Programmable Multi-Axis Controller

Startup Guide
EtherCAT Coupler Unit
Safety CPU Unit
Safety I/O Units
(IDEv4)

CK3E-□□□□
CK3M-CPU1□1
NY51□-A□□□

O042-E1-01

About Copyrights and Trademarks

Contents

1. Related Manuals

To ensure system safety, always read and follow the information provided in all *Safety Precautions* and *Precautions for Safe Use* in the manuals for the devices that are used in the system.

The following shows the manuals for OMRON Corporation (hereafter referred to as OMRON) and Delta Tau Data Systems, Inc (DT).

Manufacturer	Manual No.	Model	Manual name
OMRON	I610-E1	Model CK3E-1□10	CK3E-series Programmable Multi-Axis Controller Hardware User's Manual
OMRON	O036-E2	Model CK3M-CPU1□1	CK3M-series Programmable Multi-Axis Controller Hardware User's Manual
OMRON	W580-E1	Model NY512-A6001XX21391X	Industrial PC Platform NY-series IPC Programmable Multi-Axis Controller Industrial Box PC Hardware User's Manual
OMRON	W519-E1	Model NX-ECC203	EtherCAT® Coupler Unit User's Manual
OMRON	Z930-E1	Model NX-SL□□□□ Model NX-SI□□□□ Model NX-SO□□□□	Safety Control Unit User's Manual
OMRON	W504-E1	Model SYSMAC-SE2□□□	Sysmac Studio Version 1 Operation Manual
DT	O014-E	-	Power PMAC User's Manual
DT	O015-E	-	Power PMAC Software Reference Manual
DT	O016-E	-	Power PMAC IDE Users Manual

2. Terms and Definitions

Term	Explanation and Definition
Slave	Slaves are devices connected to EtherCAT. There are various types of slaves such as servo drivers handling position data and I/O terminals handling the bit signals.
Object	Represents information such as in-slave data and parameters.
PDO communications (Communications using Process Data Objects)	One type of EtherCAT communications in which process data objects (PDOs) are used to exchange information cyclically and in realtime. This is also called “process data communications”.
PDO Mapping	The association of objects used for PDO communications.
PDO Entry	PDO entries are the pointers to individual objects used for PDO mapping.
ESI file (EtherCAT Slave Information file)	An ESI file contains information unique to the EtherCAT slaves in XML format. You can load ESI files into the Power PMAC IDE, to easily allocate slave process data and make other settings.
ENI file (EtherCAT Network Information file)	An ENI file contains the network configuration information related to EtherCAT slaves.
Power PMAC IDE	This computer software is used to configure the Controller, create user programs, and monitor the programs. PMAC is an acronym for Programmable Multi-Axis Controller.

3. Precautions

(1) Understand the specifications of devices that are used in the system. Allow some margin for ratings and performance. Provide safety measures, such as for installing a safety circuit, in order to ensure safety and minimize the risk of abnormal occurrences.

(2) To ensure system safety, always read and follow the information provided in all *Safety Precautions* and *Precautions for Safe Use* in the manuals for each device that is used in the system.

(3) The user is encouraged to confirm the standards and regulations that the system must conform to.

(4) It is prohibited to copy, reproduce, or distribute a part or the whole of this document without the permission of OMRON Corporation.

(5) The information contained in this document is current as of April 2019.
It is subject to change without prior notice for improvement purposes.

The following notations are used in this document.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or may result in serious injury or death. Additionally, there may be severe property damage.

⚠ Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure correct operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operations easier.

Symbols

	The filled circle symbol indicates operations that you must carry out. The specific operation is shown in the circle and explained in text. This example indicates a “general precaution” for something that you must carry out.

4. Overview

This document describes the procedures used to connect the Safety CPU Unit and Safety I/O Units (hereafter referred to as the Slave) attached to OMRON High EtherCAT Coupler Unit model NX-ECC203 using OMRON Programmable Multi-Axis Controller model CK3E-☐☐☐☐/ CK3M-CPU1☐1/NY51☐-A☐☐☐(hereafter referred to as the Controller) and EtherCAT, as well as for checking the connection.
Refer to *Section 6. EtherCAT Connection Procedure* to learn about the setting methods and key points to perform PDO communications via EtherCAT.

5. Applicable Devices and Device Configuration

5.1. Applicable Devices

The applicable devices are as follows:

Manufacturer	Name	Model
OMRON	Programmable Multi-Axis Controller	Model CK3E-□□□□
OMRON	Programmable Multi-Axis Controller	Model CK3M-CPU1□1
OMRON	Programmable Multi-Axis Controller Industrial Box PC	Model NY51□-A□□□
OMRON	EtherCAT Coupler Unit	Model NX-ECC203
OMRON	Safety CPU Unit	Model NX-SL3□00
OMRON	Safety I/O Units	Model NX-SI□□□□ Model NX-SO□□□□
OMRON	Digital I/O Units	Model NX-ID□□□□ Model NX-IA□□□□ Model NX-OC□□□□ Model NX-OD□□□□ Model NX-MD□□□□

Precautions for Correct Use

Use model NX-ECC203 Version 1.5 or later for the EtherCAT Coupler Unit.
Models NX-ECC201 and NX-ECC202 cannot be used.

Precautions for Correct Use

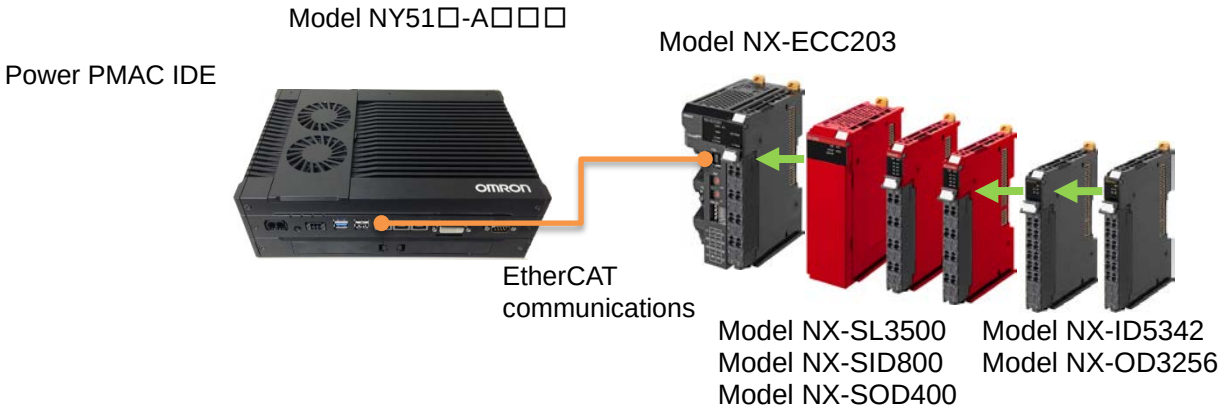
In this document, the devices with models and versions listed in *Section 5.2* are used as examples of applicable devices to describe the procedures to connect the devices and check their connections.
You cannot use devices with versions lower than the versions listed in *Section 5.2*.
To use the devices mentioned above with models not listed in *Section 5.2* or versions higher than those listed in *Section 5.2*, check the differences in the specifications by referring to the manuals before operating the devices.

Additional Information

This document describes the procedures to establish the network connections. It does not provide information on operations, installations, wiring methods, device functionalities, or device operations, which are not related to the connection procedures. For more information, refer to the manuals or contact your OMRON representative.

5.2. Device Configuration

The hardware components to reproduce the connection procedures in this document are as follows:



Manufacturer	Name	Model	Version
OMRON	Programmable Multi-Axis Controller	Model NY51□-A□□□	Ver.2.5 or later
OMRON	EtherCAT Coupler Unit	Model NX-ECC203	Ver.1.5
OMRON	Safety CPU Unit	Model NX-SL3500	Ver.1.0
OMRON	Safety Input Unit	Model NX-SID800	Ver.1.0
OMRON	Safety Output Unit	Model NX-SOD400	Ver.1.0
OMRON	Digital Input Unit	Model NX-ID5342	-
OMRON	Digital Output Unit	Model NX-OD3256	-
OMRON	Ethernet cable (with industrial Ethernet connector)	Model XS5W-T421-□M□-K	
OMRON	Sysmac Studio	SYSMAC-SE2□□□	Ver.1.25
DT	Power PMAC IDE	-	Ver.4.2.1.19

Precautions for Correct Use

Prepare the ESI file described in this section in advance. Contact your OMRON representative for information on how to procure the ESI file.

Precautions for Correct Use

Do not share the connection line of EtherCAT communications with other Ethernet networks.
Do not use devices for Ethernet such as a switching hub.
Use the Ethernet cable (double shielding with aluminum tape and braiding) of Category 5 or higher, and use the shielded connector of Category 5 or higher.
Connect the cable shield to the connector hood at both ends of the cable.

Additional Information

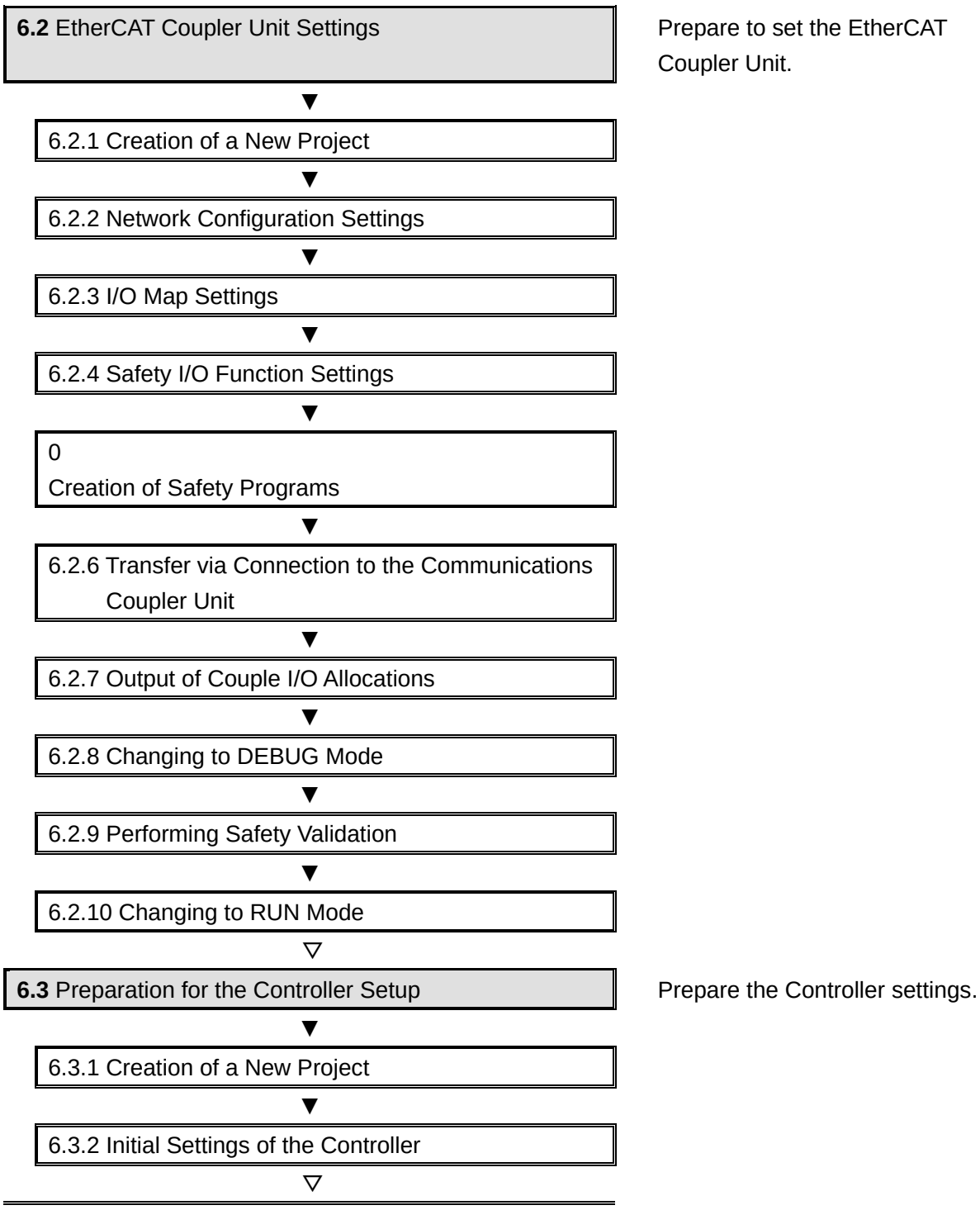
This document describes model NY51□-A□□□ as an example. The same procedures can apply to model CK3E-□□□□/ CK3M-CPU1□1.

6. EtherCAT Connection Procedure

This section describes the procedure for connecting the Controller with the Slave via EtherCAT. The description assumes that the Controller is set to factory default.

6.1. Workflow

Take the following steps to operate the PDO communications via EtherCAT after connecting the Controller with the Slave via EtherCAT.



6.4 Installation of ESI Files

Install the ESI file for the Slave into PowerPMAC IDE.

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6.5 EtherCAT Communications Setup

Set up EtherCAT communications.

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6.5.1 Communications Setup for the EtherCAT Master

▼

6.5.2 Distributed Clock Setup

▼

6.5.3 Safety Controller Variable Settings

▼

6.5.4 PDO Map Settings

▼

6.5.5 Coupler I/O and Variable Allocations

▼

6.5.6 Creation of an EtherCAT Network Information File

▽

6.6 Controller Settings

Set up the Controller.

▼

6.6.1 EtherCAT Communications Check

▼

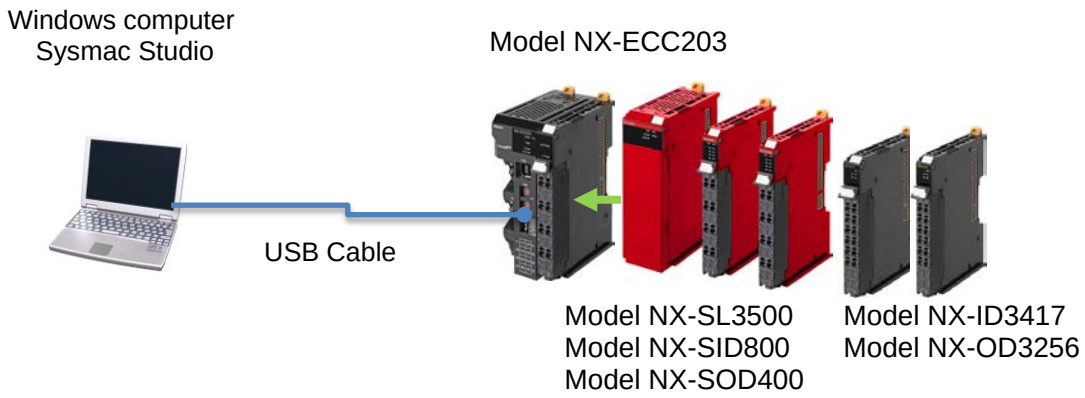
6.6.2 Writing the User Program

▼

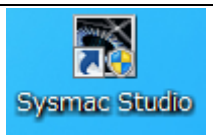
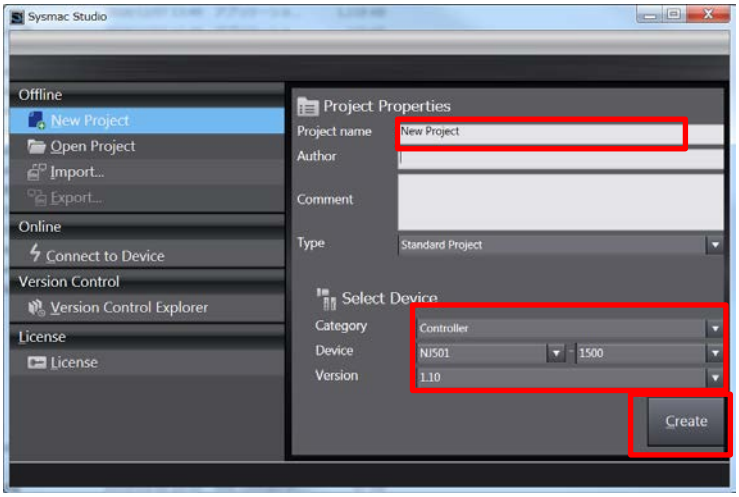
6.6.3 Project Data Transfer

6.2. EtherCAT Coupler Unit Settings

Configure the slave terminal settings for the EtherCAT Coupler Unit.
Prepare a computer with Sysmac Studio installed.

