Operating a Power Xpert C445 Global Motor Management Relay with a Siemens PLC via Profibus DP

Introduction

The purpose of this application note is to demonstrate how to operate and monitor a C445 Motor Management Relay via a Profibus DP network and a Siemens Simatic PLC with a Profibus master module. The C445XC-P PROFIBUS module is used to interface the C445 to the PROFIBUS network.

A GSD file is available for the C445XC-P and it may be downloaded from the Eaton website. The Profibus address is configured using the dip switches on the Base Control Module.

While this application example uses a Siemens Simatic S7-1200 controller with a Profibus DP master module to control and monitor the C445, any PROFIBUS master may be used for this purpose. Siemens Simatic Step 7 Basic, V13 programming software was used for this application example. The Simatic S7 PLC will be configured to poll the Motor Insight to operate and monitor the C445 Motor Management Relay.

The C445XC-P module supports PROFIBUS DPV0 and DPV1 functionality. This document will demonstrate how to configure the Profibus master to monitor motor and status parameters from the C445 as well as controlling a motor via the C445.

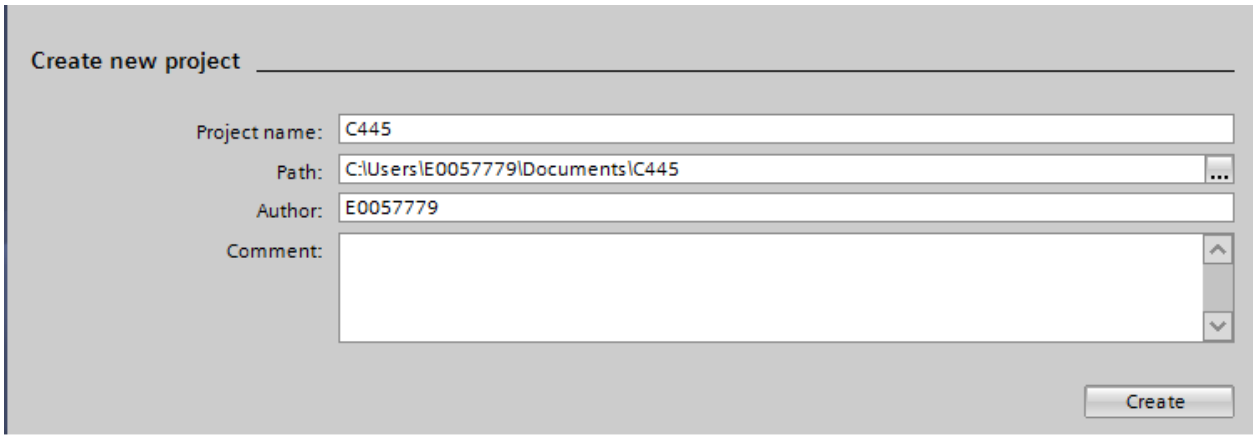
System Overview

The C445 Relay uses Output1 on the Base Control Module in the Direct Operation Mode to control a FVNR motor via a separate contactor. An Eaton XT or Freedom contactor is used. Output1 is a normally open relay contact wired to the contactor coil. This output supports both 24vdc and 120vac. Output1 also acts as the fault/trip contact for protecting the motor. The Siemens PLC controls the motor over Profibus via the relay output by turning the Run bit on. The C445 protects the motor by opening this relay output contact when a fault or trip condition occurs. Complete wiring diagrams for all supported operation modes for the C445 can be found in the C445 user manual, publication MN042003EN.

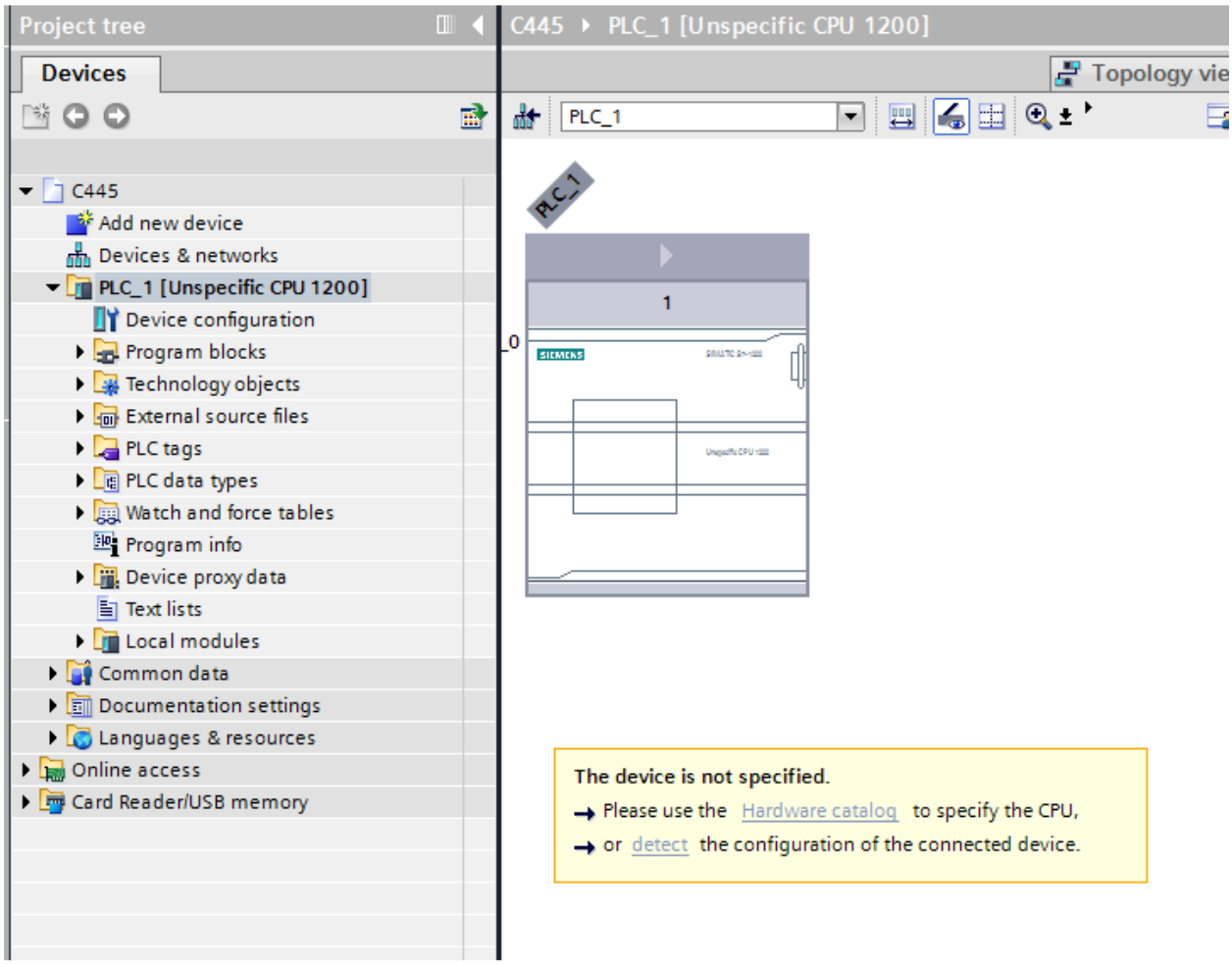
Creating a Project in Siemens Simatic Software

Create a project in Simatic software by starting the software and selecting Create New Project.

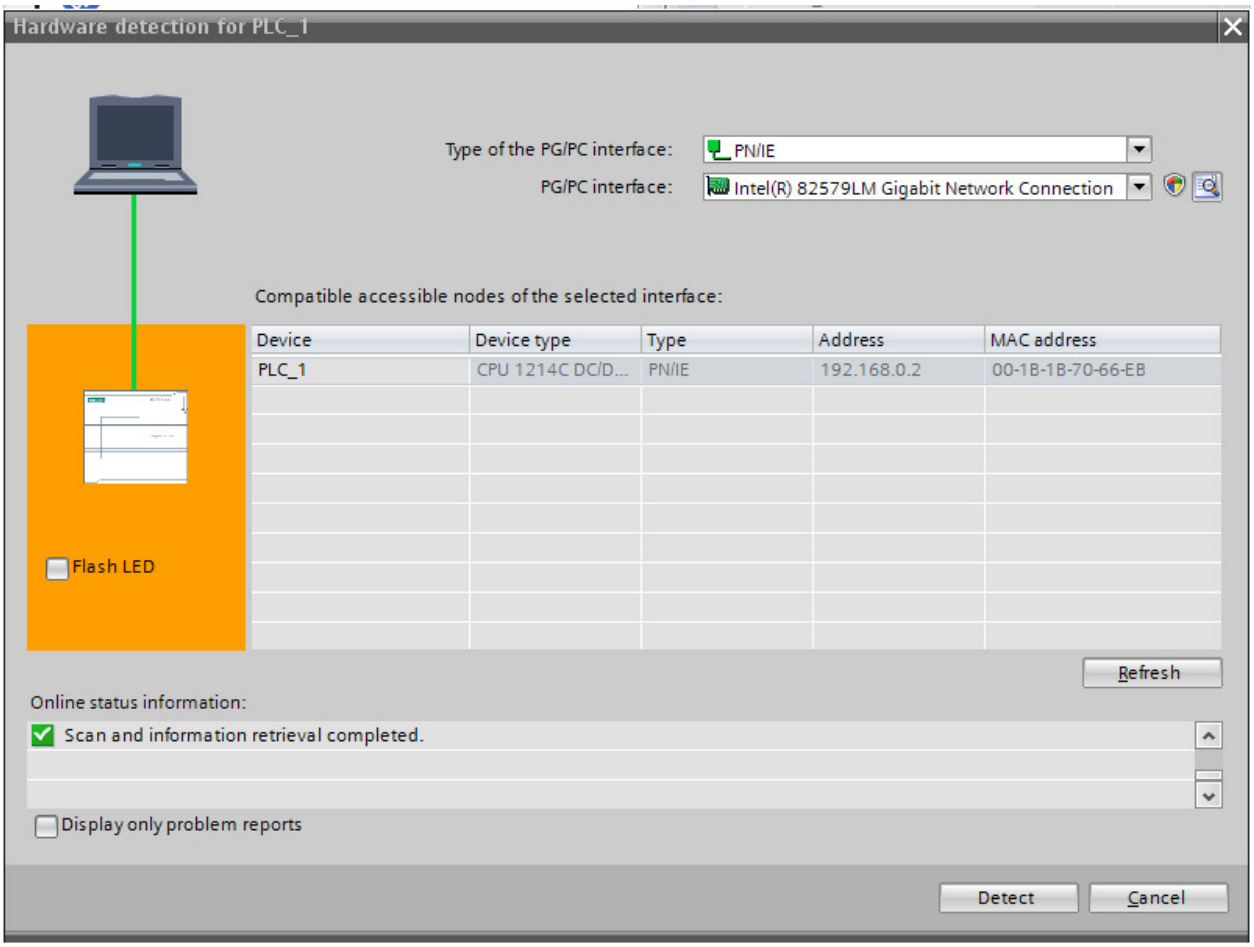
Enter a Project name and Path where the project will be stored, then select the Create button per the following:



