data[0].8	BOOL	Output 1
C445_Output2	C445:O1.Data[0].9	C445:O1.Data[0].9	BOOL	Output 2
C445_Output3S	C445:O1.Data[0].10	C445:O1.Data[0].10	BOOL	Output 3
C445_Output3R	C445:O1.Data[0].11	C445:O1.Data[0].11	BOOL	Output 3 ReSet

Monitor Tags | Edit Tags

Errors

```
Creating tag: C445_Output3S
Creating tag: C445_Output3R
Totals:
    24 tags created
    0 tags overwritten on collision
    24 descriptions imported
    0 descriptions deleted
    0 new comments imported
    0 comments overwritten on collision
    0 comments deleted on collision
Complete - 0 errors, 0 warnings
```

References

C445 Motor Management Relay User Manual, publication MN042003EN

Power Xpert inControl software user manual, publication MN040013E

Additional Help

In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-326-2273.

All other supporting documentation is located on the Eaton web site at www.eaton.com

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