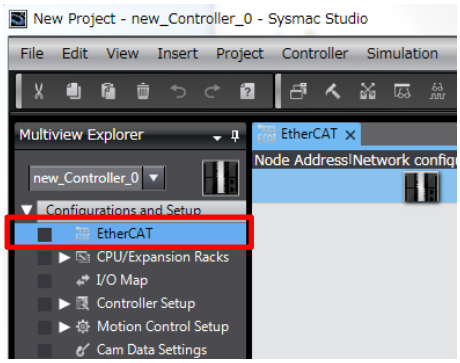


6.2.1. Creation of a New Project

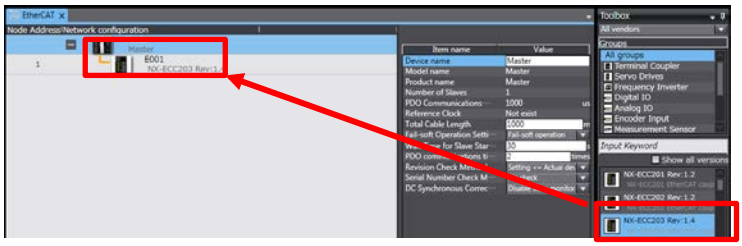
1	Connect the coupler to the computer using a USB cable.	
2	Turn on the power to the coupler and safety controller.	
3	Start the Sysmac Studio. * If the dialog for confirming access rights appears upon start-up, select starting of Sysmac Studio.	
4	Create a project in the Sysmac Studio. **Project Properties** Enter **Project name** and other items of information. **Select Device** Select *controller* for **Category**. You can specify any **Device** and **Version**. In this example, select *NJ501-1500* and *1.10*. Click **Create**.	

6.2.2. Network Configuration Settings

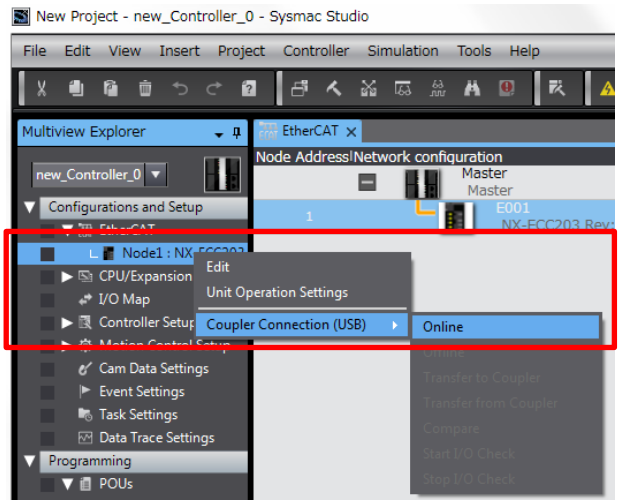
1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer.



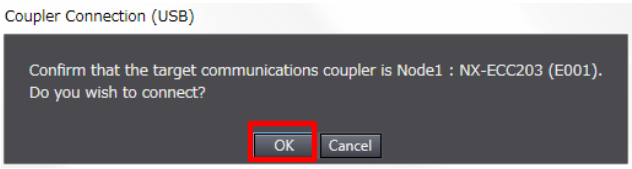
2 Select EtherCAT Coupler Unit **NX-ECC203** in the toolbox, and drag and drop it directly below the master in the EtherCAT Configuration Edit tab page.



3 Right-click **NX-ECC203** in the Multiview Explorer, and select **Coupler Connection (USB)** then **Online**.

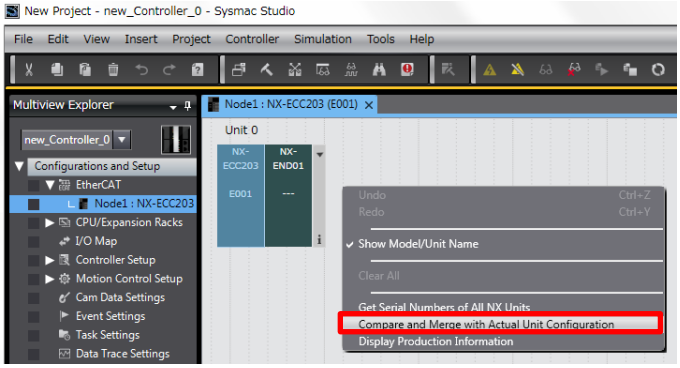


After you have confirmed the destination of the USB connection, click the **OK** button.

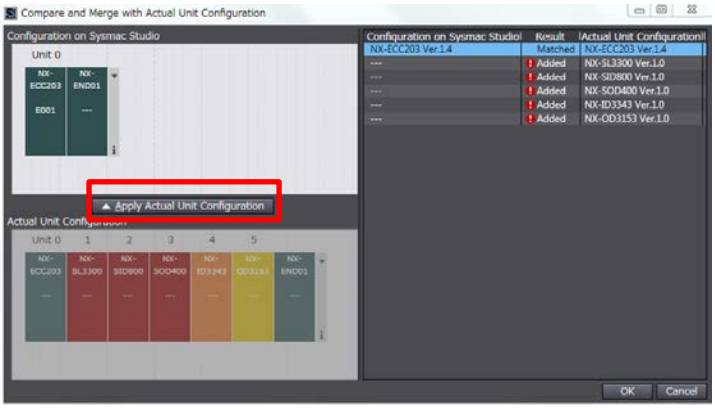


4 Double-click **NX-ECC203** in the Multiview Explorer to open the NX-ECC203 edit page.

Right-click in the NX-ECC203 tab page and select **Compare and Merge with Actual Unit Configuration** from the menu.



5 Click **Apply Actual Unit Configuration** to apply the actual unit configuration.

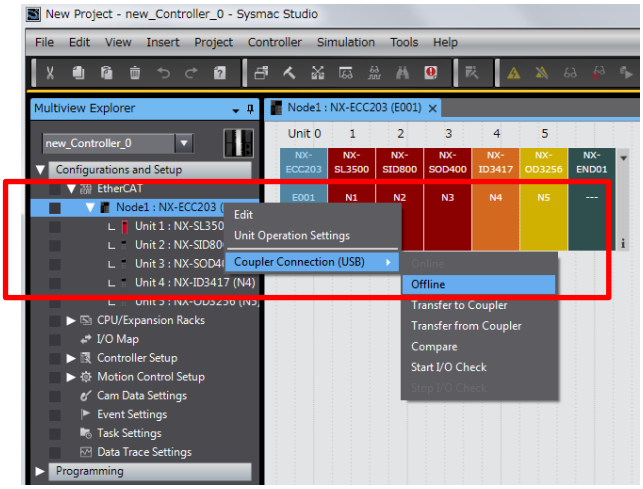


Precautions for Correct Use

You can read only the Unit configuration in the Slave Terminal by comparing and merging with the actual Unit configuration. You cannot read the I/O allocation information, Unit operation settings, and Unit application data.

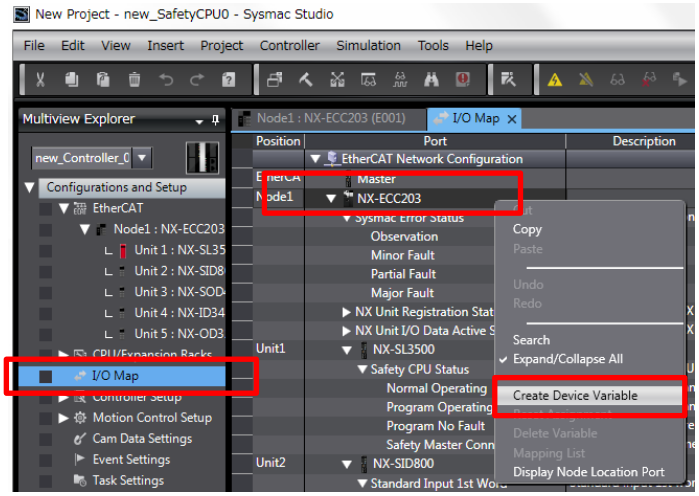
6.2.3. I/O Map Settings

1 Right-click **NX-ECC203** in the Multiview Explorer, and select **Coupler Connection (USB)** then **Offline**.



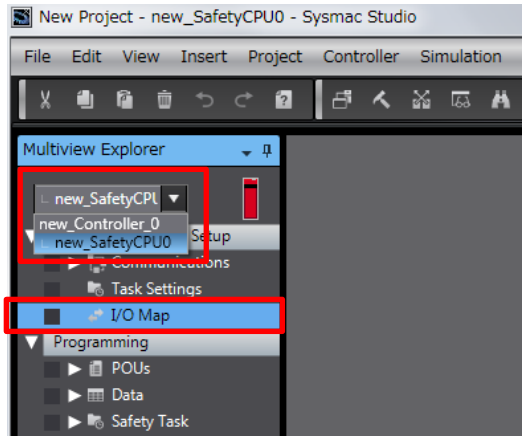
2 In the Multiview Explorer, select **Configurations and Setup**, then I/O map tab page to open the I/O map pane.

Right-click on **NX-ECC203**, and select **Create Device Variable** from the menu.

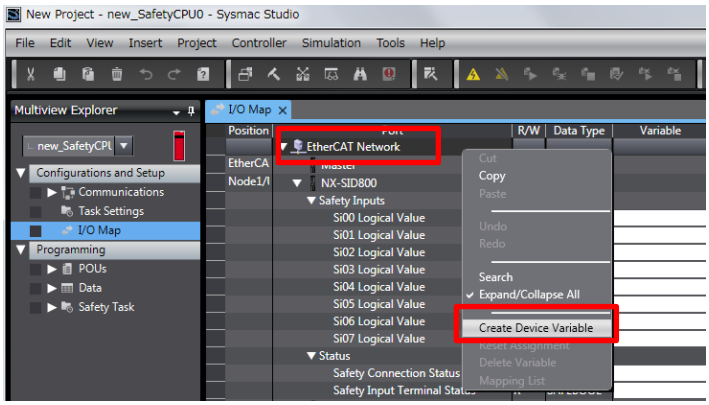


3 From the controller selection box in the Multiview Explorer, select the target Safety CPU Unit.

Double-click **I/O map** to open the Safety I/O map tab page.



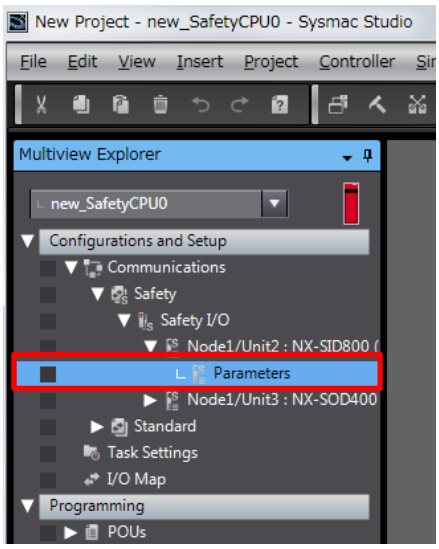
4 Right-click on **EtherCAT Network**, and select **Create Device Variable** from the menu.



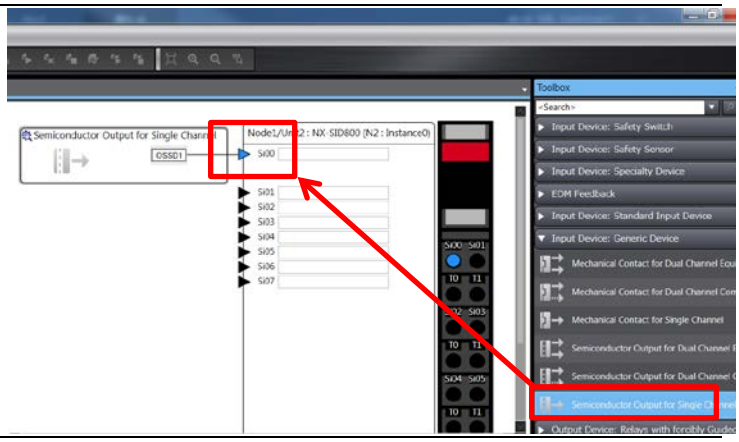
6.2.4. Safety I/O Function Settings

1 From the controller selection box in the Multiview Explorer, select the target Safety CPU Unit.

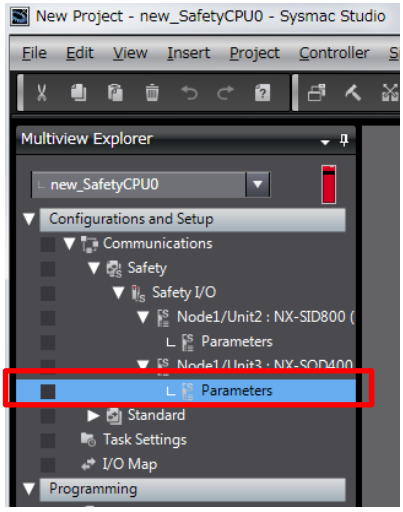
Double-click **Safety Slave Unit Parameter Settings** under NX-SID800 of **Configurations and Setup**.

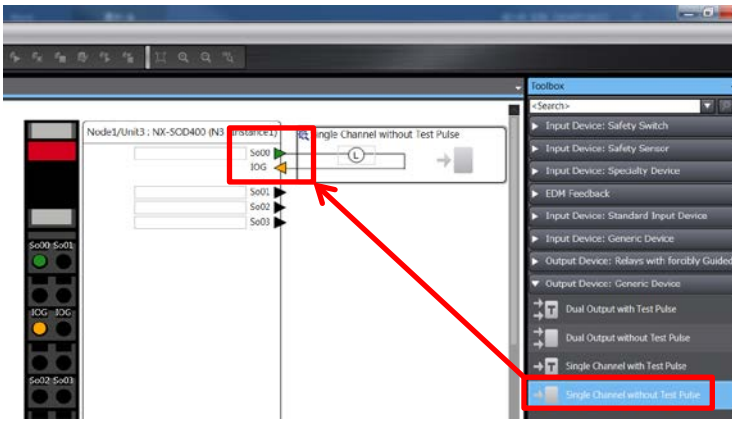


2 Select **Output Single-channel Semi-conductor** from the toolbox **Input device: Semi-conductor output type**, and drag and drop it on to the input terminal.

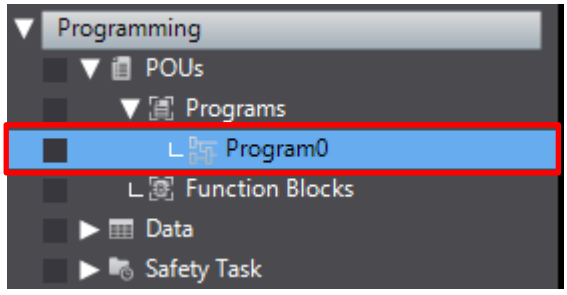
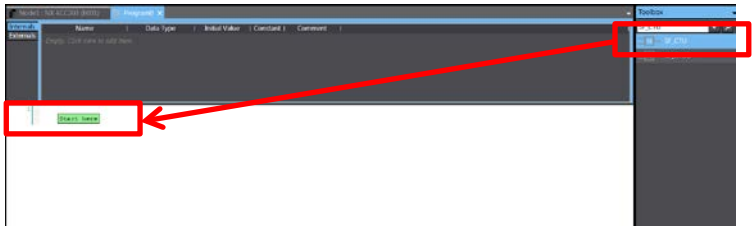
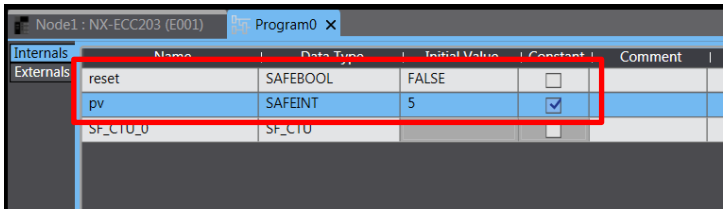


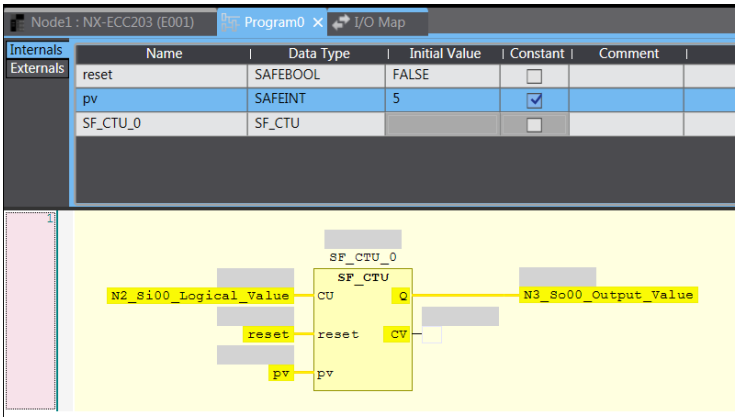
3 Double-click **Safety Slave Unit Parameter Settings** under NX-SO400 of **Configurations and Setup**.