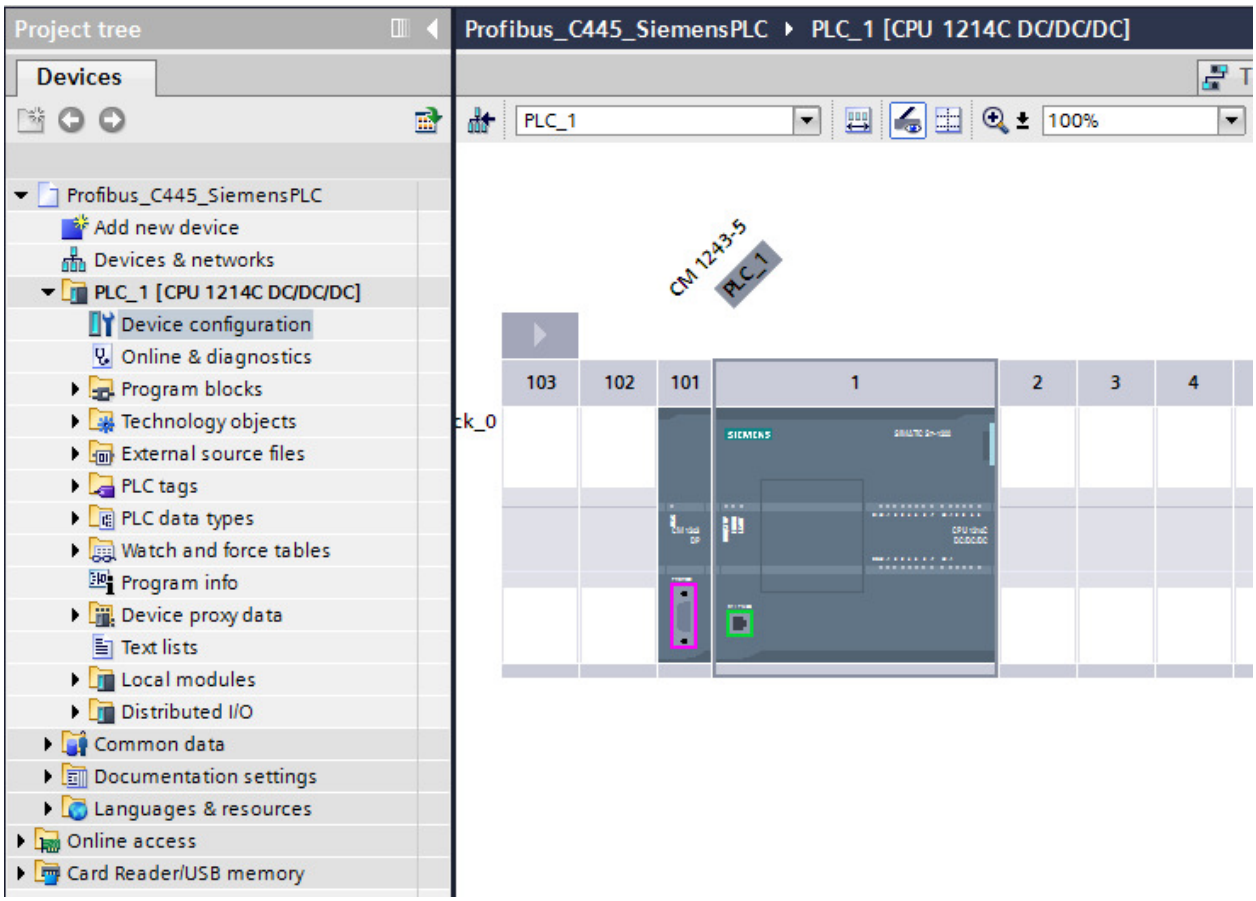
From the next screen, select Configure a device, then select Add new device. An S7-1200 PLC is being used for this application. Select the CPU under Unspecified CPU 1200. Choose the correct version (V3.0 for this example) and select the ADD button. The following Project View will be displayed, showing a generic CPU.



Click the CPU box to select it, then select “detect” in the yellow area below it. The Hardware Detection screen will be displayed as follows:

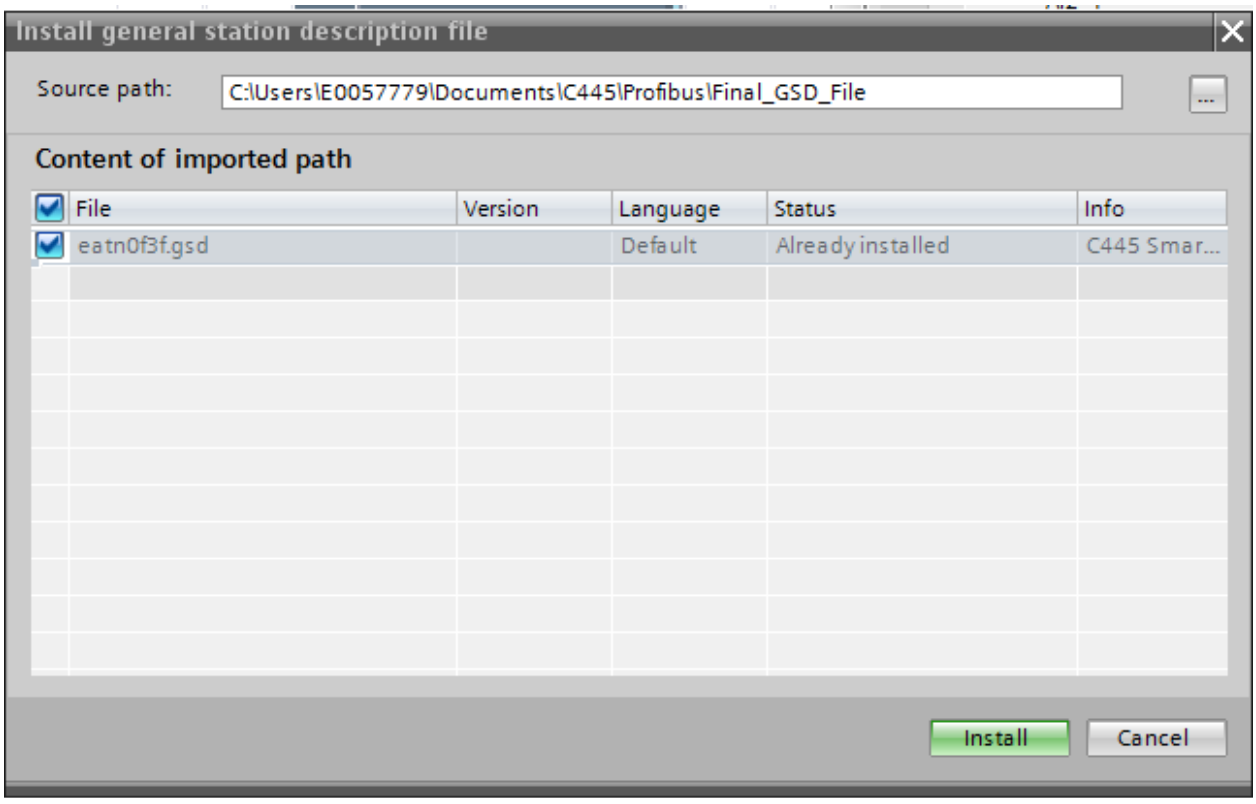


For this example, the Ethernet port on the PLC is being used to communicate with the PLC. It will also be used to upload/download the project later. Set up your computer and software to communicate with your PLC. Once communications is properly set up, select the Detect button and the software will detect the actual controller type and the Profibus master module connected to it as follows:



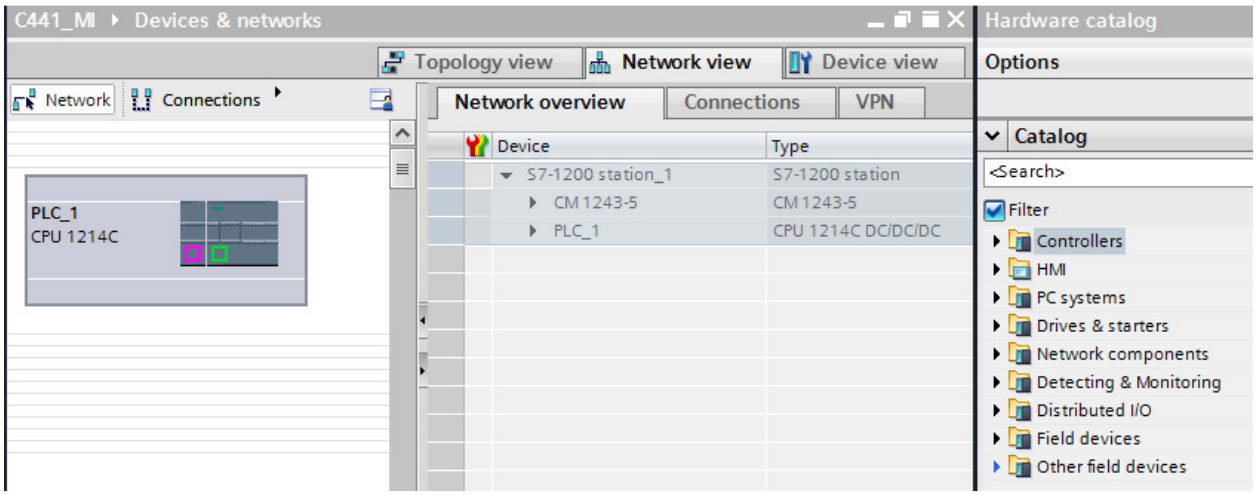
Connect a standard Profibus cable between the PROFIBUS master and the C441Q/S module. Use the standard Profibus connectors and turn on the termination on one or both ends. Refer to the C445 User Manual (publication MN042003EN) for details on the PROFIBUS cable connector pinouts if needed.

Then in the Simatic software, select the Options drop down menu and choose: “Install general station description file (gsd)”. Download the GSD file from the Eaton website for the C441Q/S modules, then search for it on your hard drive by selecting the ellipses in the upper right hand corner of the following screen:

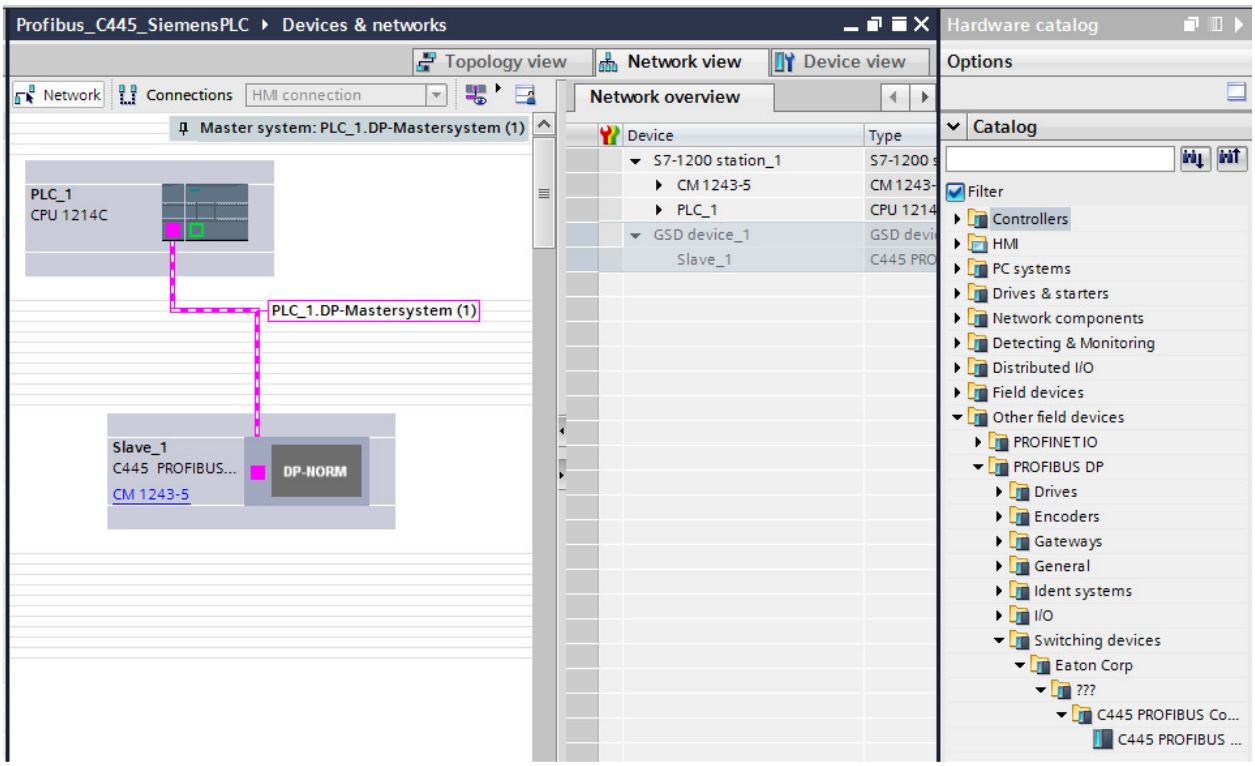


Select the 2 boxes by selecting the box next to File and next to the C445 GSD file, then select Install and follow the directions to install the GSD file for the C445 Motor Management Relay.

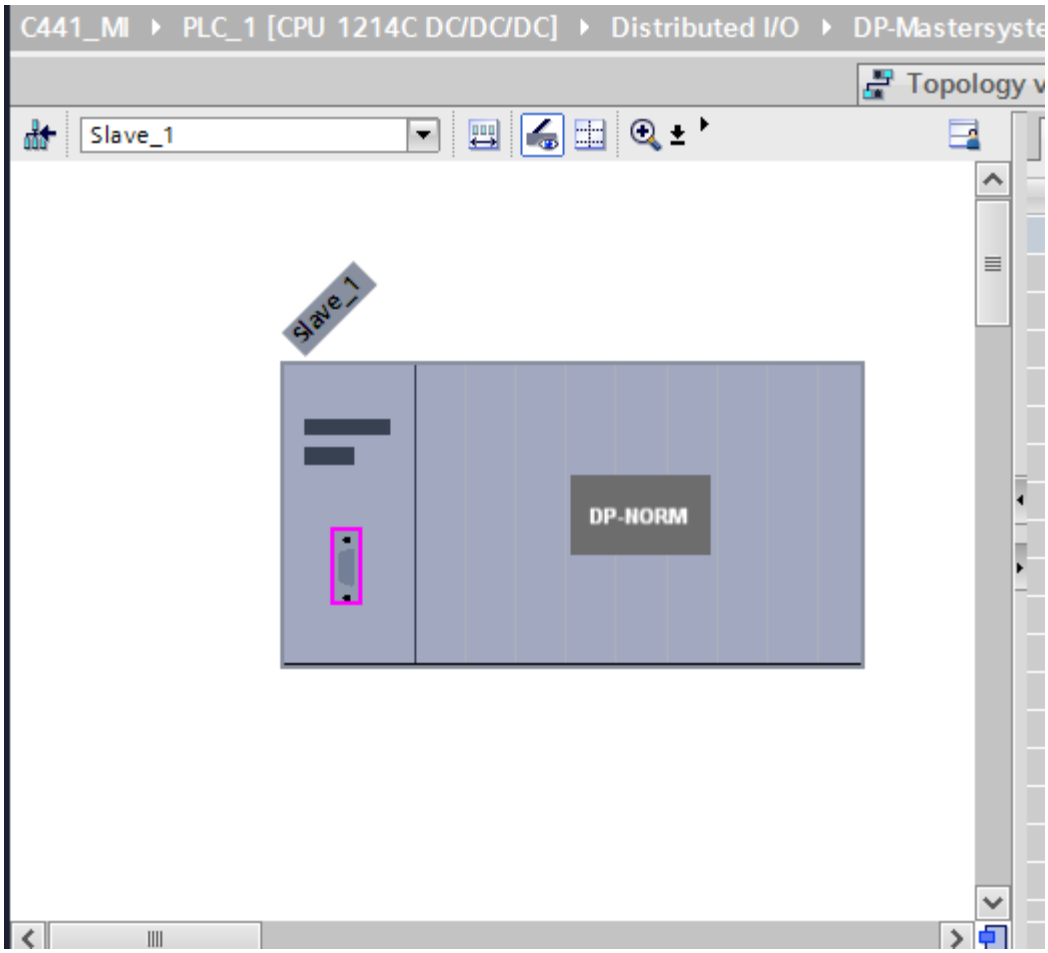
Per the following, select the Network View tab.



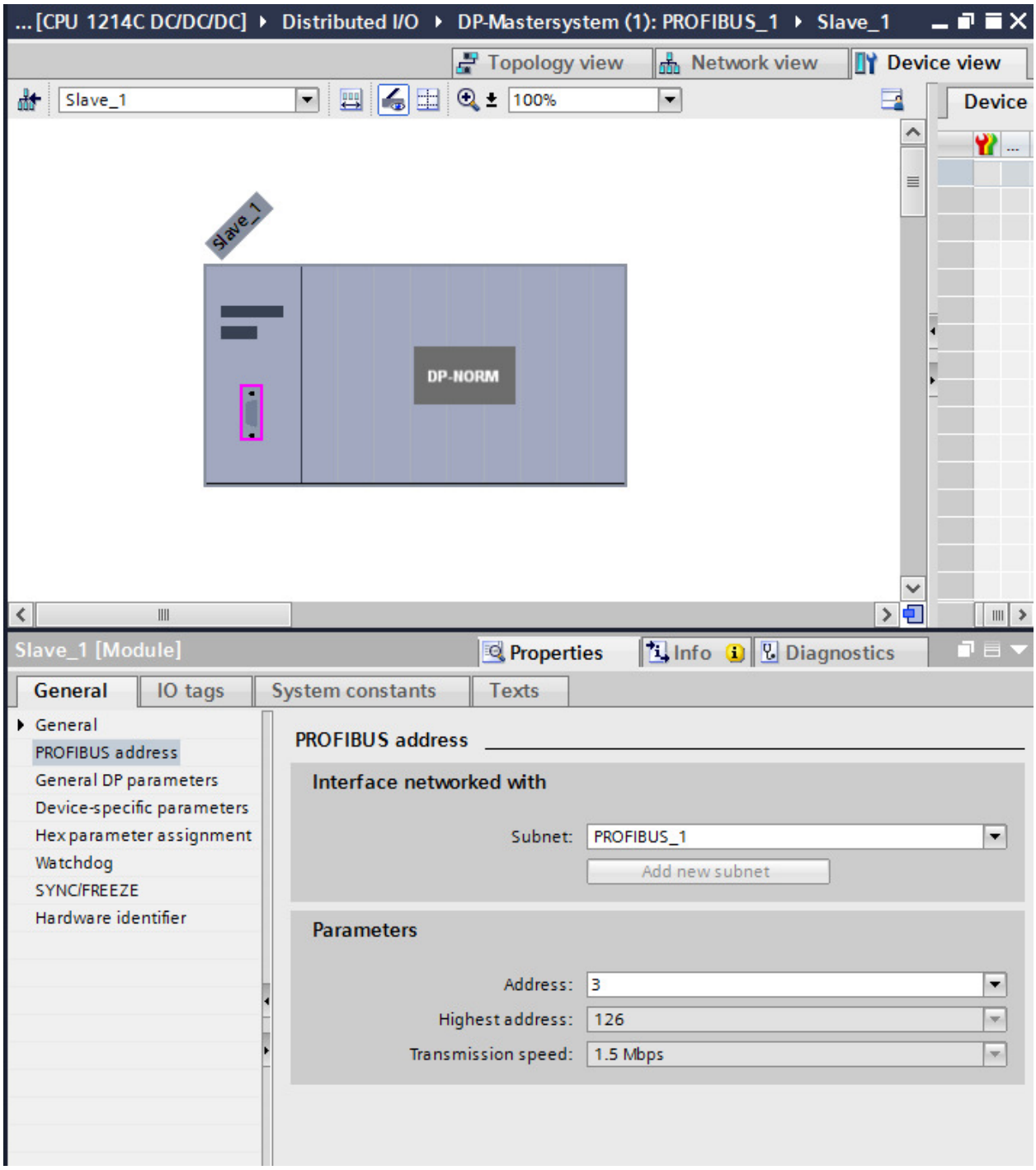
The PLC will be displayed. In the Catalog at the far right, select the arrow next to “Other field devices”, then next to PROFIBUS DP / Switching devices / Eaton Corp / ??? /C445 PROFIBUS Communication Card / C445 PROFIBUS Communication Card. Drag and drop the device called C445 PROFIBUS Communication Card below the controller/PROFIBUS master on the Network View screen. Then select the purple square on the PROFIBUS master and drag it to the purple square on the C445 PROFIBUS Option Board and release the mouse button. The following should now be displayed:



The Profibus network has been created in the offline project. Double click the Slave_1 C445 PROFIBUS module and the following will be displayed:

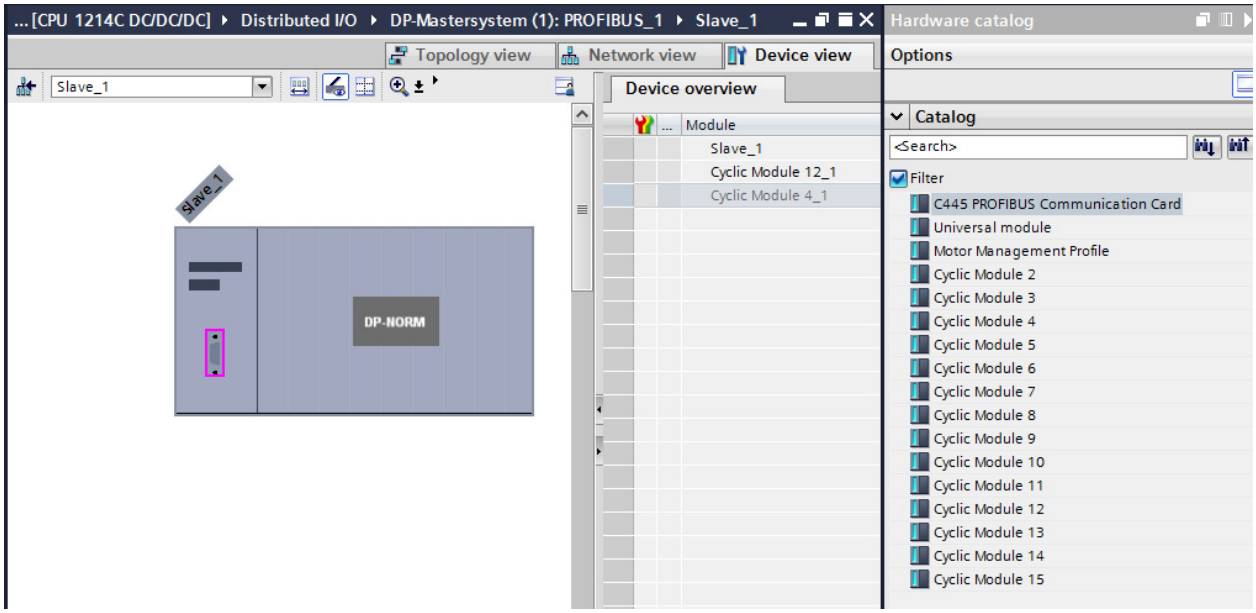


Double click the Slave_1 box and its Properties will open below it as follows:



Change the Profibus address to match the address selected on the C445 Base Control Module for the C445XC-P PROFIBUS card. For this example, the Profibus address being used is 3. The Transmission speed will default to 1.5 Mbps, which is fine. Any speed will work here because the C445XC-P card is set to Auto. The data rate is dependent on the overall network cable length.

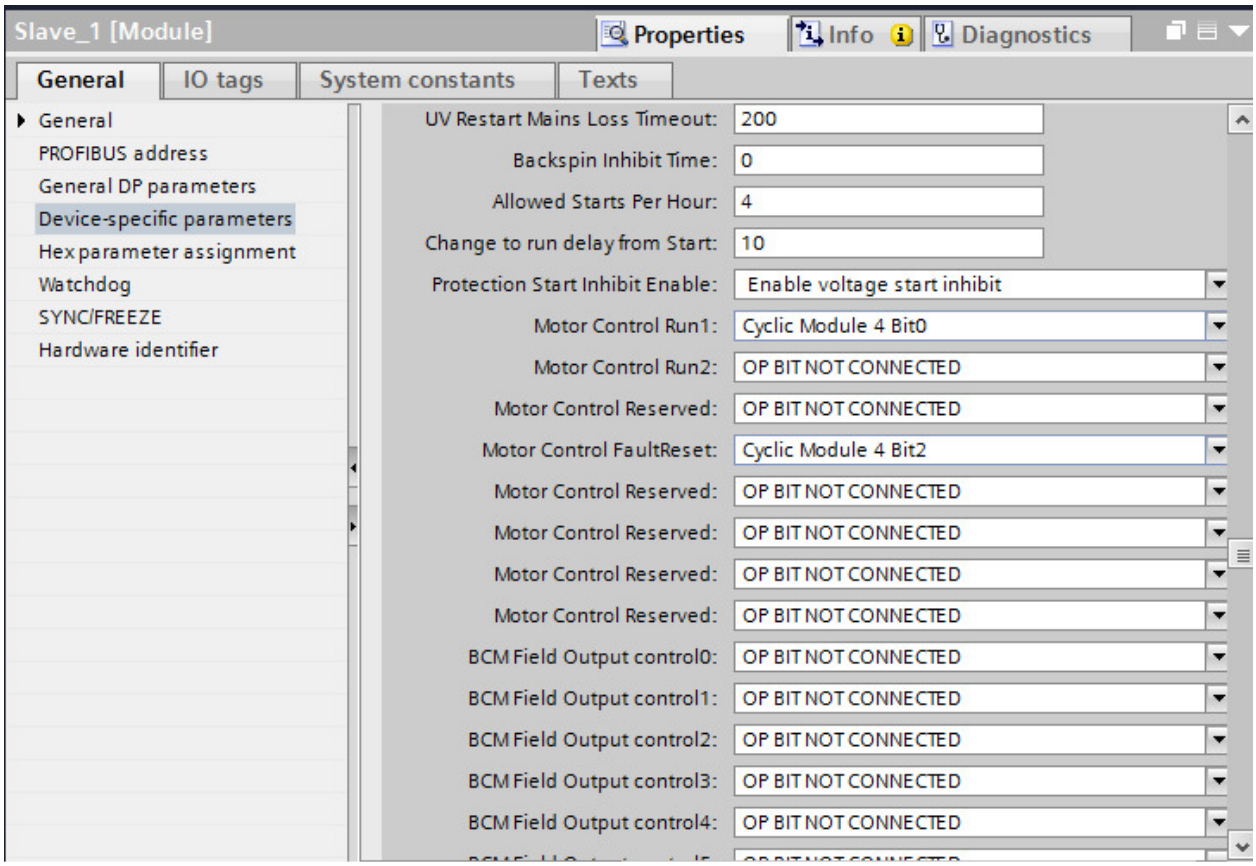
Drag and drop up to 2 of the selections on the right to lines below the “Slave_1 line. For this example Cyclic Module 12 is used and Cyclic Module 4. Cyclic Module 12 contains 16 input bytes and Cyclic Module 4 contains 1 output byte. It should look like the following:



Refer to the C445 user manual, Appendix C for additional information.

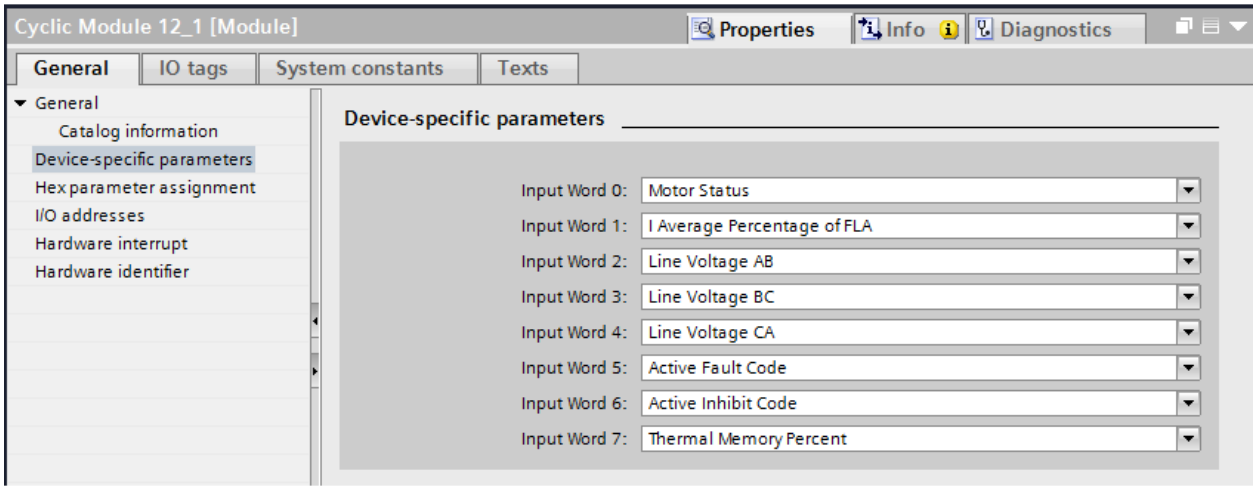
To configure the Cyclic Module 4 control bits, select the Device-specific parameters under the General tab in the Properties window below the module for the C445 as shown below. Then select the following:

Motor Control Run1: Cyclic Module 4 bit0
Motor Control Fault Reset: Cyclic Module 4 bit2



The data for the 8 input words for Cyclic Module 12 must also be selected.