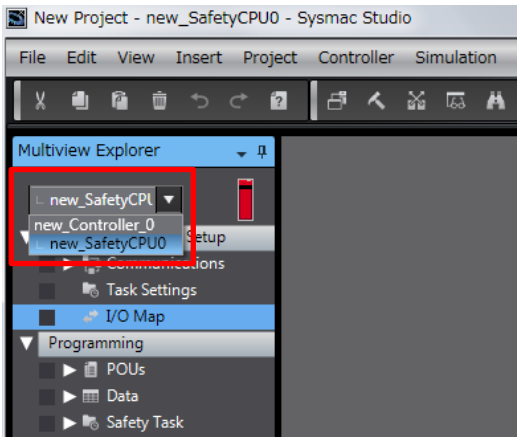
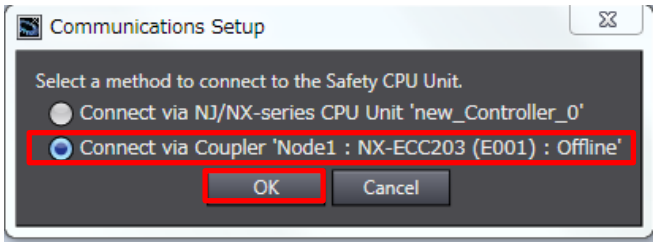
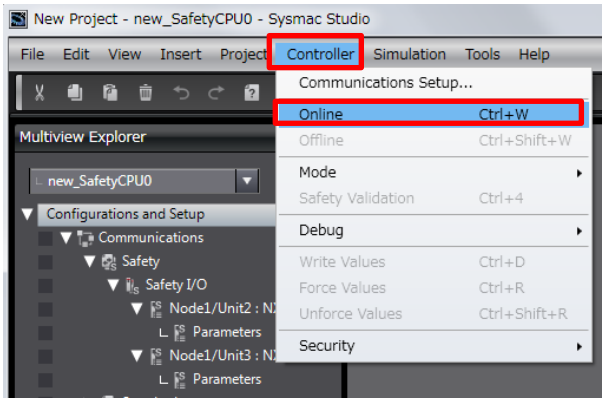
4	Select **Single Channel (without test pulse)** from the toolbox **Output device**, and drag and drop it on to the output terminal.	

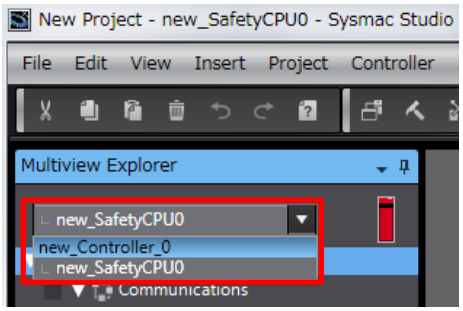
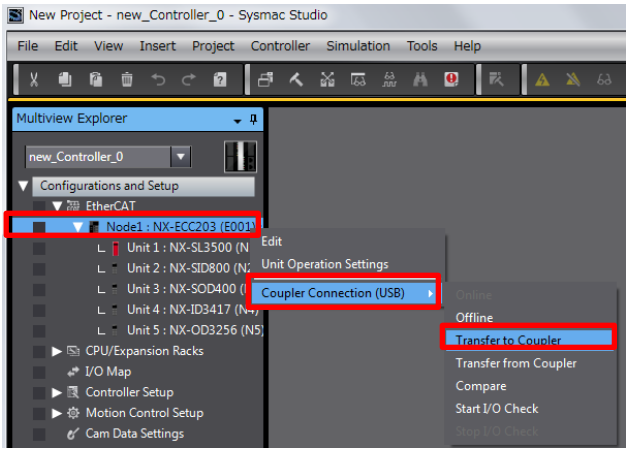
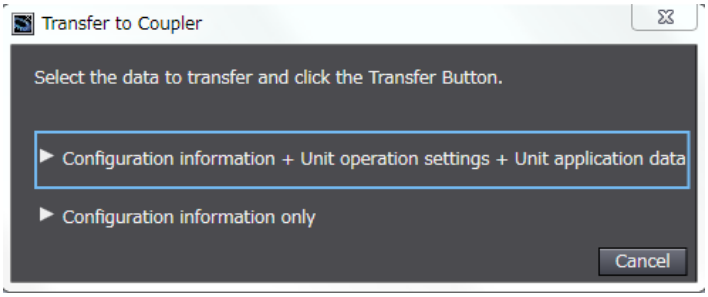
6.2.5. Creation of Safety Programs

1	Registering programs Right-click **Programs** under **Programming** – **POUs** in the Multiview Explorer, and select **Add** – **Programs** from the menu.	
2	Drag a SF_CTU from the ToolBox to a new network where the words **Start Here** are displayed.	
3	Select the tab for internal variables, and then register and edit the local variables. **Name** : reset **Data Type:** SAFEBOOL **Initial Value**: FALSE **Name** : pv **Data Type:** SAFEINT **Initial Value**: 5	

4	Select parameters on on the FBD network and directly enter the variable names. **CU** : N2_Si00_Logical_Value **Reset** : reset **PV** : pv **Q** : N3_So00_Output_Value	

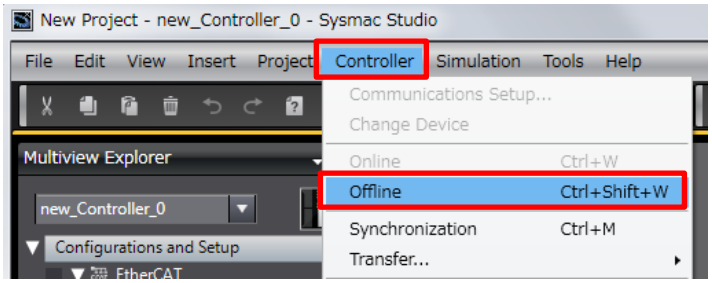
6.2.6. Transfer via Connection to the Communications Coupler Unit

1	From the controller selection box in the Multiview Explorer, select a Safety CPU Unit.	
2	Select **Controller**, then **Communications Setup** from the menu. Select **Connect via Coupler** in the Communications Setup dialog box, then click the **OK** button.	
3	Select **Controller**, then **Online** from the menu. The unit is in online connection with slave terminals.	

4	From the controller selection box in the Multiview Explorer, select a Controller Unit.	
5	In the edit page for slave terminals, right-click the Communications Coupler Unit, then select **Coupler Connection (USB)** – **Transfer to Computer**.	
	Click **Configuration information + Unit operation setting + Unit application data**.	

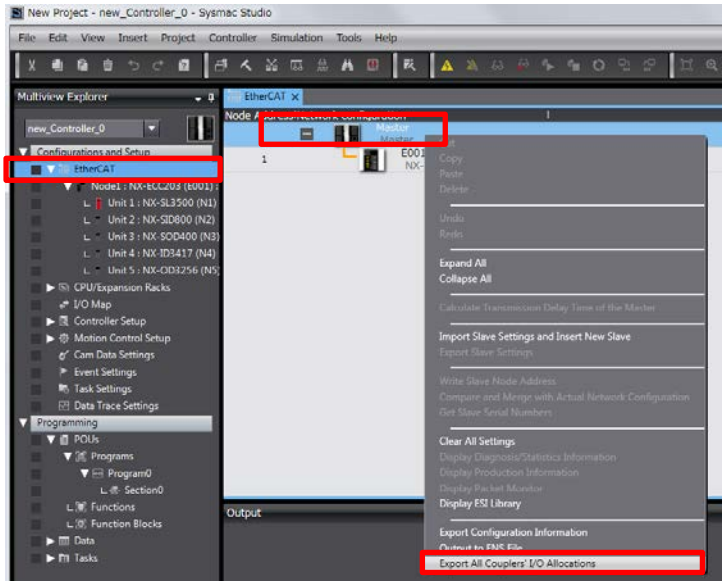
6.2.7. Output of Couple I/O Allocations

1 Select **Controller**, then **Offline** from the menu.



2 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer.

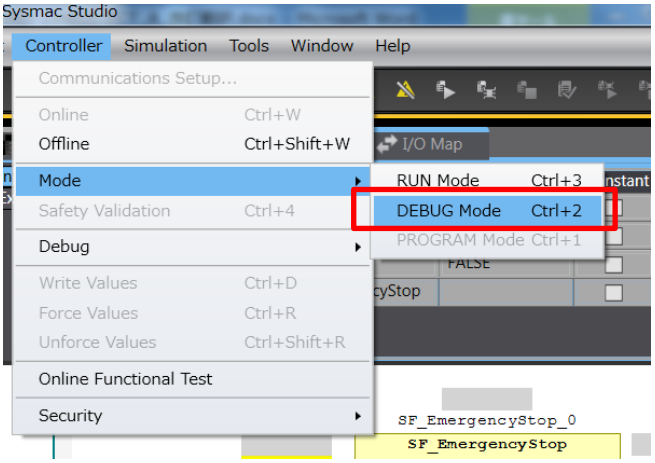
Right-click on **Master**, then select **Export All Coupler's I/O Allocations**.

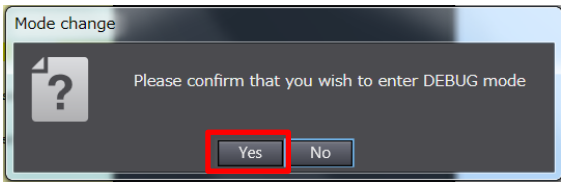
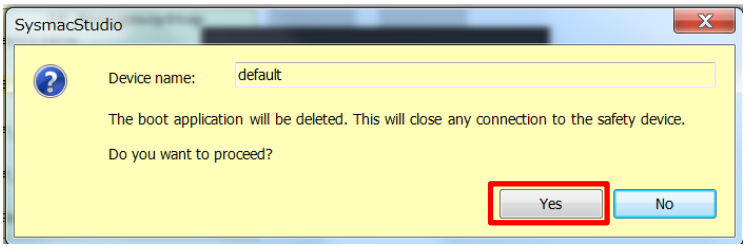
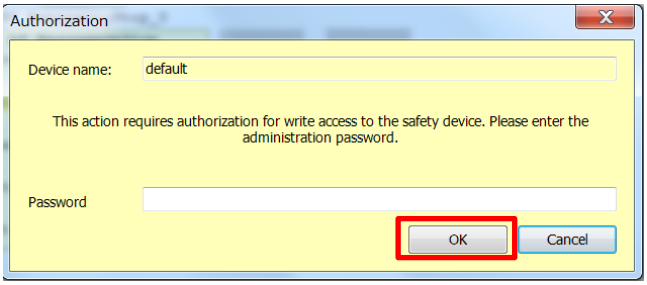
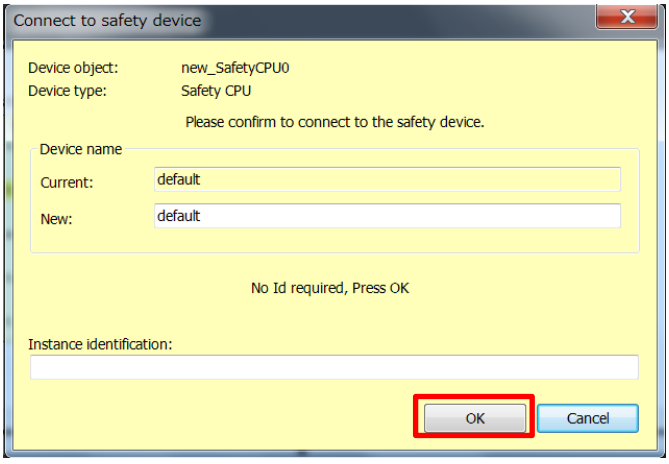


6.2.8. Changing to DEBUG Mode

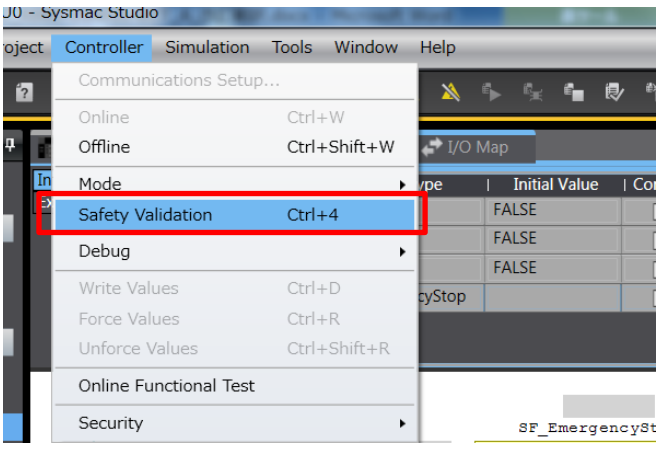
1 Select the Safety CPU Unit from the Controller Selection Box in the Multiview Explorer.

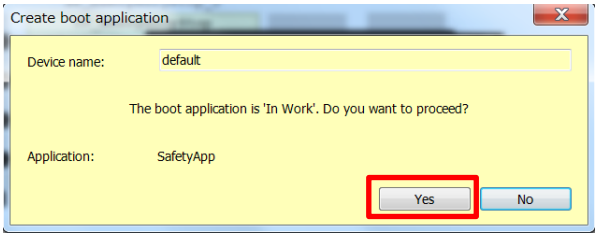
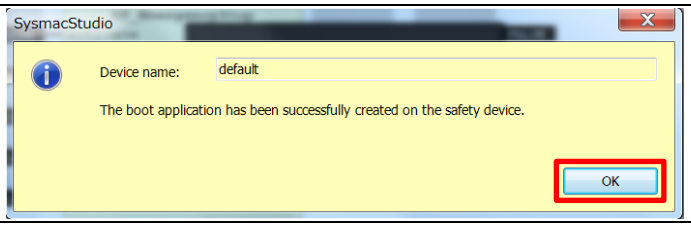
2 Select **Mode** – **DEBUG Mode** from **Controller** Menu.



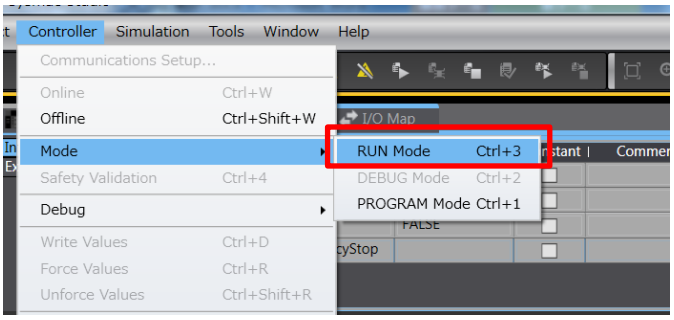
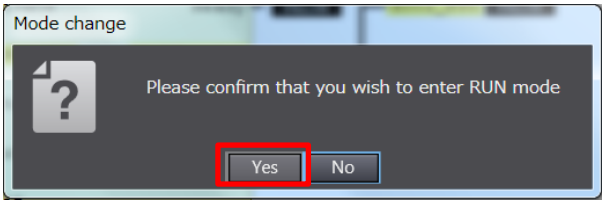
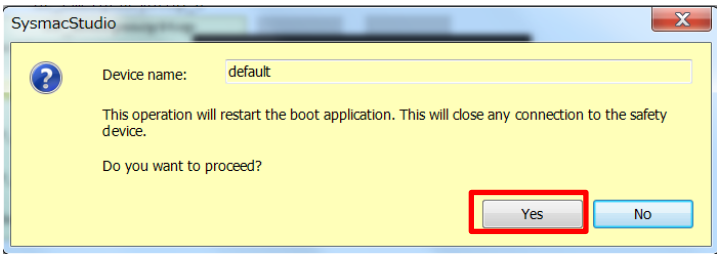
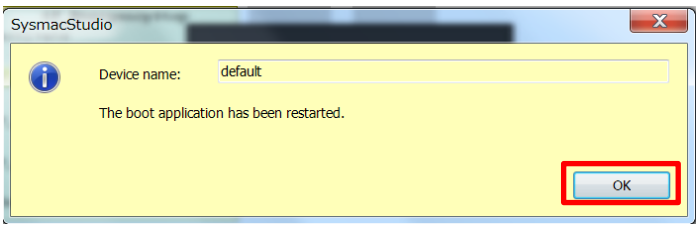
3	The following mode confirmation Dialog Box is displayed. Click the **Yes** Button.	
4	The following Connect to Safety Device Dialog Box is displayed. Click the **Yes** Button.	
5	The following transfer confirmation Dialog Box is displayed. Click the safety of the system and then click the **Yes** Button.	
6	The following password confirmation dialog box is displayed. When you use the DEBUG mode for the first time, or when the safety password is not specified, leave the **Password** field blank and click the **OK** button.	