To select the 8 input parameters to monitor from the C445 using Cyclic Module 12, double click Cyclic Module 12 under the Device Overview window. Then under Properties and Device-specific parameters, select the parameters to monitor for each word as shown below:



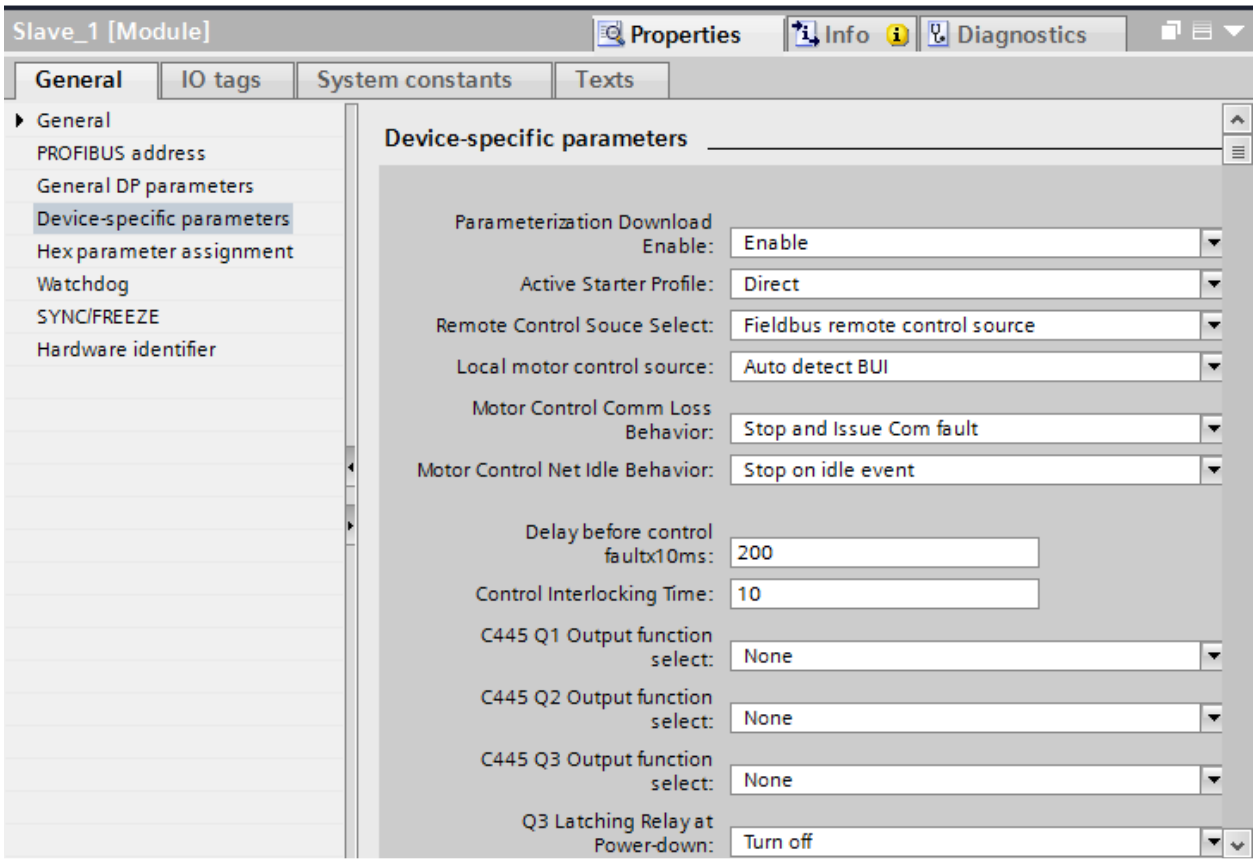
The Motor Status Word is defined as follows:

Bit 0: Running 1
Bit 1: Running 2
Bit 2: Remote = 1, Local = 0

Bit 3: Faulted
Bit 4: Warning
Bit 5: Inhibit
Bit 6: Ready
Bit 7: At Speed

Any of the available values shown under the drop down menus for each Input Word may be assigned.

It is also very important to enable this parameterization file to be downloaded to the C445 by the Siemens PLC / PROFIBUS master. This is how the I/O configuration data is downloaded to the C445. This is enabled in the Siemens TIA Portal software by double clicking the Slave (C445) module again and selecting the Device-specific parameters under Properties. The first parameter as shown below must be set to Enable for this parameterization file to be downloaded to the C445 each time the master establishes a connection with the C445. This feature also allows a new C445 to be automatically configured if a C445 needs to be replaced, minimizing downtime.

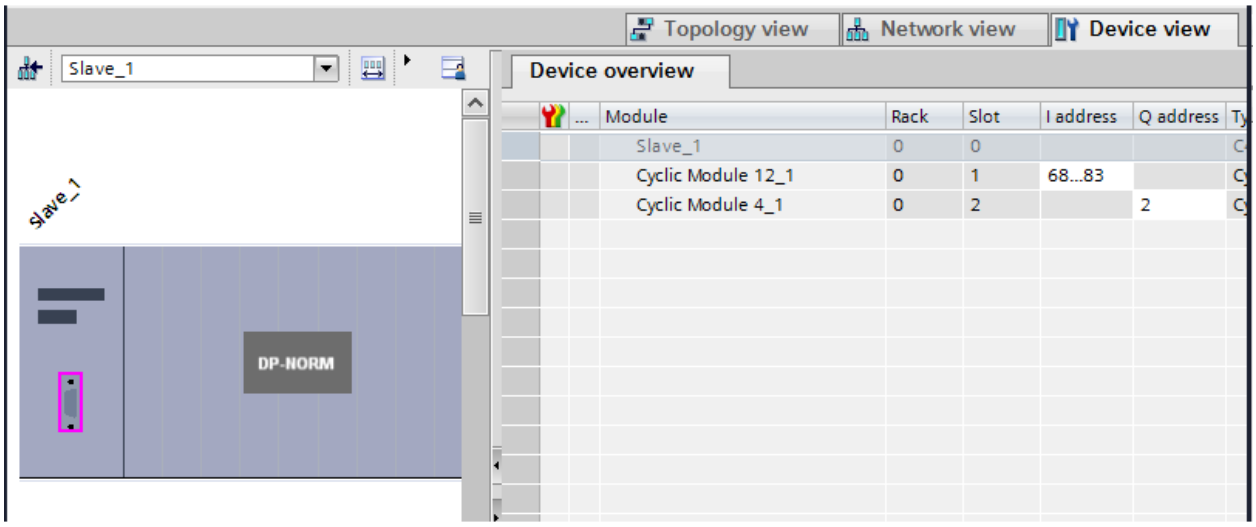


When utilizing the PROFIBUS parameterization file with the C445, care must be taken for the following situations:

1. If the inControl software is used to modify any configuration parameters in a C445, these same changes must be made for the same parameters in the PROFIBUS parameterization file.
2. Be sure all the motor parameters and all other parameters for the C445 in the PROFIBUS parameterization file are correct before enabling this file for download.

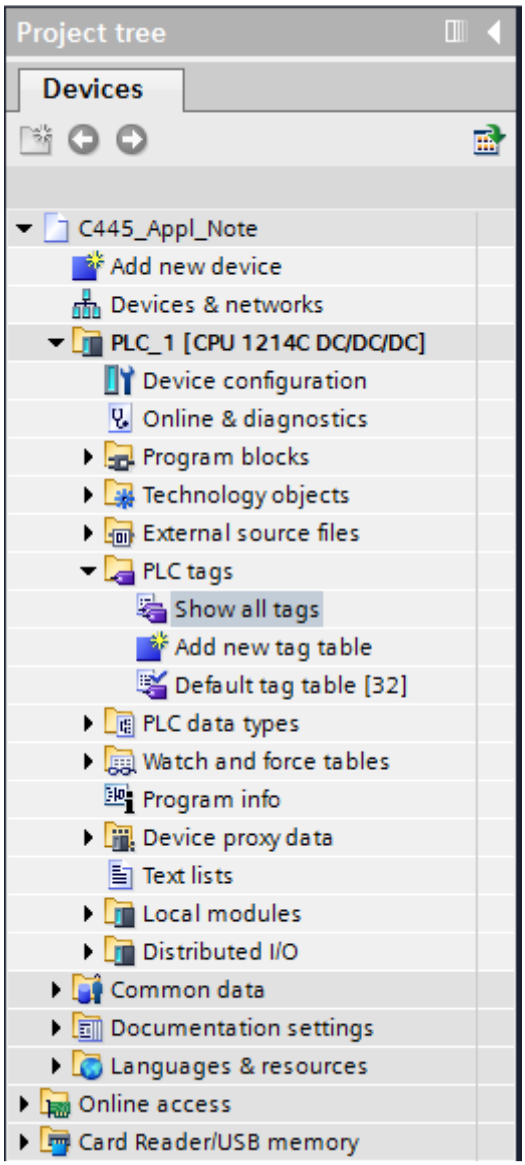
Map the I/O Tags for the C445 in the Siemens Programming Software

Under the device view for the C445 (Slave), the Device Overview shows the generic I/O addresses assigned to the output byte and the 16 input bytes (8 input words) for the C445, per the following.

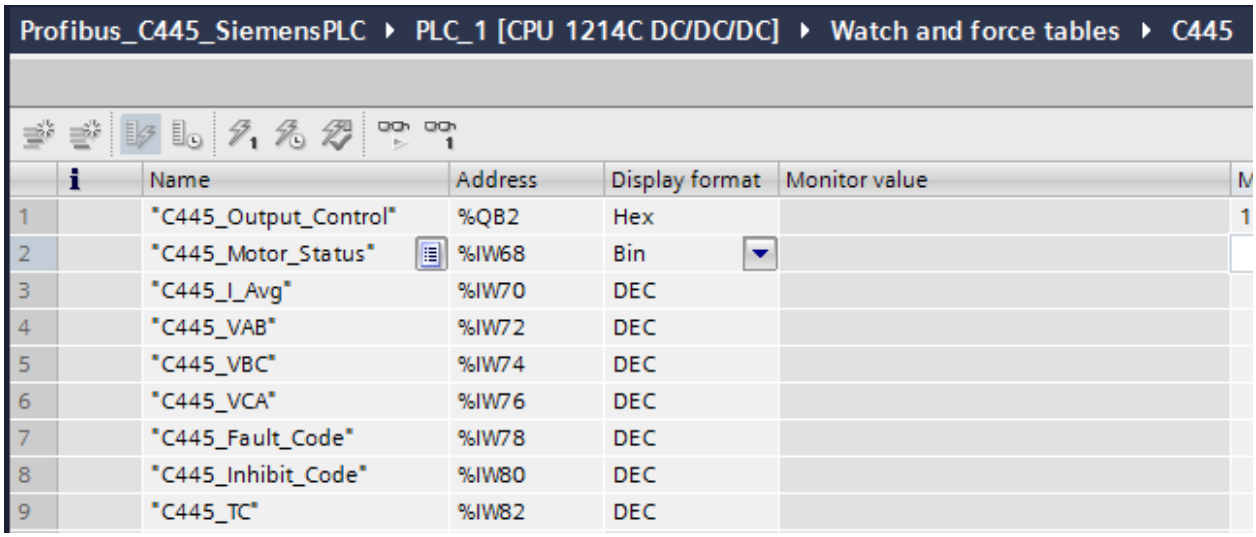


This is showing the I/O addresses that will be added to the PLC tags as described below.

To map the I/O tags so they may be used in the user program to control and monitor the C445, select PLC tags in the project tree on the left and then choose Show all tags as shown below.



When double clicking Show all tags, the PLC tags screen will be displayed. Add tags to this screen as shown below. 8 input word tags were added based on the addresses assigned by the software and 1 output byte tag. Names may be entered for each tag and these tag names can then be used in the user program.

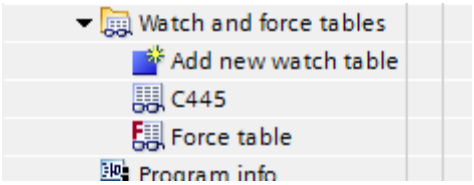


	Name	Address	Display format	Monitor value
1	"C445_Output_Control"	%QB2	Hex	
2	"C445_Motor_Status"	%IW68	Bin	
3	"C445_I_Avg"	%IW70	DEC	
4	"C445_VAB"	%IW72	DEC	
5	"C445_VBC"	%IW74	DEC	
6	"C445_VCA"	%IW76	DEC	
7	"C445_Fault_Code"	%IW78	DEC	
8	"C445_Inhibit_Code"	%IW80	DEC	
9	"C445_TC"	%IW82	DEC	

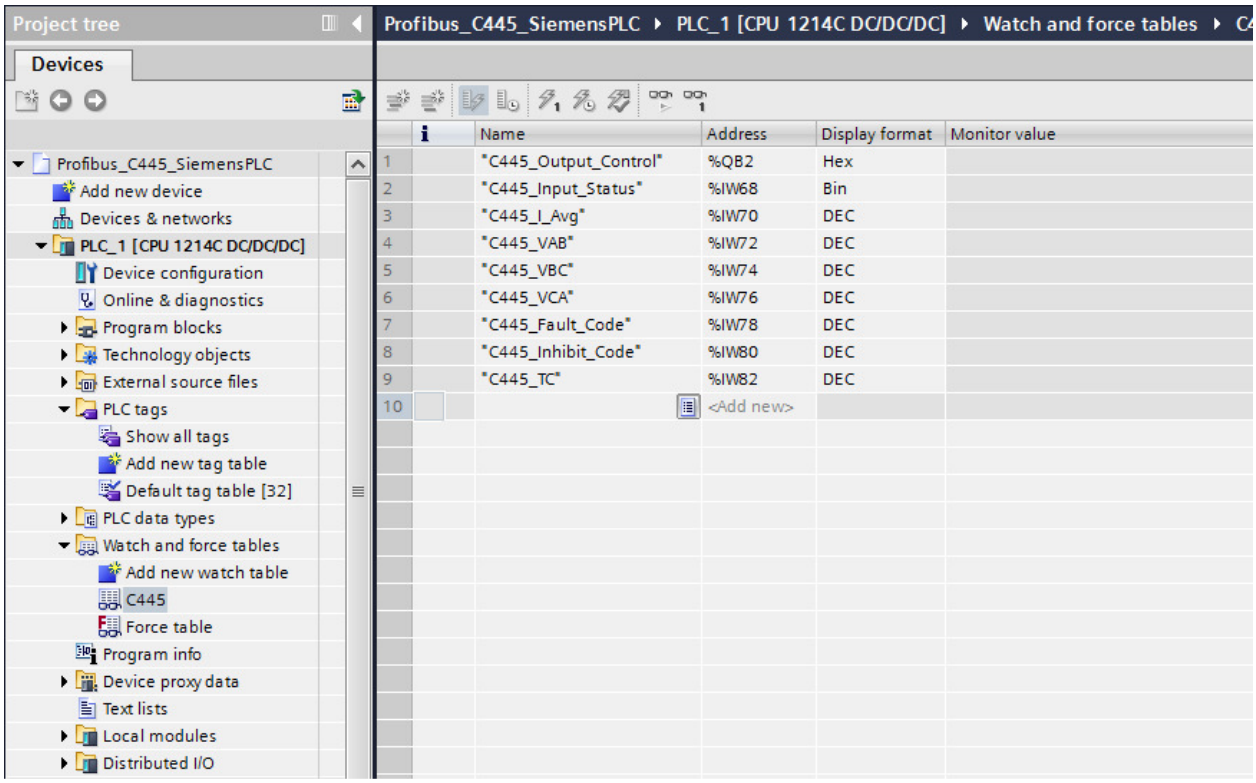
Controlling and Monitoring the C445 with the Siemens PLC

In place of a user program, this example will add the I/O tags for the C445 to a Watch List and control the C445 by modifying the C445_Output_Control tag and monitor the C445 by reading the 8 input tags.

Next, double click “Add new watch table” under “Watch and Force tables” in the Project Tree on the left per the following:

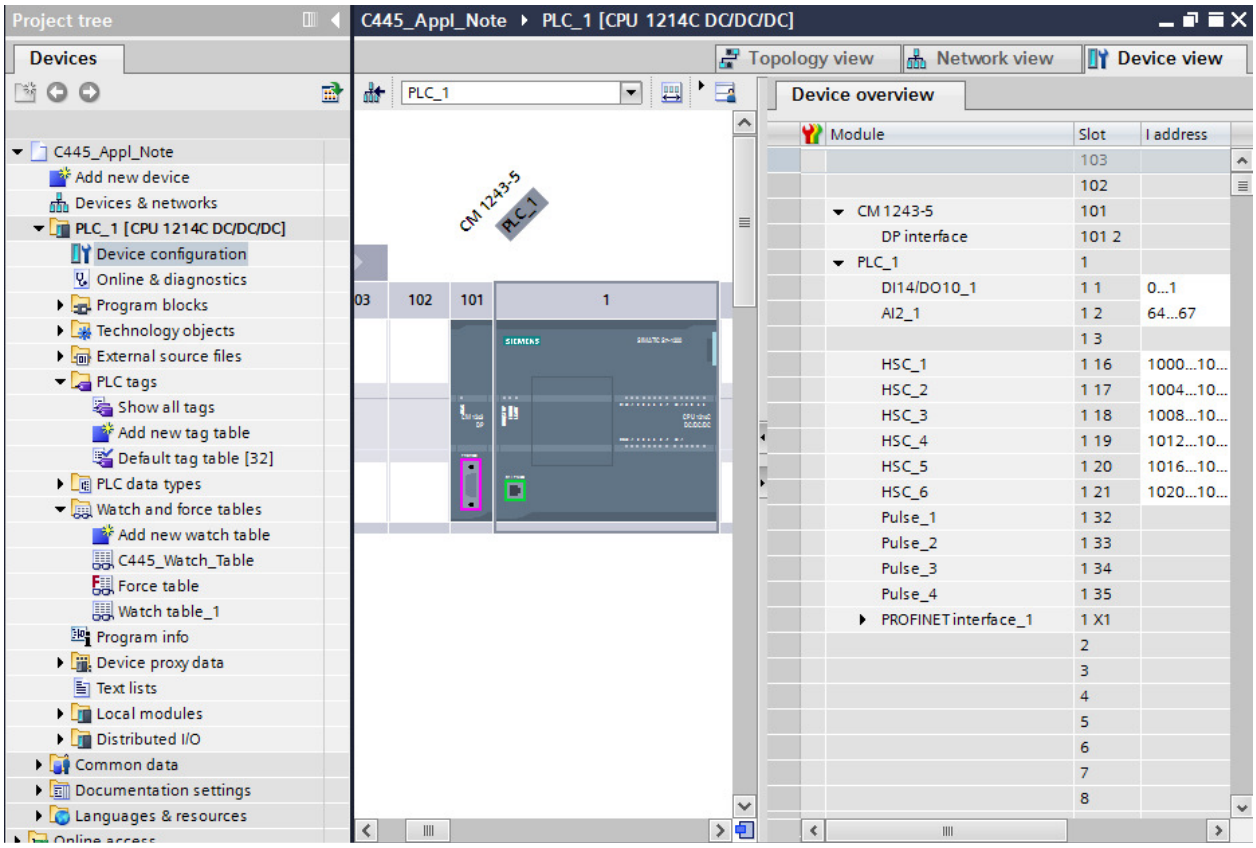


The new watch table is named “C445” for this example. Add the I/O addresses for the C445 as shown below. Note that the names for these addresses that you entered into the PLC Tags area are automatically populated as the addresses are entered. This watch table will allow testing the C445 Motor Management Relay over PROFIBUS without writing a program. This will allow monitoring the input data from the C445, while operating it.

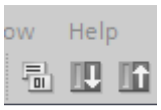


Downloading the program to the Siemens S7 PLC

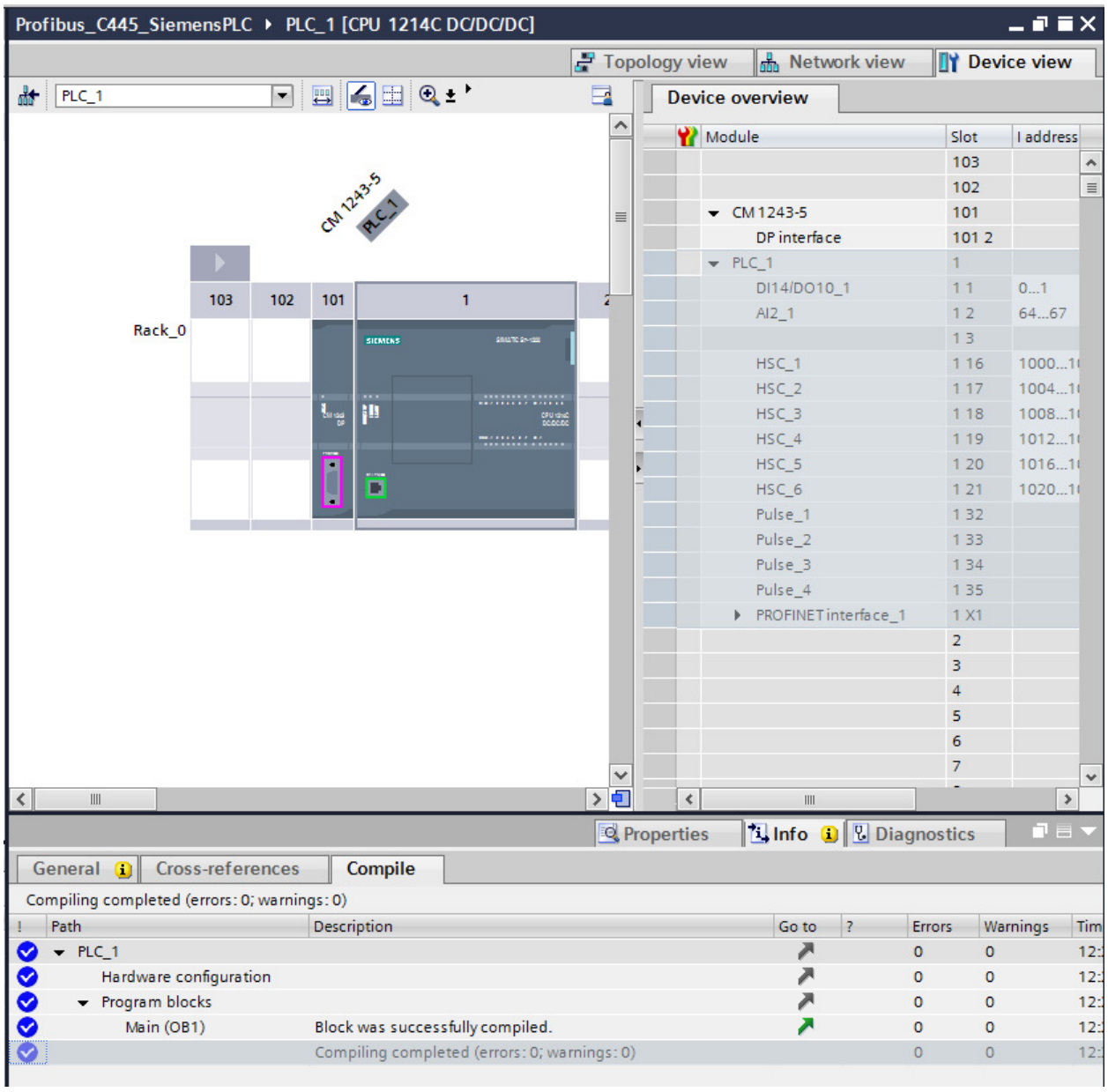
The project must first be compiled with no errors before it is downloaded to the PLC. In the Project Tree under PLC_1 [CPU….], double click “Device configuration” as follows to display the Device View containing the PLC.