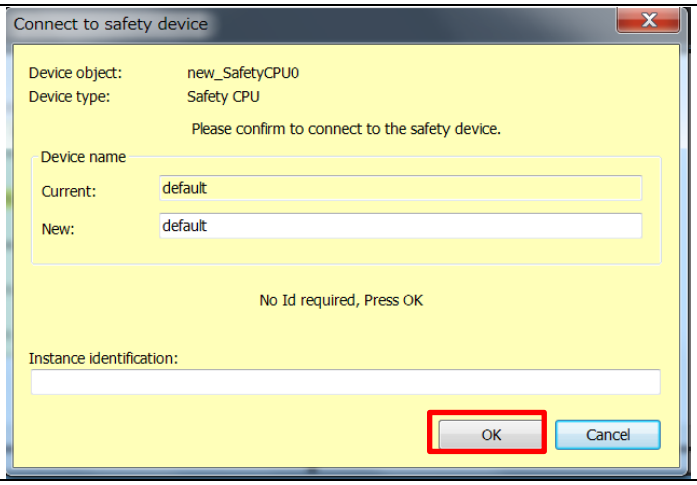
6.2.9. Performing Safety Validation

1	Select **Safety Validation** from the Controller Menu.	

2	Click the **Yes** Button.	
3	Click the **OK** Button	

6.2.10. Changing to RUN Mode

1	Select **Mode – RUN Mode** from the **Controller** Menu.	
2	Click the **Yes** Button.	
3	Click the **Yes** Button.	
4	Click the **OK** Button.	

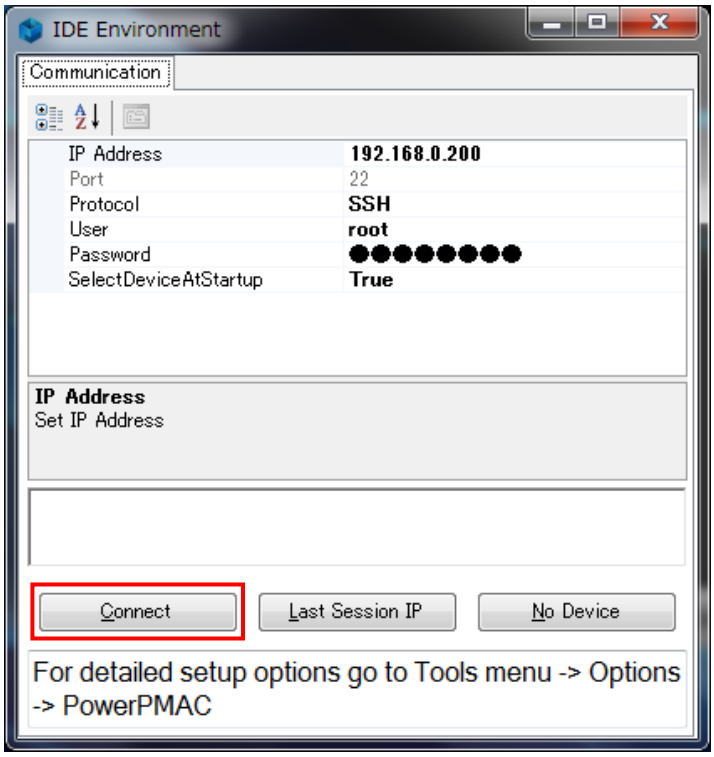
5	Click the **OK** Button.	

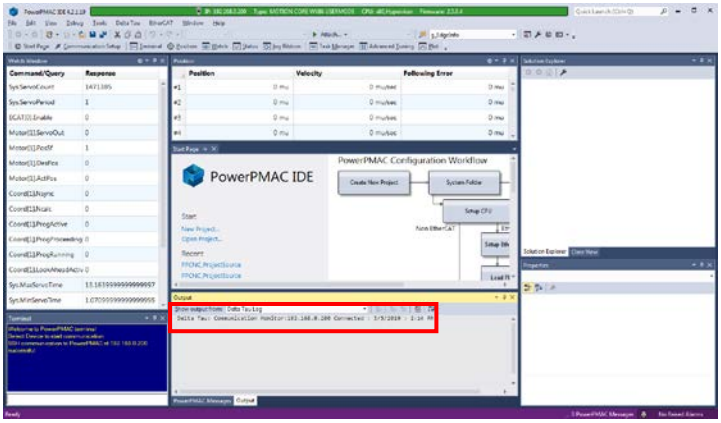
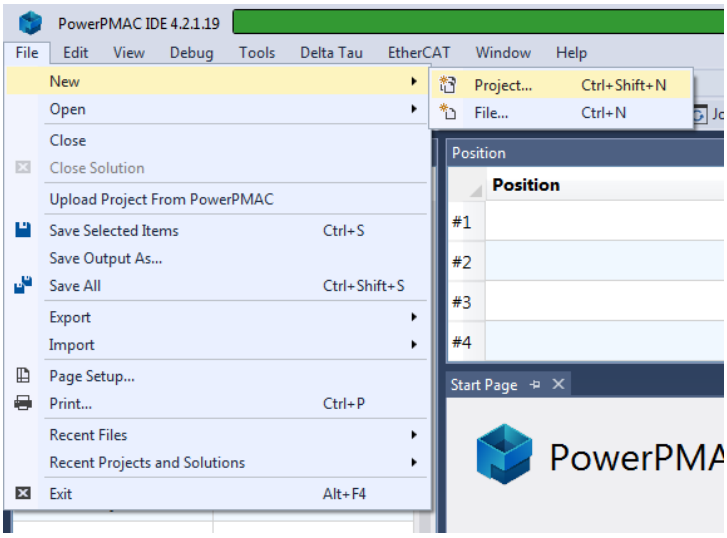
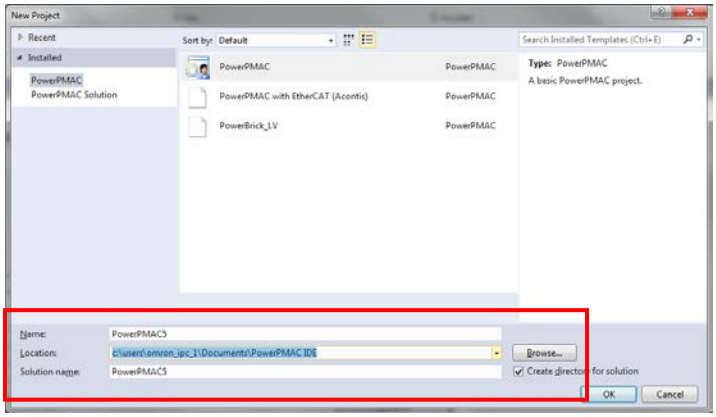
6.3. Preparation for the Controller Setup

Prepare the Controller settings.

Install Power PMAC IDE and Acontis EC-Engineer on the computer in advance.

6.3.1. Creation of a New Project

1	Turn on the power to the Controller.	
2	Start Power PMAC IDE. * If the dialog for confirming access rights appears upon start-up, select starting of Power PMAC IDE.	
3	The Communication screen appears. Specify the IP address of the destination Controller and click **Connect**. * The IP address of the Controller is set to “192.168.0.200” by default. * If necessary, change the Windows IP address to “192.168.0.X”.	

4	Power PMAC IDE starts, and is online to the Controller.	
5	From the **File** menu, select **New** then **Project**.	
6	Enter a project name and location, and select **OK**.	

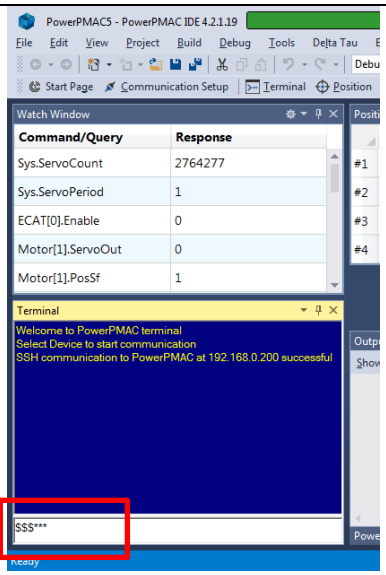
6.3.2. Initial Settings of the Controller

Configure the initial settings for the Controller.

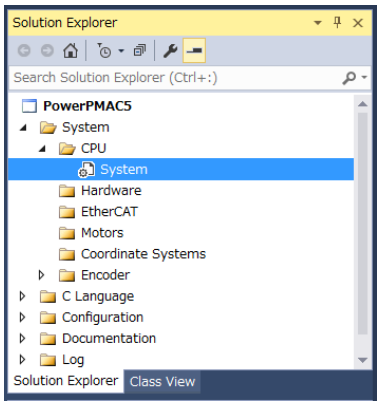
Precautions for Correct Use

Configuring the initial settings clears all data in the Controller memory. Back up necessary data in advance.

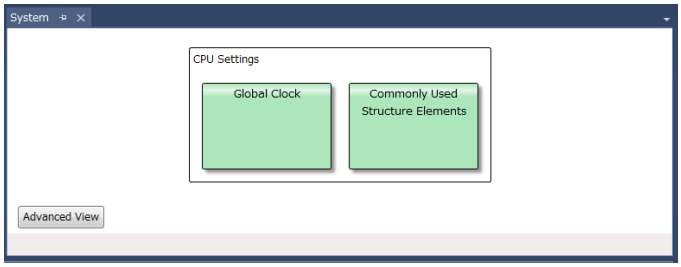
1 In the Terminal tab page, type the $$$*** command to reset the Controller to factory default.



2 Select **System** – **CPU** – **System** in the Solution Explorer.



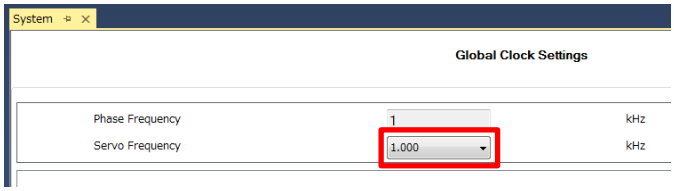
3 Select **Global Clock**.



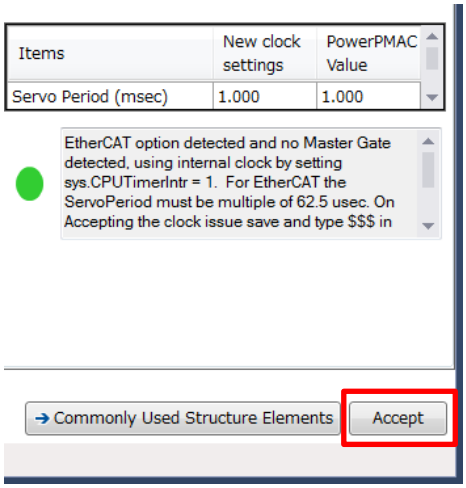
4 Specify **Servo Frequency**.

Select the **Servo Frequency** setting from 4 kHz, 2 kHz, or 1 kHz.

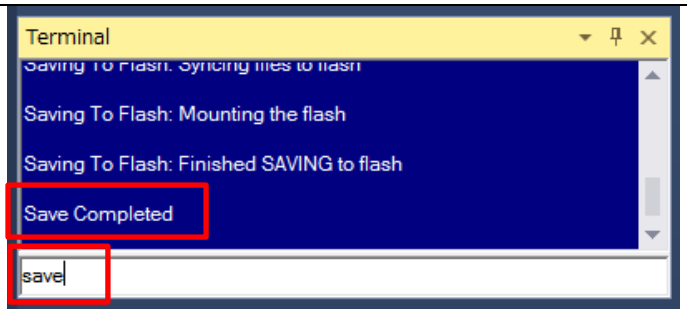
* Servo Frequency is set to 1 kHz for the example in this document.



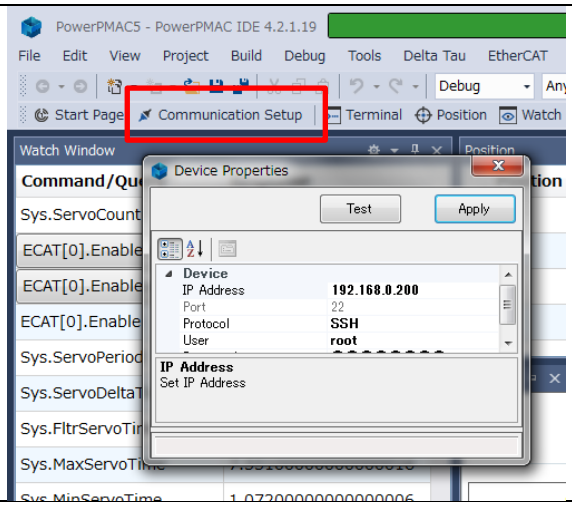
5 Click the **Accept** button.

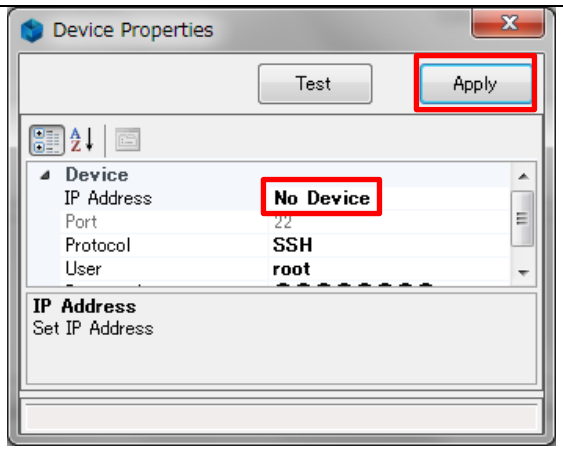
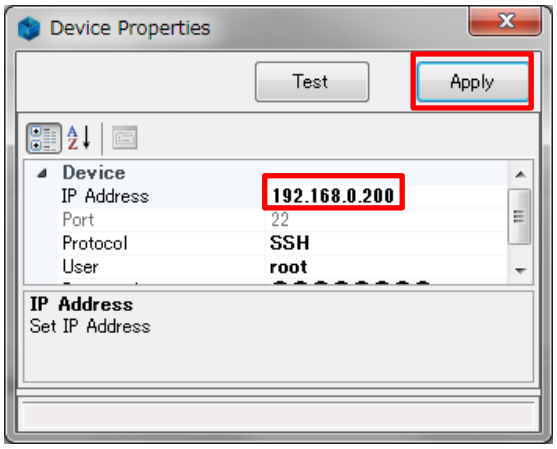


6 If you have changed the servo frequency setting, type the SAVE command in the Terminal tab page of Power PMAC IDE.
When complete, the “Save Complete” message appears in the Terminal tab page.



7 Click **Delta Tau** – **Communication Setup** on the toolbar to display the Device Properties dialog box.



8	In the Device Properties dialog box, select *No Device* for IP Address, then click the **Apply** button. This operation sets the Controller to the offline state.	
9	Restart the Controller. The servo frequency that has been set is reflected.	
10	Wait until the startup process of the Controller is complete. Then click **Delta Tau** – **Communication Setup** on the toolbar to display the Device Properties dialog box. In the Device Properties dialog box, return the IP Address to the previous setting, then click the **Apply** button. This operation sets the Controller to the online state.	

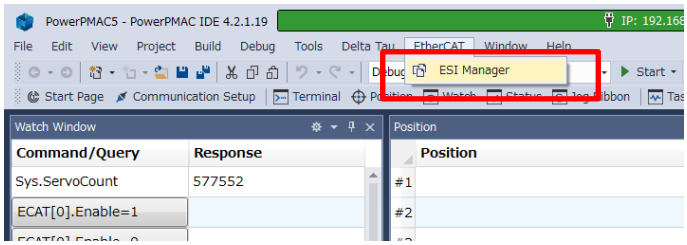
6.4. Installation of ESI Files

Install the ESI file for the Slave into Power PMAC IDE.

Precautions for Correct Use

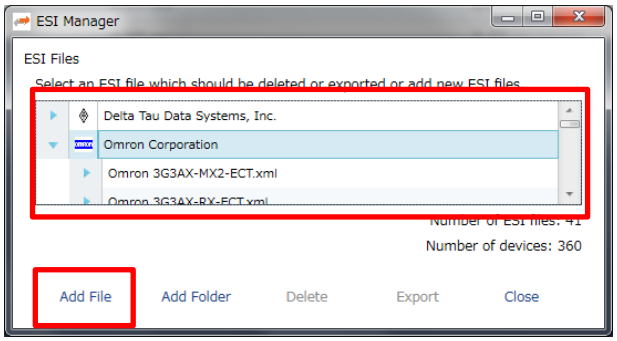
Prepare the ESI file described in this section in advance. Contact your OMRON representative for information on how to procure the ESI file.

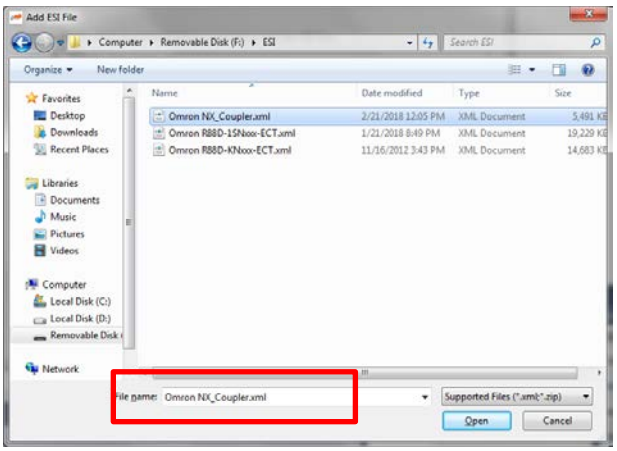
1 Start EC-Engineer.



2 Confirm that *Omron NX_Coupler.xml* is registered in the ESI file list of ESI Manager.

If it is not yet registered, click **Add File** and register *Omron NX_Coupler.xml*.





3 Click **Close** to close the ESI Manager.

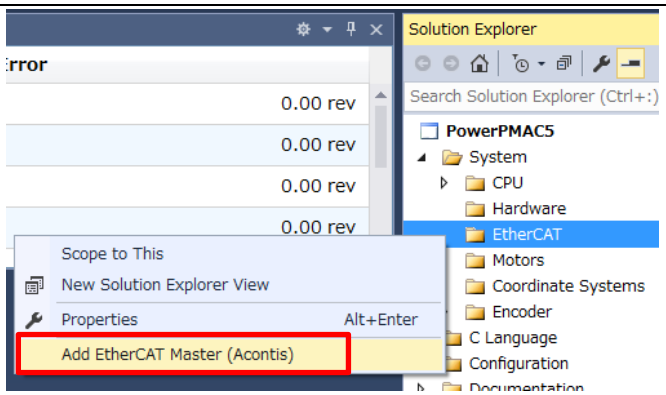
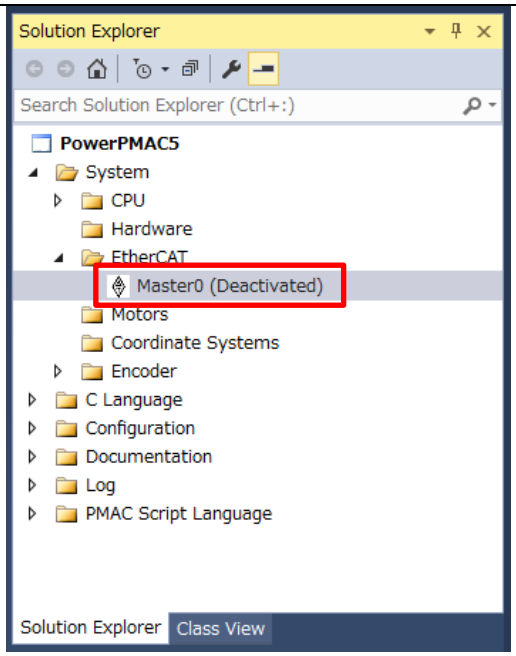
6.5. EtherCAT Communications Setup

Set up EtherCAT communications.

Precautions for Correct Use

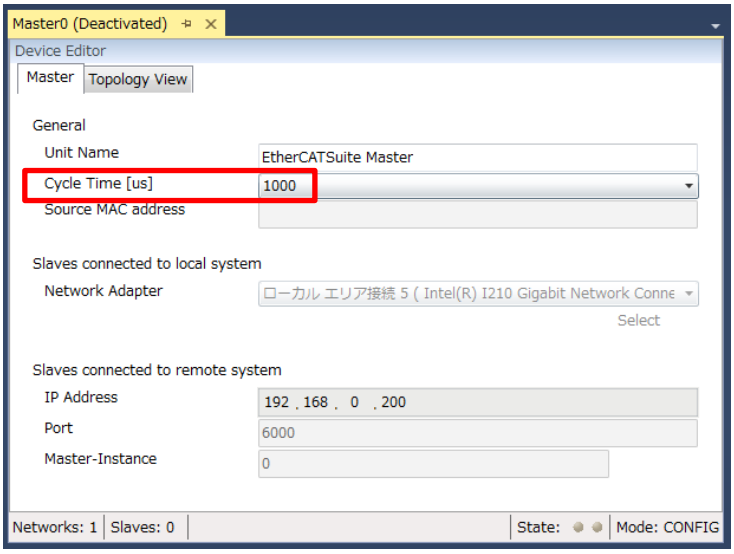
Before taking the following steps, make sure that the devices are connected via an Ethernet cable. If they are not connected, turn OFF the power to the devices, and connect the Ethernet cable.

6.5.1. Communications Setup for the EtherCAT Master

1	Connect the Controller with slave devices using an Ethernet cable. * Refer to the manuals for slave devices to configure them.	
2	Select System – **EtherCAT** in the Solution Explorer and right-click on EtherCAT, then select **Add EtherCAT Master(Acontis)**.	
3	Master0 (Deactivated) is added to Solution Explorer.	

4 In the Master tab page, specify a communication period for **Cycle Time [us]**.

* You must specify the communication period in accordance with the servo frequency of the Controller. 1000 us is set in this document.



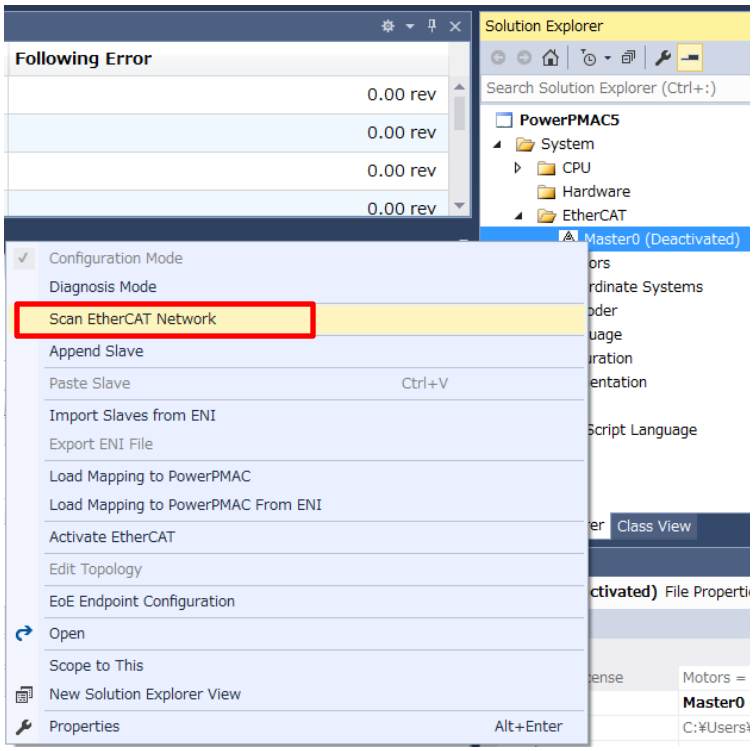
Correspondence between the servo frequencies of the Controller and communication periods is as follows:

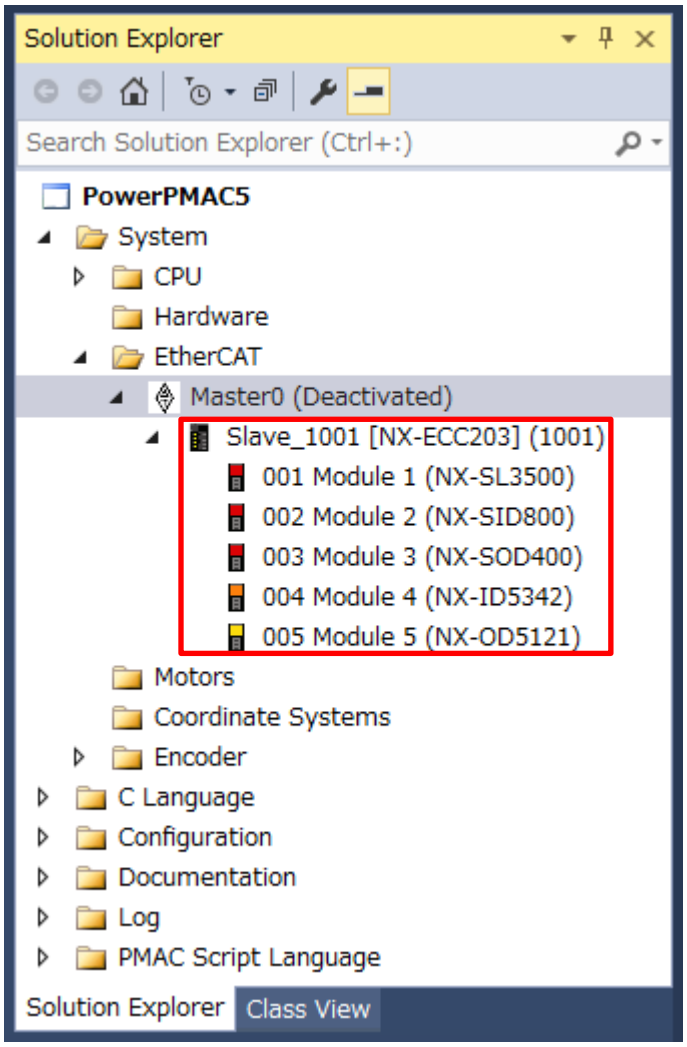
4 kHz : 250 us

2 kHz : 500 us

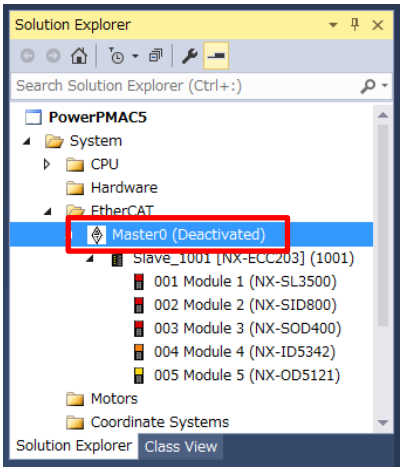
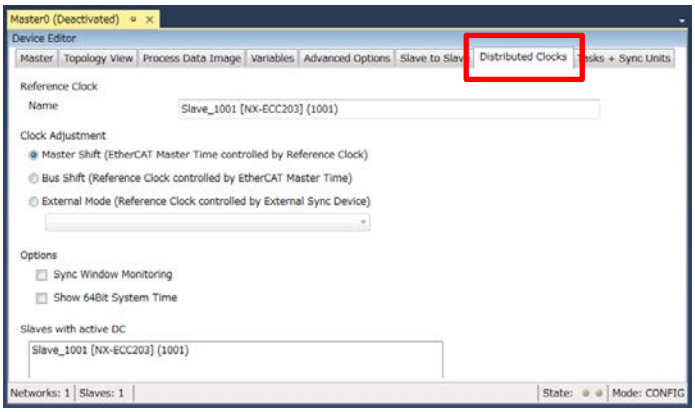
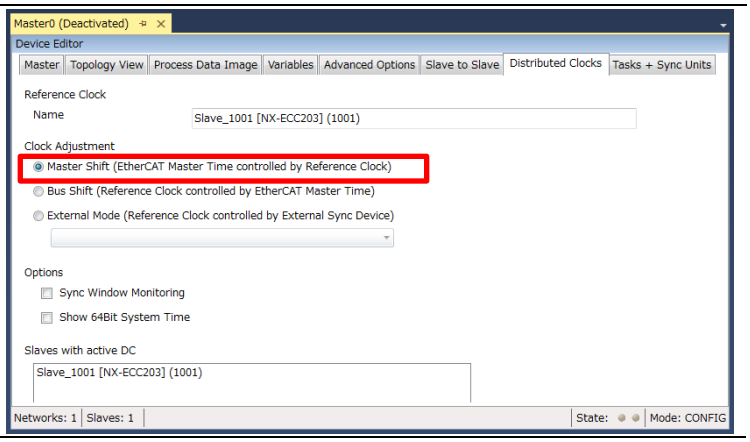
1 kHz : 1000 us

5 Select **System** – **EtherCAT** in the Solution Explorer and right-click on **Master0 (Deactivated)**, then select **Scan EtherCAT Network**.



6	Make sure that the slave is displayed in the Solution Explorer.	

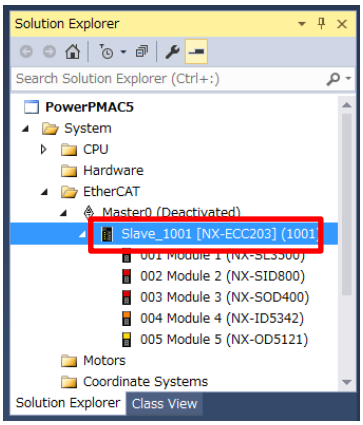
6.5.2. Distributed Clock Setup

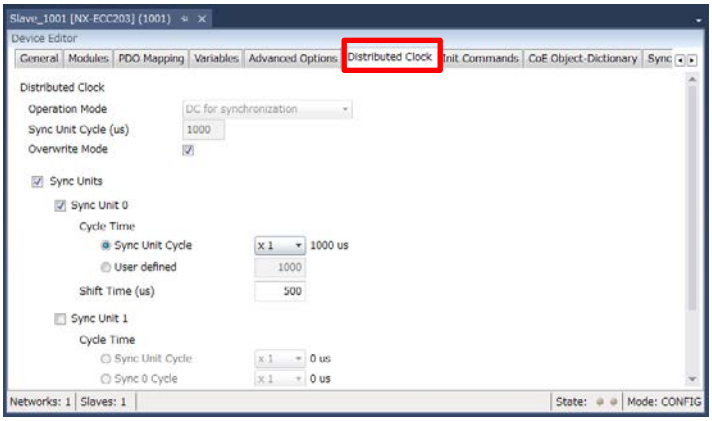
1	Setting Distributed Clocks (DC) for Master In the Master0 (Deactivated) tab page, select **Distributed Clocks** tab.	 
2	Select **Master Shift (EtherCAT Master Time controlled by Reference Clock)**.	

■ When using in DC mode

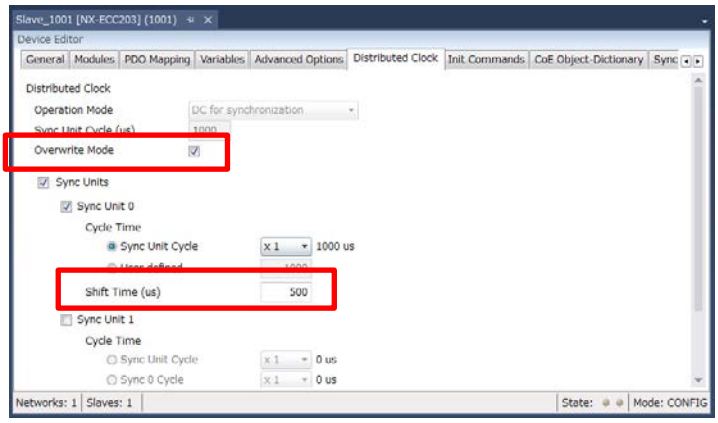
3 Setting Distributed Clock (DC) for the Slave

In the Solution Explorer, select the target slave and display the Distributed Clock tab page.





4 Select the **Overwrite Mode** check box and specify **Shift Time**.



Correspondence between the servo frequencies of the Controller and **Shift Time** values is as follows:

4 kHz : 125 us

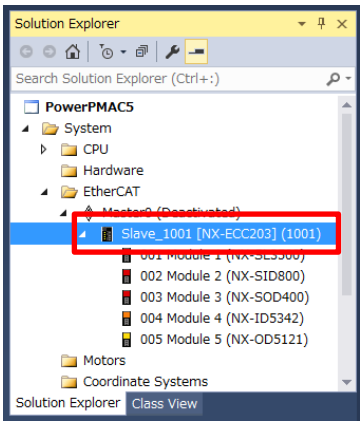
2 kHz : 250 us

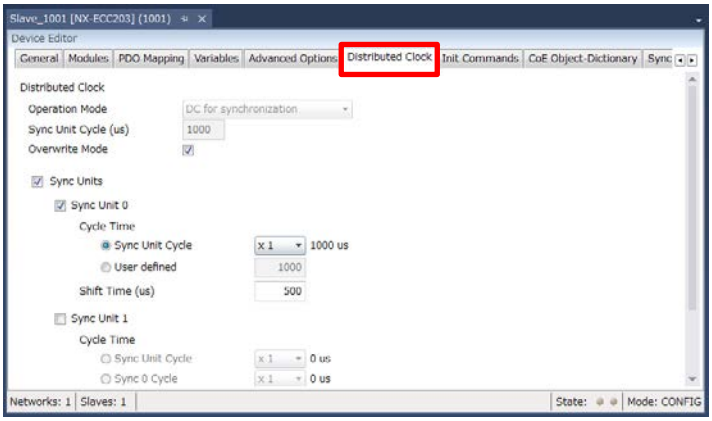
1 kHz : 500 us

■ When using in Free-Run mode

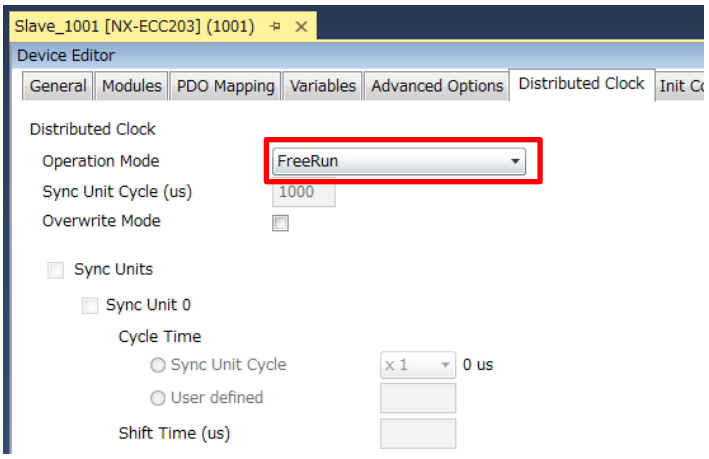
3 Setting Distributed Clock (DC) for the Slave

In the Solution Explorer, select the target slave and display the Distributed Clock tab page.