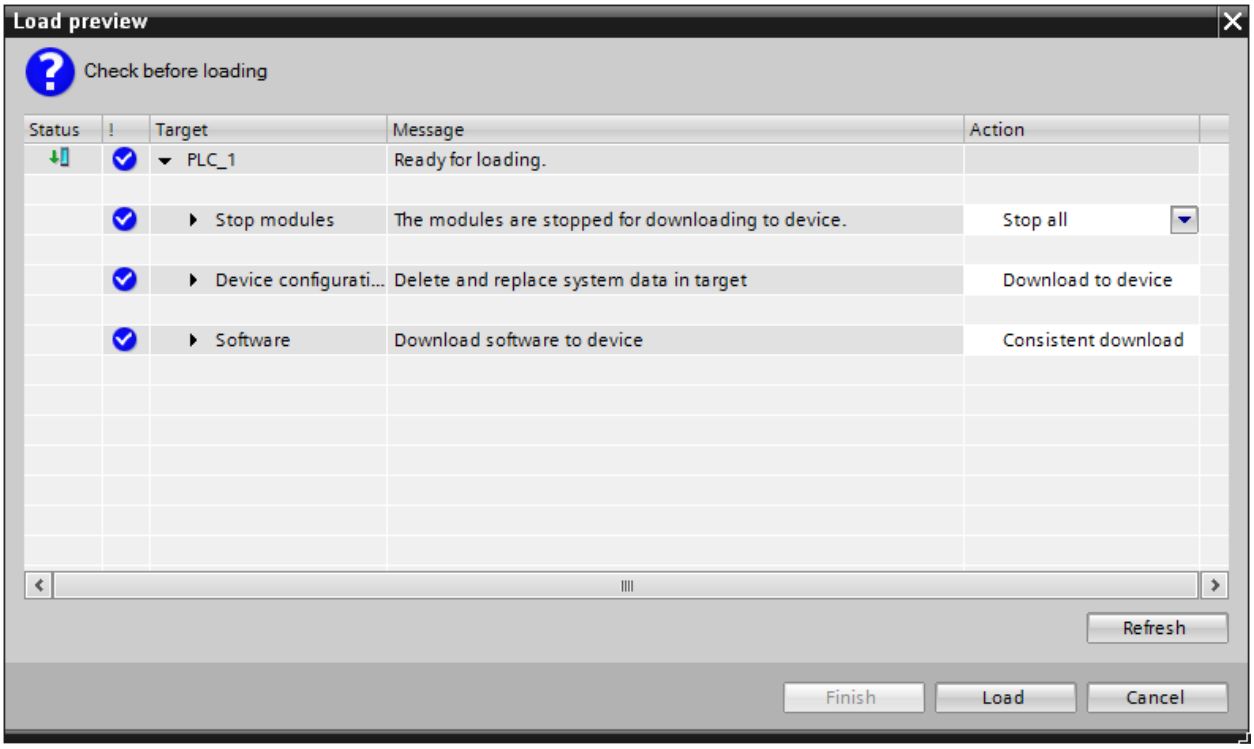
Select the PLC then click the Compile button. The compile button is just to the left of the Download button on the tool bar. Shown below are, from left to right: Compile button, download button and the upload button. As you hover over each of these buttons in the software, it will display its function.



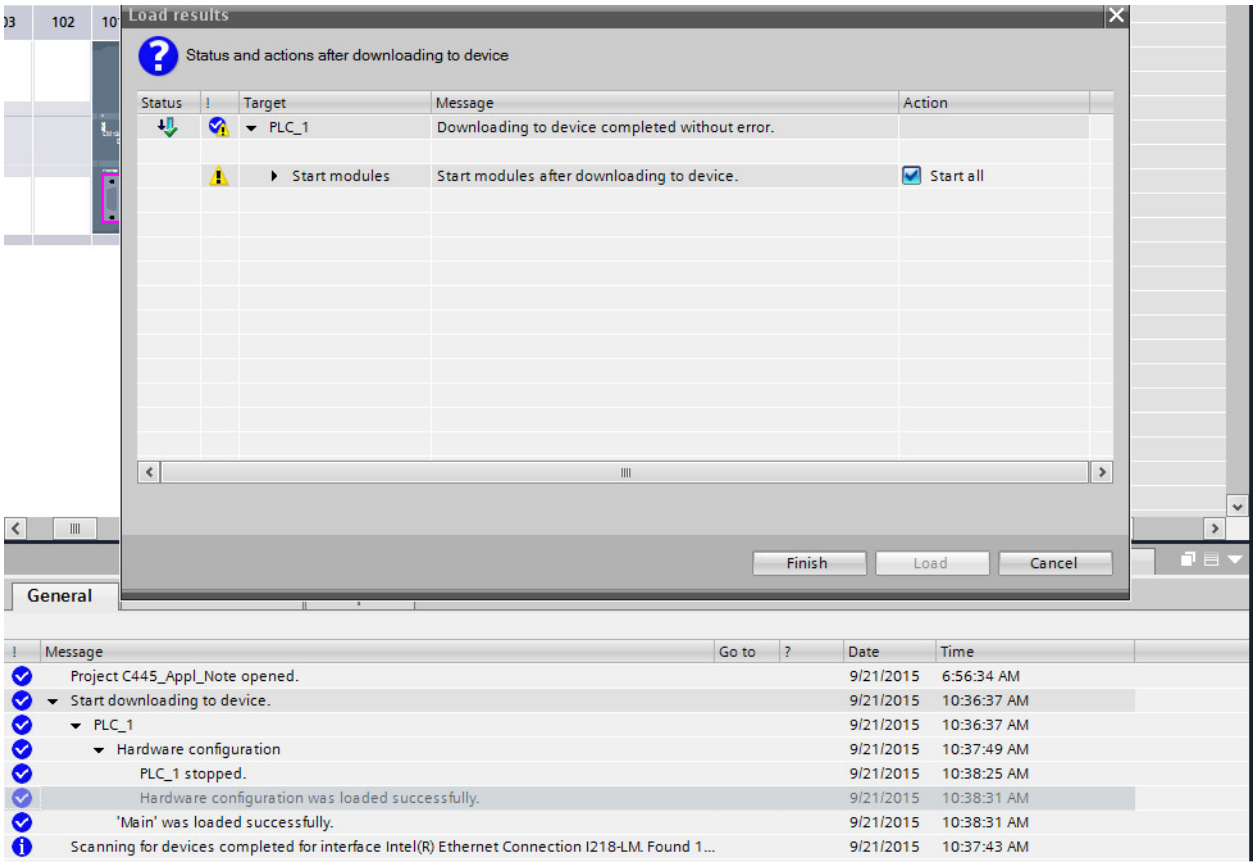
The results of the compile process will be displayed in the area below the PLC as follows:



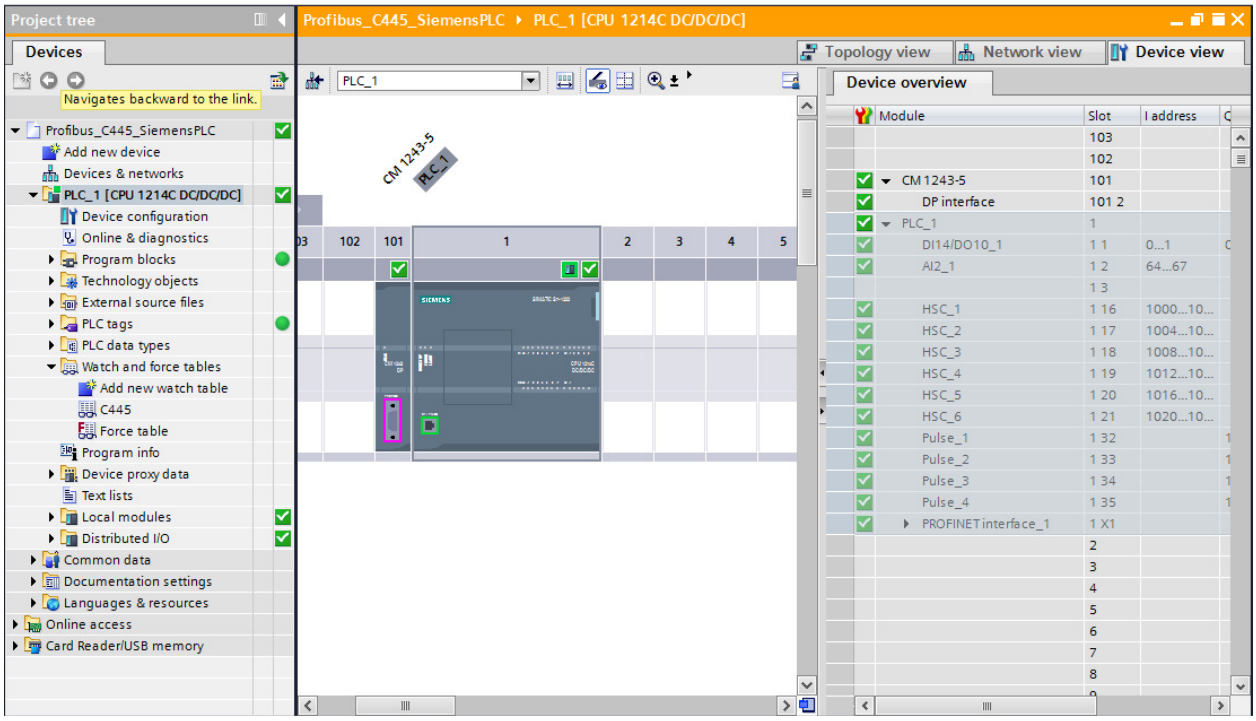
Next, select the download button to download the project to the PLC. The following window will be displayed. If the controller was in the Run mode, it must be stopped for the download. Select “Stop all” per the following, then select the Load button.