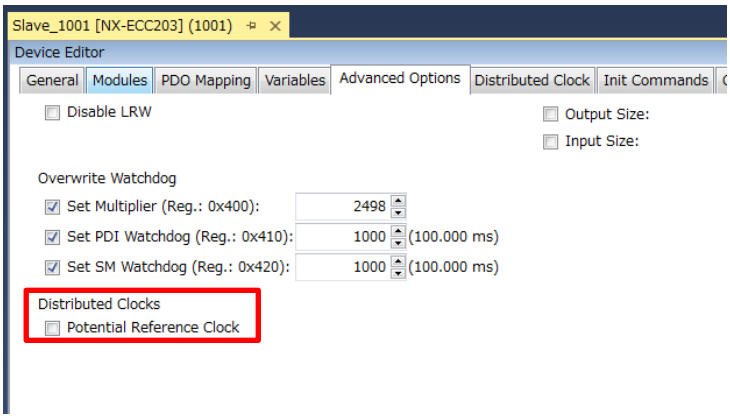




4 Select *FreeRun* from the drop down list for **Operation Mode**.



5 In the Advanced Options tab page, clear the **Potential Reference Clock** check box.



6.5.3. Safety Controller Variable Settings

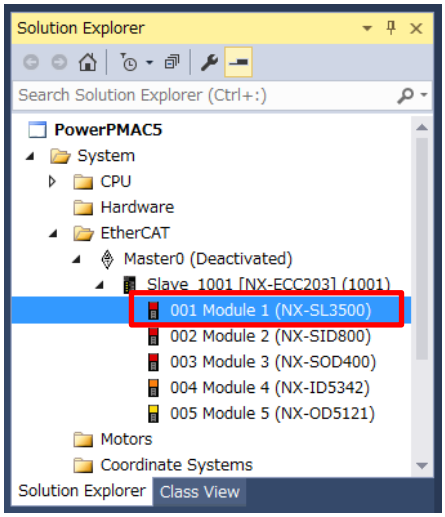
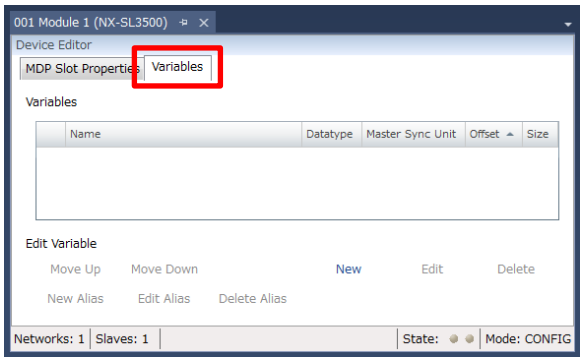
(1) Checking the coupler I/O allocations

Decompress the ZIP file you saved in 6.2.7 Output of Couple I/O Allocations, open the expanded “CouplerMemoryMap.xml” using Internet Explorer, and check the contents.

(2) Setting Input Data

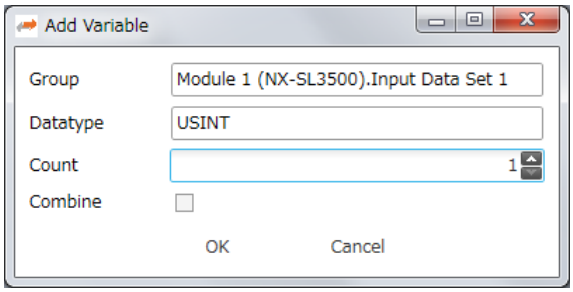
Register the following input data.

- Slot1(NX-SL3500)Input Data Set1
- Slot1(NX-SL3500)Input Data Set2

1	Select a safety controller in the Project Explorer pane of EC-Engineer. Display the Variables tab page.	 

2 [Slot1(NX-SL3500)Input Data Set1]
Registering Node1/Unit2 (NX-SID800)

Click **New** in the Variables tab page, and register 4 variables shown on the right.



FSoE Slave CMD	#x6020:01	USINT

Group: Module 1(NX-SL3500).Input Data Set 1
Datatype: USINT
Count: 1

Safety Input 1st Word	#x6021:01	UINT
FSoE Slave CRC_0	#x6020:03	UINT
FSoE Slave Conn_ID	#x6020:02	UINT

Group: Module 1(NX-SL3500).Input Data Set 1
Datatype: UINT
Count: 3

3 [Slot1(NX-SL3500)Input Data Set1]
Registering Node1/Unit3 (NX-SOID400)

Click **New** in the Variables tab page, and register 4 variables shown on the right.

FSoE Slave CMD	#x6040:01	USINT
Safety Input 1st Byte	#x6041:01	USINT

Group: Module 1(NX-SL3500).Input Data Set 1
Datatype: USINT
Count: 2

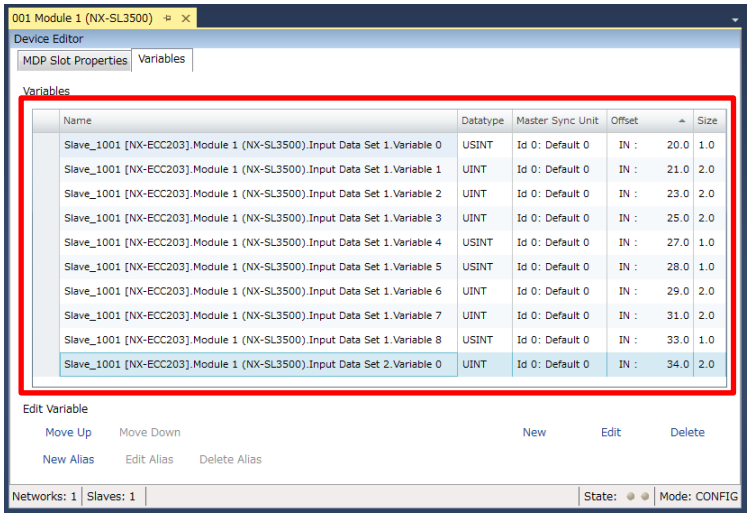
FSoE Slave CRC_0	#x6040:03	UINT
FSoE Slave Conn_ID	#x6040:02	UINT

Group: Module 1(NX-SL3500).Input Data Set 1
Datatype: UINT
Count: 2

4 [Slot1(NX-SL3500)Input Data Set1]
Registering Padding

Click **New** in the Variables tab page, and register the variable shown on the right.

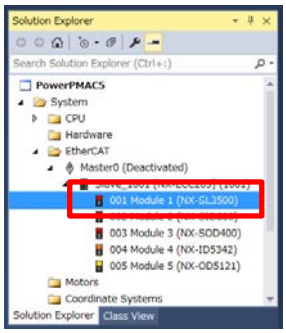
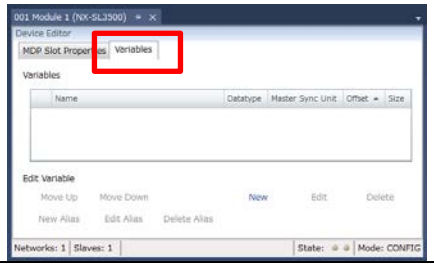
Group: Module 1(NX-SL3500).Input Data Set 1
Datatype: USINT
Count: 1

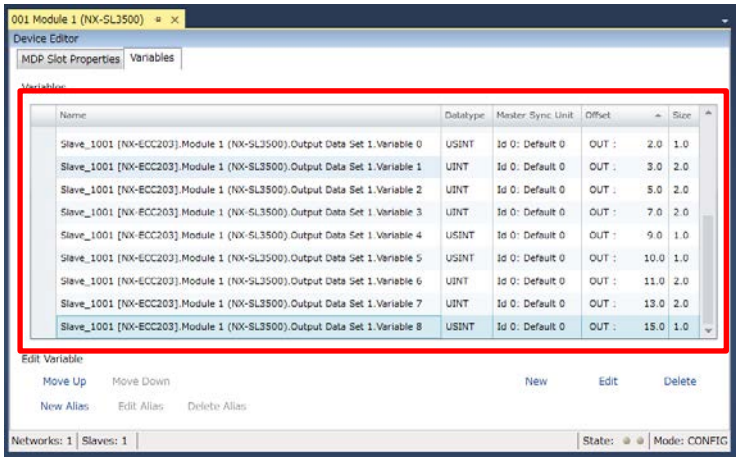
5	[Slot1(NX-SL3500)Input Data Set2] Registering Safety CPU Status Click **New** in the Variables tab page, and register the variable shown on the right.	<table><tr><td>Safety CPU Status</td><td>#x6004:01</td><td>UINT</td></tr></table> Group: Module 1(NX-SL3500).Input Data Set 2 Datatype: UINT Count: 1
6	Checking Input Data Make sure that the settings (Input) in the Variables tab page are correct.	

(3) Setting Output Data

Register the following output data.

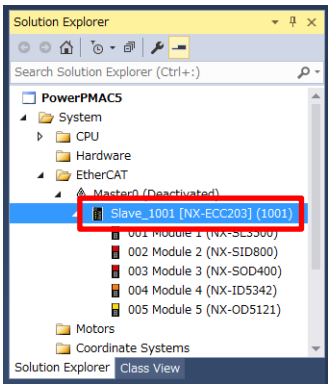
- Slot1(NX-SL3500)Output Data Set1
- Slot1(NX-SL3500)Output Data Set2

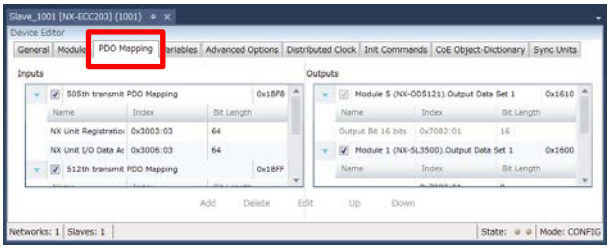
7	Select a safety controller in the Project Explorer pane of EC-Engineer. Display the Variables tab page.	 
8	[Slot1(NX-SL3500)Output Data Set1] Registering Node1/Unit2 (NX-SID800) Click **New** in the Variables tab page, and register 4 variables shown on the right.	FSoE Master CMD | #x7020:01 | USINT Group: Module 1(NX-SL3500).Output Data Set 1 Datatype: USINT Count: 1 Safety Output 1st Word | #x7021:01 | UINT FSoE Maste CRC_0 | #x7020:03 | UINT FSoE Master Conn_ID | #x7020:02 | UINT Group: Module 1(NX-SL3500).Output Data Set 1 Datatype: UINT Count: 3

9	[Slot1(NX-SL3500)Output Data Set1] Registering Node1/Unit3 (NX-SOD400) Click **New** in the Variables tab page, and register 4 variables shown on the right.	<table><tr><td>FSoE Master CMD</td><td>#*x*7040:01</td><td>USINT</td></tr><tr><td>Safety Output 1st Byte</td><td>#*x*7041:01</td><td>USINT</td></tr></table> Group: Module 1(NX-SL3500).Output Data Set 1 Datatype: USINT Count: 2 <table><tr><td>FSoE Master CRC_0</td><td>#*x*7040:03</td><td>UINT</td></tr><tr><td>FSoE Master Conn_ID</td><td>#*x*7040:02</td><td>UINT</td></tr></table> Group: Module 1(NX-SL3500).Output Data Set 1 Datatype: UINT Count: 2
10	[Slot1(NX-SL3500)Output Data Set1] Registering Padding Click **New** in the Variables tab page, and register the variable shown on the right.	Group: Module 1(NX-SL3500).Output Data Set 1 Datatype: USINT Count: 1
11	[Slot1(NX-SL3500)Output Data Set2] * *Output Data Set2* is not used and does not need to be set.	
12	Checking Output Data Make sure that the settings (Output) in the Variables tab page are correct.	

6.5.4. PDO Map Settings

1 In the Project Explorer, select the target slave to display the PDO Mapping tab page.

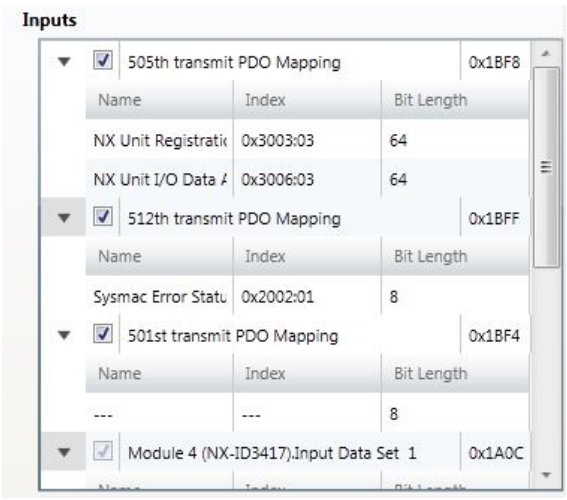




2 Setting PDO mapping (Inputs)

Confirm the check boxes in the Inputs field.

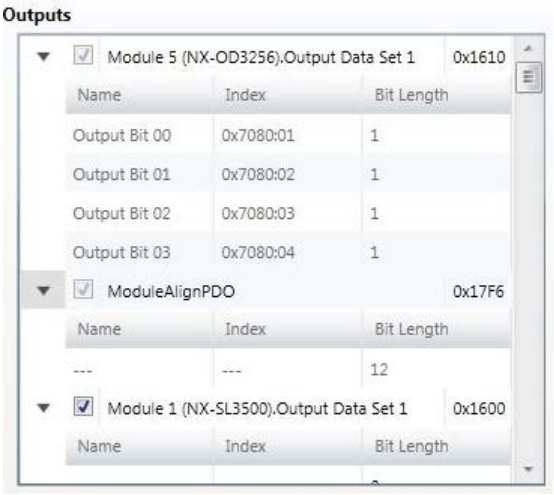
* If you do not want to use data in the Inputs field, clear the currently displayed check boxes.



3 Setting PDO mapping (Outputs)

Confirm the check boxes in the Outputs field.

* If you do not want to use data in the Outputs field, clear the currently displayed check boxes.



6.5.5. Coupler I/O and Variable Allocations

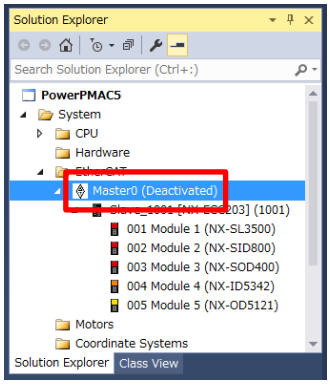
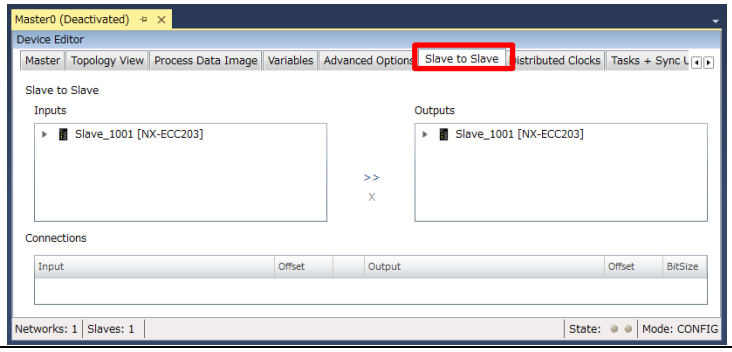
(1) Checking the coupler I/O allocations

Decompress the ZIP file you saved in 6.2.7 Output of Couple I/O Allocations, open the expanded “CouplerCopyInfo.xml” using Internet Explorer, and check the contents.

(2) Setting Input Data

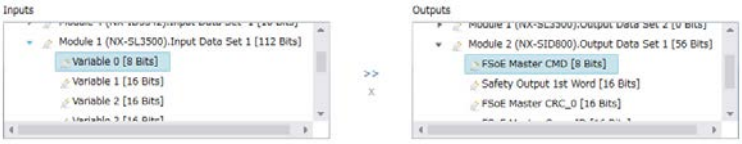
Associate the following items:

- **Module 1 (NX-SL3500).Input Data Set 1**, and **Module 2 (NX-SID800).Output Data Set 1**
- **Module 1 (NX-SL3500).Input Data Set 1**, and **Module 3 (NX-SOD400).Output Data Set 1**

1	Select *Class-A Master* in the Project Explorer page of EC-Engineer. Display the Slave to Slave tab page.	 

2 Associate the variables of Inputs **Module 1 (NX-SL3500).Input Data Set 1** with Outputs **Module 2 (NX-SID800).Output Data Set 1**.