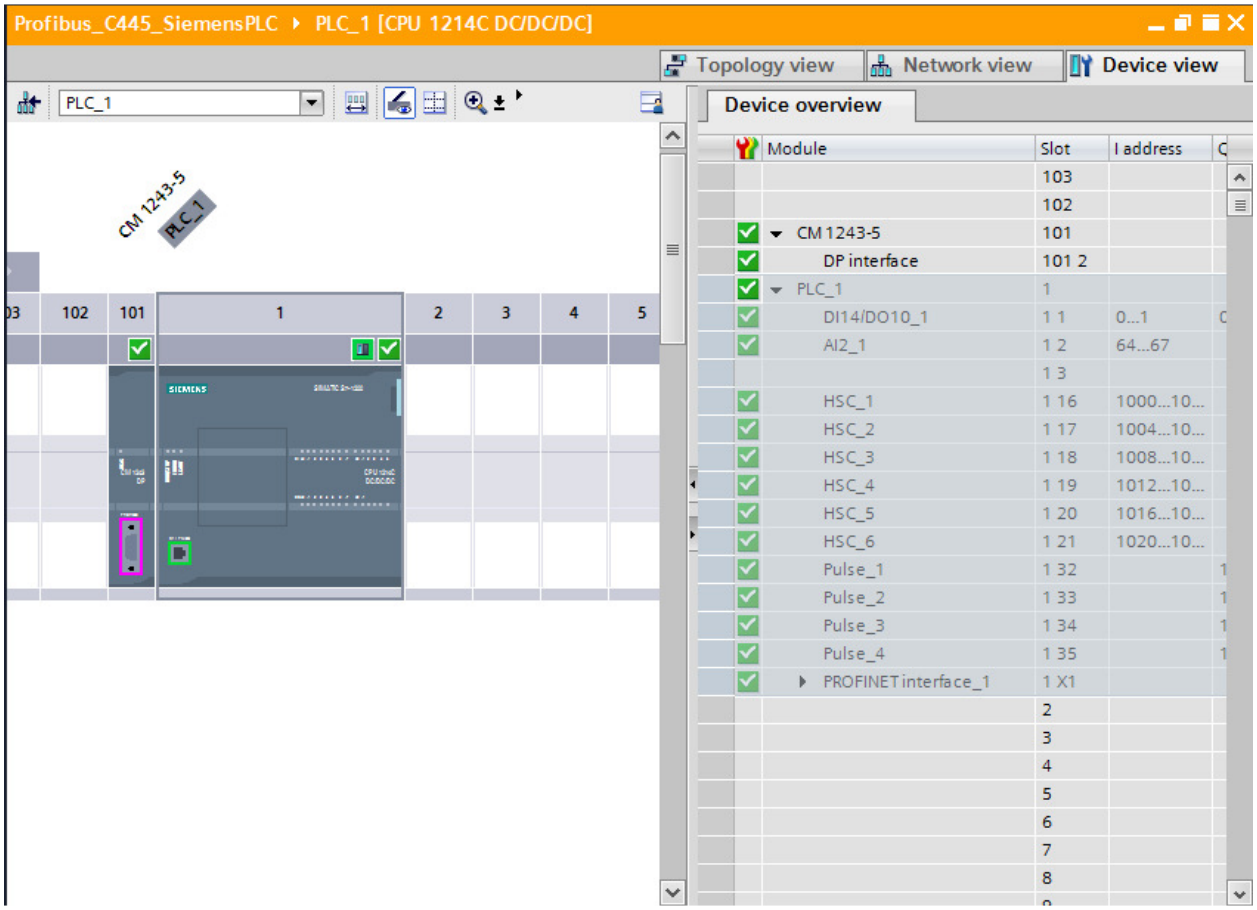
The results of the Load will be displayed in the lower portion of the project screen as shown below. “Start all” should be selected, then select the Finish button. This will complete the download and place the PLC into the Run mode per the following:



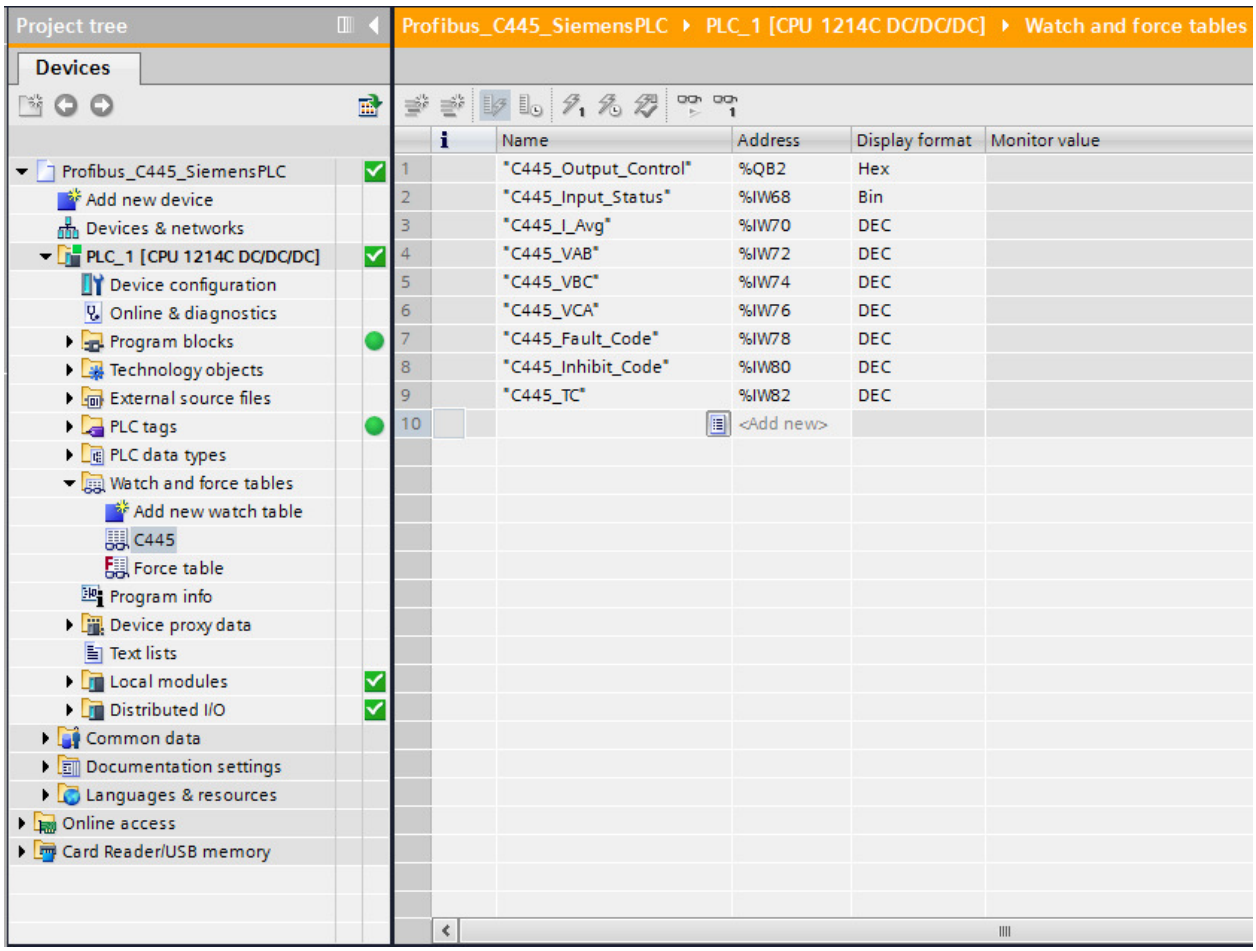
With the PLC selected, select “Go online” from the Tool Bar to go online with the project running in the PLC.



When online, the Simatic software should look like the following:



In the Project Tree on the left, double click “C445” under “Watch and force tables” to display the following:



Below is the Tool Bar located above the Watch List.

If the second icon from the right is selected, the Watch List will begin monitoring and displaying the I/O data as follows:

Profibus_C445_SiemensPLC ▸ PLC_1 [CPU 1214C DC/DC/DC] ▸ Watch and force tables ▸ C445

		Name	Address	Display format	Monitor value
1		"C445_Output_Control"	%QB2	Hex	16#01
2		"C445_Input_Status"	%IW68	Bin	2#0000_0000_0000_1000
3		"C445_I_Avg"	%IW70	DEC	99
4		"C445_VAB"	%IW72	DEC	480
5		"C445_VBC"	%IW74	DEC	480
6		"C445_VCA"	%IW76	DEC	480
7		"C445_Fault_Code"	%IW78	DEC	0
8		"C445_Inhibit_Code"	%IW80	DEC	0
9		"C445_TC"	%IW82	DEC	77
10			<Add new>		

In the “Modify value” column for QB2 enter a 1 to energize Output1 and a 0 to de-energize Output1. If the system is wired to the motor as described earlier in the document, when Output1 is energized, the motor will Run. Note that the C445 must be in Auto (Remote) mode.

The data can be entered/viewed in different formats by changing the Display Format for any value.

Each time values are entered or modified in the “Modify Value” column for the Outputs tag, the lightning bolt with a 1 under it shown below must be selected to instruct the software and the PLC to write the value to the C445.

Refer to the Profibus Chapter in the C445 Global Motor Management Relay User Manual (publication MN042003EN) for additional information on the configuration, control and monitoring parameters, Fault Codes and more.

References

C445 Global Motor Management Relay User Manual, Publication MN042003EN

Power Xpert inControl Software User Manual, Publication MN040013EN

Additional Help

In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-326-2273 option 2, option 6.

All other supporting documentation is located on the Eaton web site at www.eaton.com/C445

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