Select an **(NX-SL3500).Input Data Set 1** item, then select the corresponding **(NX-SID800).Output Data Set 1** item and click **>>**.

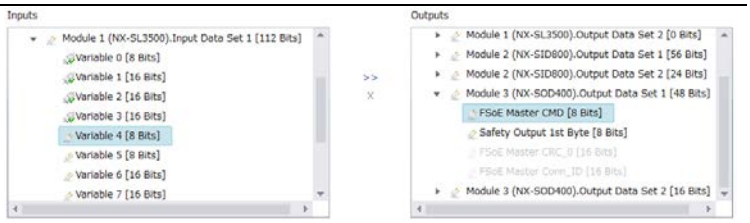


Associate the following items:

Inputs	Outputs
Variable 0	FSoE Master CMD
Variable 1	Safety Output 1st Word
Variable 2	FSoE Master CRC_0
Variable 3	FSoE Master Conn_ID

3 Associate the variables of Inputs **Module 1 (NX-SL3500).Input Data Set 1** with Outputs **Module 3 (NX-SOD400).Output Data Set 1**.

Select an **(NX-SL3500).Input Data Set 1** item, then select the corresponding **(NX-SOD400).Output Data Set 1** item and click **>>**.



Associate the following items:

Inputs	Outputs
Variable 4	FSoE Master CMD
Variable 5	Safety Output 1st Word
Variable 6	FSoE Master CRC_0
Variable 7	FSoE Master Conn_ID

* Variable 8 does not need to be allocated.

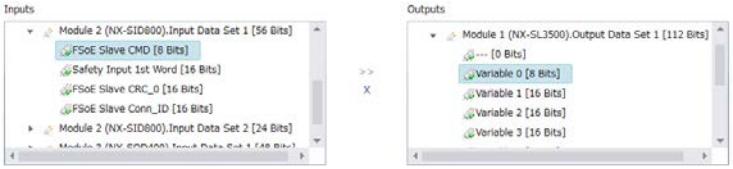
(3) Setting Output Data

Associate the following items:

- **Module 2 (NX-SID800).Input Data Set 1**, and **Module 1 (NX-SL3500).Output Data Set 1**
- **Module 3 (NX-SOD800).Input Data Set 1**, and **Module 1 (NX-SL3500).Output Data Set 1**

4 Associate the variables of Inputs **Module 2 (NX-SID800).Input Data Set 1** with Outputs **Module 1 (NX-SL3500).Output Data Set 1**.

Select an **(NX-SID800).Input Data Set 1** item, then select the corresponding **(NX-SL3500).Output Data Set 1** item and click **>>**.

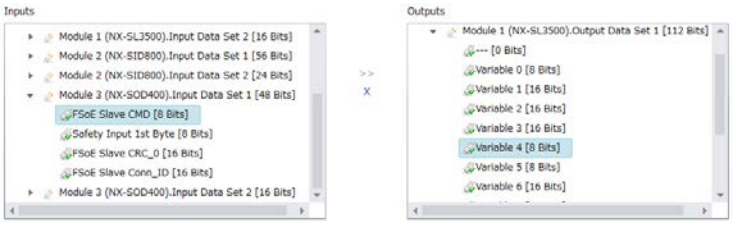


Associate the following items:

Inputs	Outputs
FSoE Slave CMD	Variable 0
Safety Input 1st Word	Variable 1
FSoE Slave CRC_0	Variable 2
FSoE Slave Conn_ID	Variable 3

5 Associate the variables of Inputs **Module 3 (NX-SOD800).Input Data Set 1** with Outputs **Module 1 (NX-SL3500).Output Data Set 1**.

Select an **(NX-SOD800).Input Data Set 1** item, then select the corresponding **(NX-SL3500).Output Data Set 1** item and click **>>**.



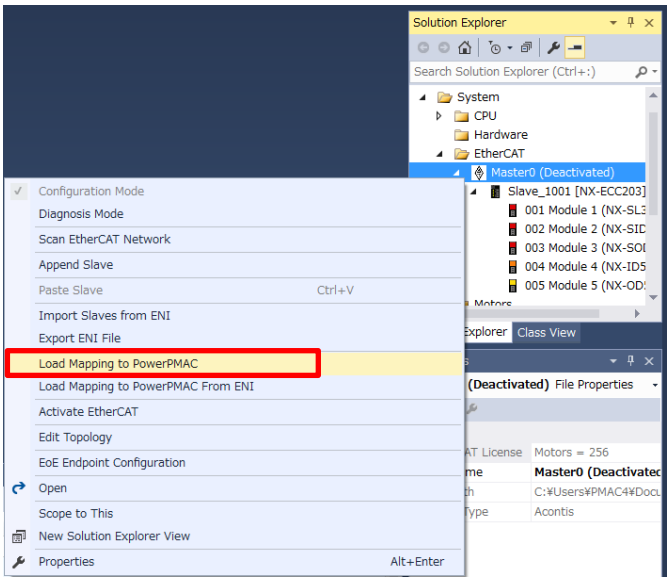
Associate the following items:

Inputs	Outputs
FSoE Slave CMD	Variable 4
Safety Input 1st Word	Variable 5
FSoE Slave CRC_0	Variable 6
FSoE Slave Conn_ID	Variable 7

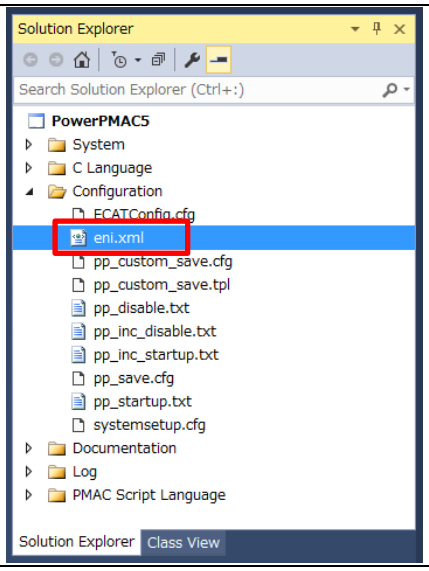
* Variable 8 does not need to be allocated.

6.5.6. Creation of an EtherCAT Network Information File

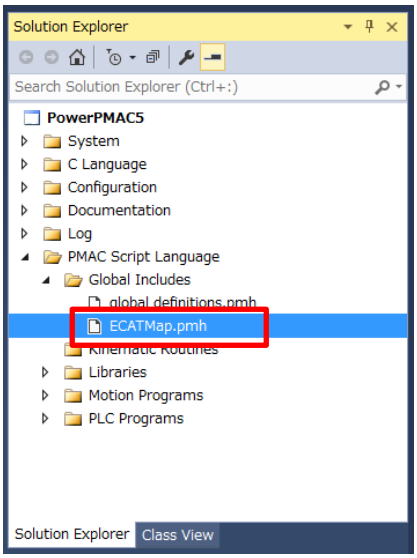
1 Select **System** – **EtherCAT** in the Solution Explorer and right-click on **Master0 (Deactivated)**, then select **Load Mapping to PowerPMAC**.



2 An eni.xml file is added under the **Configuration** directory in the Solution Explorer.



3 An ECATMap.pmh file is added under the **PMAC Script Language/Global Includes** directory in the Solution Explorer.

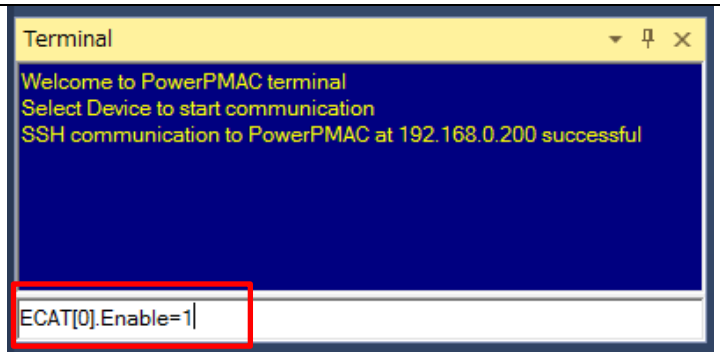


6.6. Controller Settings

6.6.1. EtherCAT Communications Check

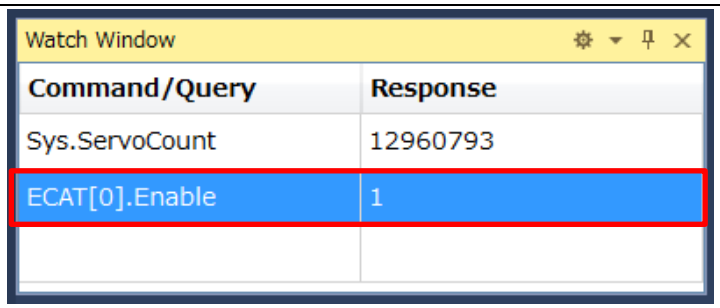
Take the following steps to ensure that EtherCAT communications are available.

1 From the Terminal pane, run the ECAT[0].Enable=1 command to start EtherCAT communications.

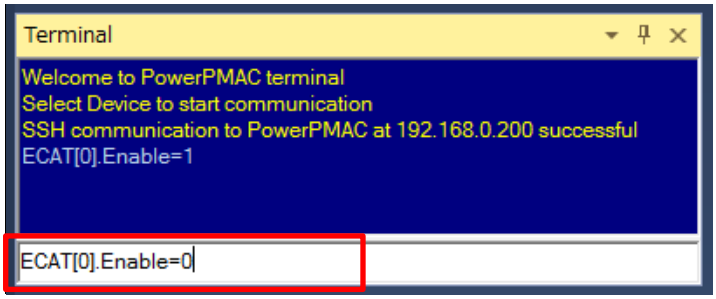


2 In the Terminal or Watch pane, make sure that the ECAT[0].Enable value turns to *1*.

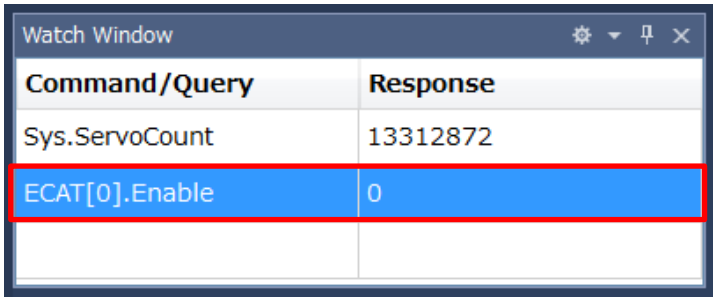
* The OP mode is entered and EtherCAT communications are established.



3 After making sure that correct communications are available, run the ECAT[0].Enable=0 command from the Terminal pane to stop EtherCAT communications.



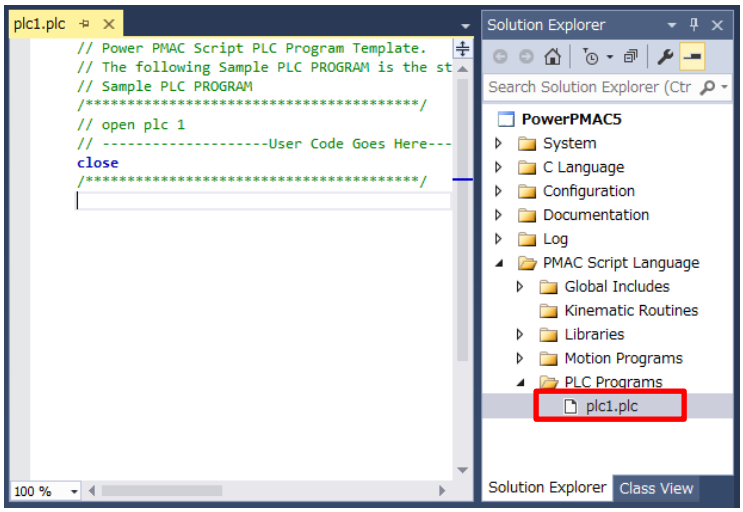
4 In the Terminal or Watch pane, make sure that the ECAT[0].Enable value turns to *0*.



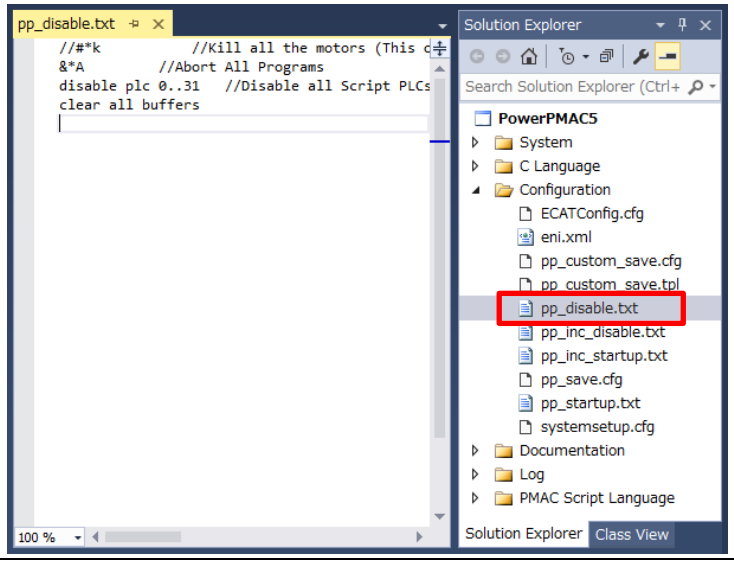
6.6.2. Writing the User Program

Create programs to be used to check operations.

A specific language is used for the operation check programs. Refer to *Power PMAC User's Manual* and *Power PMAC Software Reference Manual* for details.

1	In the Solution Explorer pane, open **Project name** – **PMAC Script Language** – **PLC Programs** – **plc1.plc**.	

2	In the programming area of the plc1.plc tab page, write a program as show on the right.
	
	This sample program blinks the NX-OD3256 output indicator every 5 seconds.
	
	* In this example, PDO mapping is assumed to be the default setting. If you want to change PDO mapping, rewrite the "Slave_0...." description.
		open plc 1
		
		while(Sys.EcatMasterReady == 0){}
		
		ECAT[0].Enable = 1
		
		P1000 = Sys.Time + 5
		while(P1000 > Sys.Time){}
		
		Slave_0_7080_1_OutputBit00 = 1
		
		P1000 = Sys.Time + 5
		while(P1000 > Sys.Time){}
		
		Slave_0_7080_1_OutputBit00 = 0
		
		close

3	Setting the start of the user program In the Solution Explorer pane, open **Project name** – **Configuration** – **pp_disable.txt**.	

4	In the programming area of the pp_disable.txt tab page, add the program shown on the right to the last line. The pp_disable.txt program is automatically executed when the Controller starts. This example program runs the PLC1 script.	enable plc 1;

6.6.3. Project Data Transfer

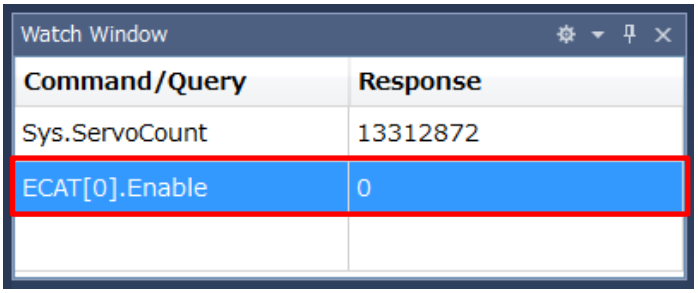
Transfer the created project data to the Controller.

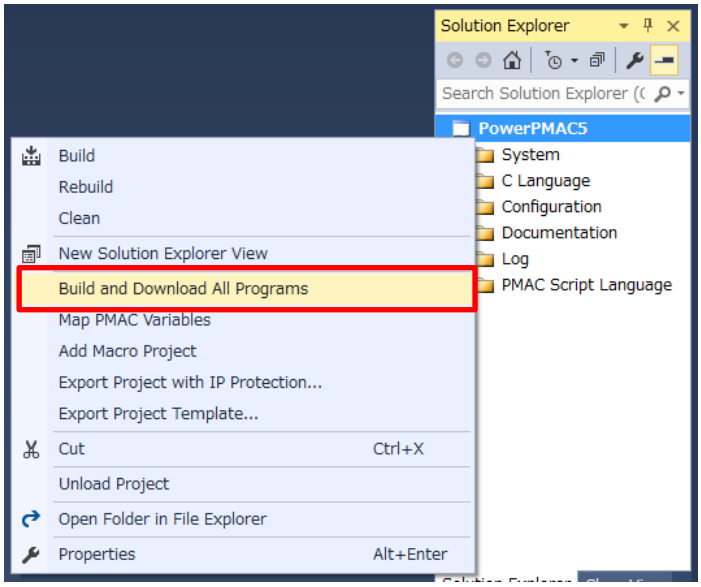
⚠ WARNING

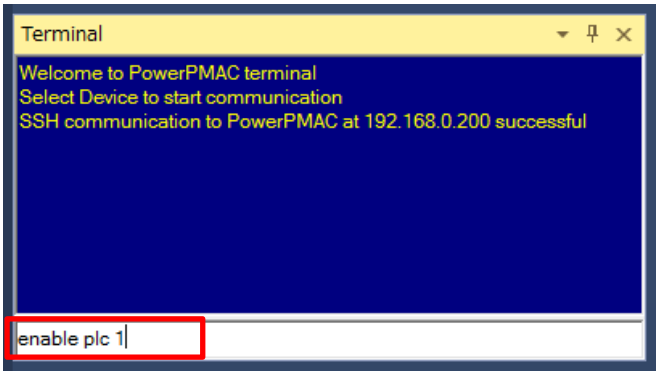
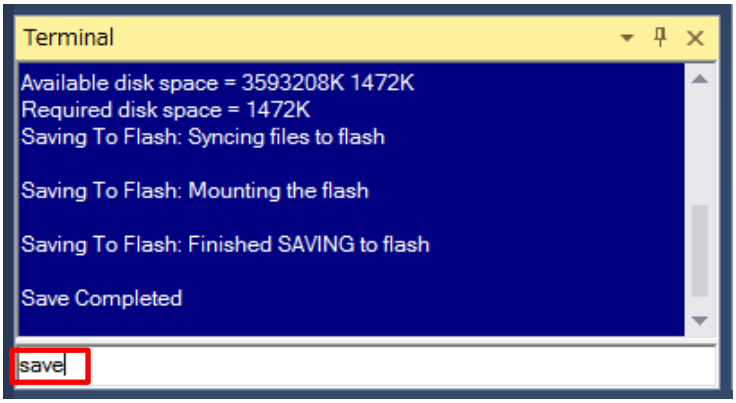
When the user program and “configuration and setting” data are transferred from Power PMAC IDE, devices or the machine may perform unexpected operations. Therefore, before you transfer project data, ensure the destination slave is operating safely.

⚠ Caution

Transferring project data restarts the Controller and interrupts communications with slaves. The time that communications are interrupted depends on the EtherCAT network configuration.
Before you transfer project data, make sure that the slave settings will not adversely affect the devices.

1	In the Terminal tab page or Watch Window, make sure that the ECAT[0].Enable value is *0*. If the value is 1, run the ECAT[0].Enable=0 command from the Terminal tab page to stop EtherCAT communications.	

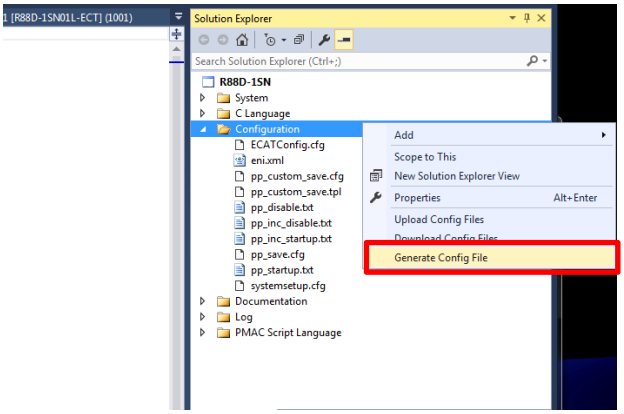
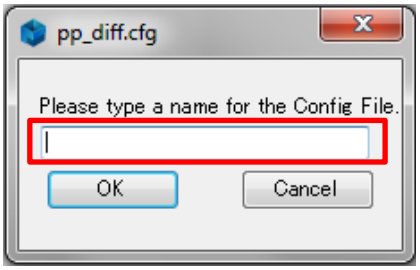
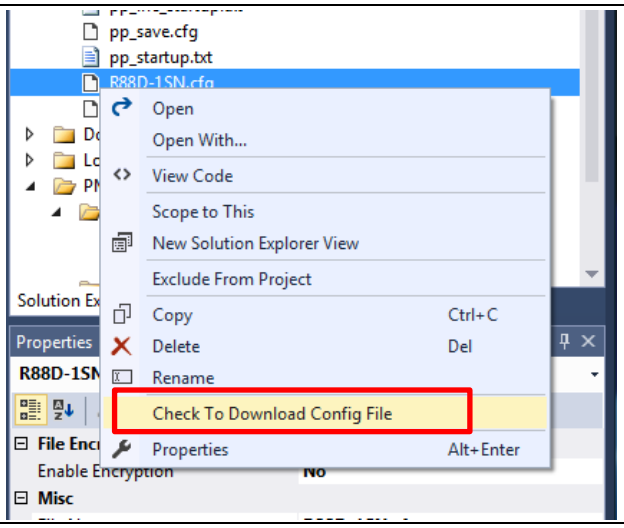
2	Downloading a project Right-click the project name in the Solution Explorer pane on the upper right of the IDE screen, and select **Build and Download All Programs** to run the build and download. * The transferred project is not yet saved to the Controller at this stage. If you turn OFF the power to the Controller, the transferred project will be discarded.	
3	Make sure that there are no errors in the Output Window. * If the transfer fails, check details of the error in the Output Window. If the error is a program error, you must review the program. If the error is related to EtherCAT settings, return to 6.5 EtherCAT Communications Setup and check whether there are any incorrect settings.	

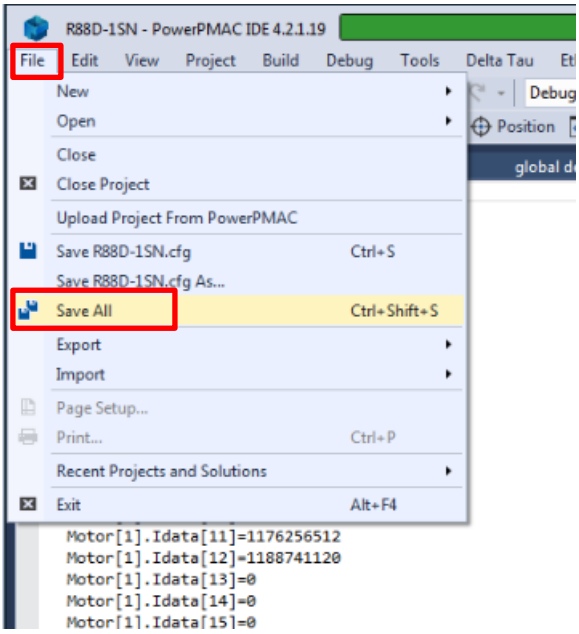
4	The program starts running when it has been downloaded successfully. EtherCAT communications are in the OP state. Make sure that the NX-OD3256 output indicator blinks. * If the indicator does not blink, check that the ECAT[0].Enable value is *1* in the Terminal tab page or Watch Window. If the value is *0*, run the following command from the Terminal tab page. enable plc 1	
5	After you have confirmed an appropriate operation, save the project to the Controller. Run the save command from the Terminal tab page. * The save command stores the downloaded project in the Controller. This operation saves the settings to be executed automatically when the power to the Controller is turned on.	

7. Appendix Saving and Loading a Project

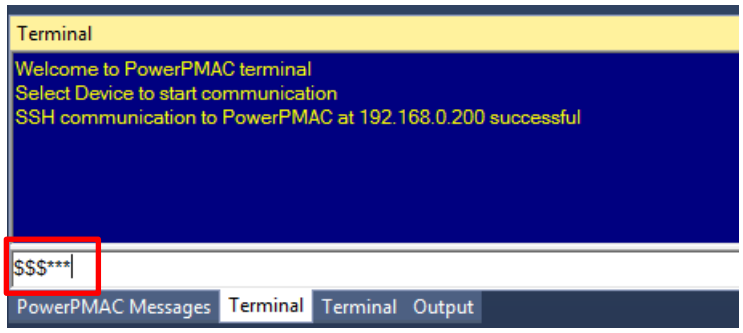
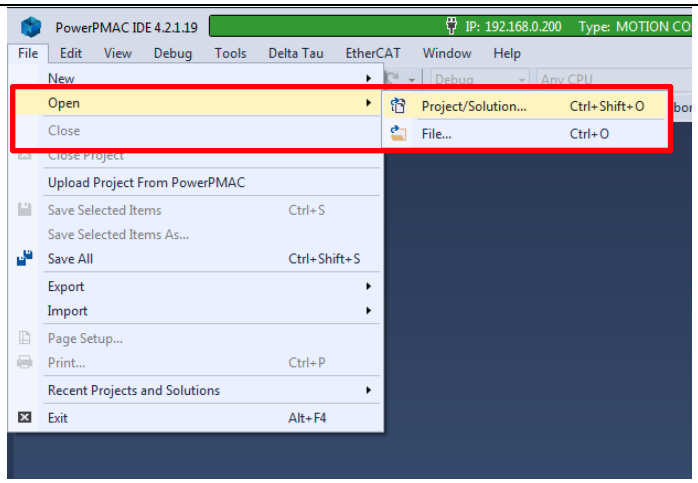
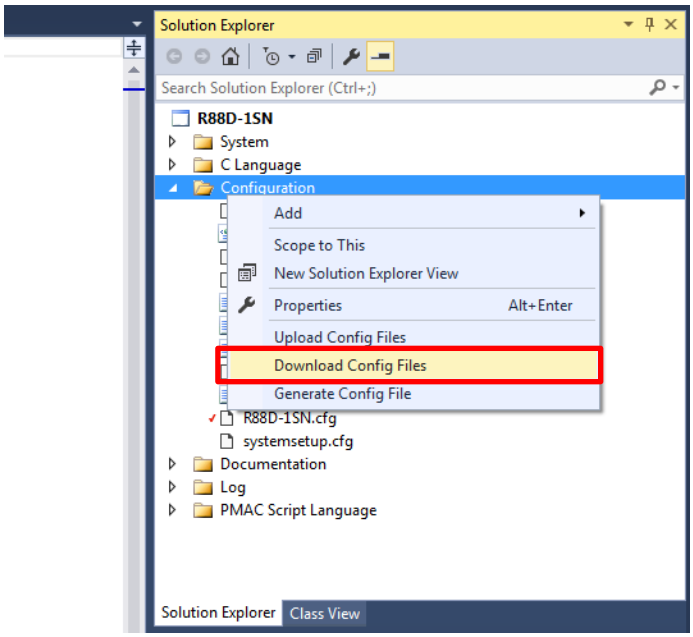
The following describes the procedures to save a Power PMAC IDE project on the computer, and to reuse it.

7.1. Saving a Project

1	Creating a Configuration File Create a Configuration File to save parameters you have changed. Right-click **Configuration** in the Solution Explorer pane, and select **Generate Configuration File**. A Configuration File is added to **Configuration**.	
2	Enter a file name in the textbox, then click the OK button.	
3	Right-click on the Configuration File, and from the menu, select **Check To Download Config File** to include it in files to be downloaded.	

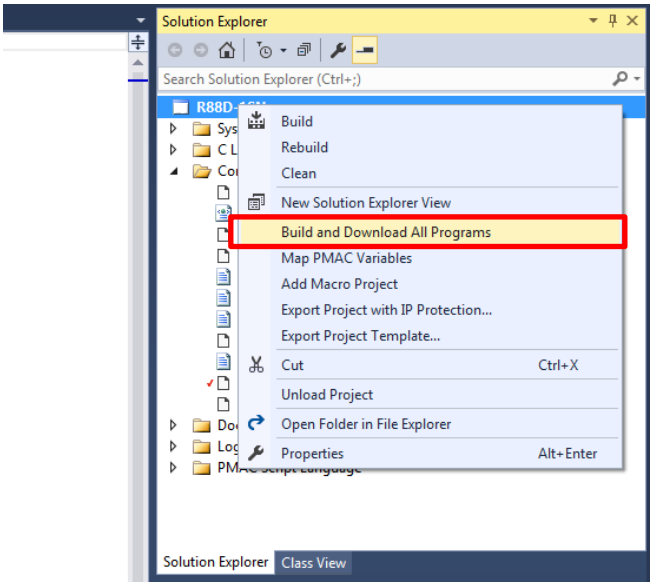
4	Saving a Project In the **File** menu, run **Save All** to save the project on the computer.	

7.2. Loading and Downloading a Project

1	Start Power PMAC IDE, and connect to the Controller.	
2	In the Terminal tab page, type the $$$*** command to reset the Controller settings to factory default.	
3	In the **File** menu, Click **Open** – **Project/Solution** to load the project that you saved.	
4	Right-click **Configuration** in the Solution Explorer pane, and select **Download Config Files** to download the file to the Controller.	

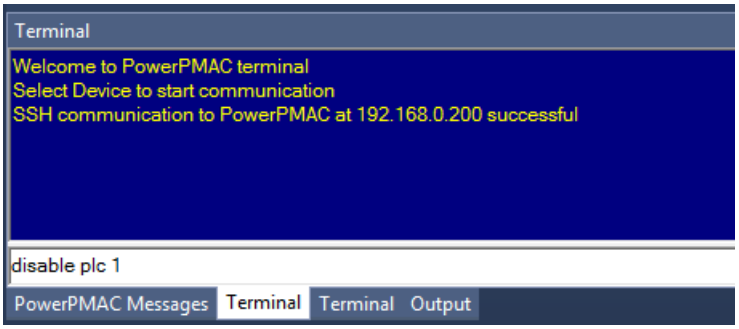
5 Right-click the project name in the Solution Explorer pane, and select **Build and Download All Programs** to run the build and download.

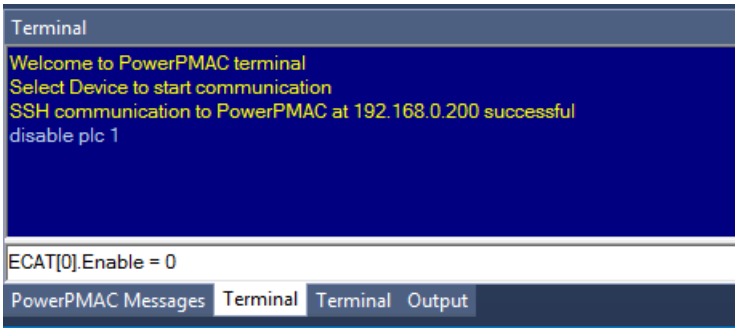
When the download process is complete, make sure that there are no errors in the Output Window.

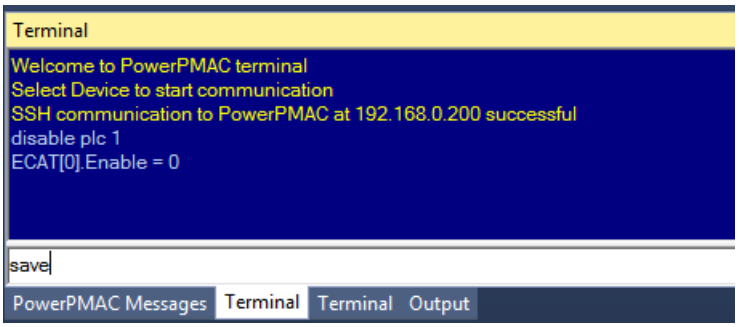
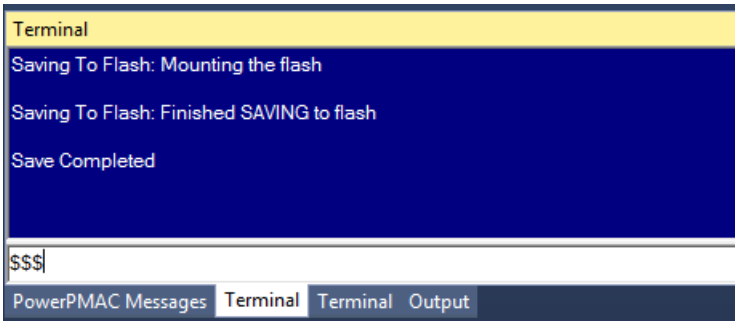


6 Stopping a program

If a program is running, execute the following command from the Terminal tab page to stop the program.
disable plc 1
ECAT[0].Enable=0





7	Saving the downloaded settings and programs After the download process is complete and you make sure that there are no errors in the Output Window, run the save command from the Terminal tab page. * The save command stores the downloaded project in the Controller. This operation saves the settings to be executed automatically when the power to the Controller is turned on.	
8	Restarting after download Run the following command from the Terminal tab page to restart the Controller with the downloaded project. $$$	

8. Appendix Troubleshooting

8.1. Factors Causing EtherCAT Communications To Be Unavailable, and Corrective Actions

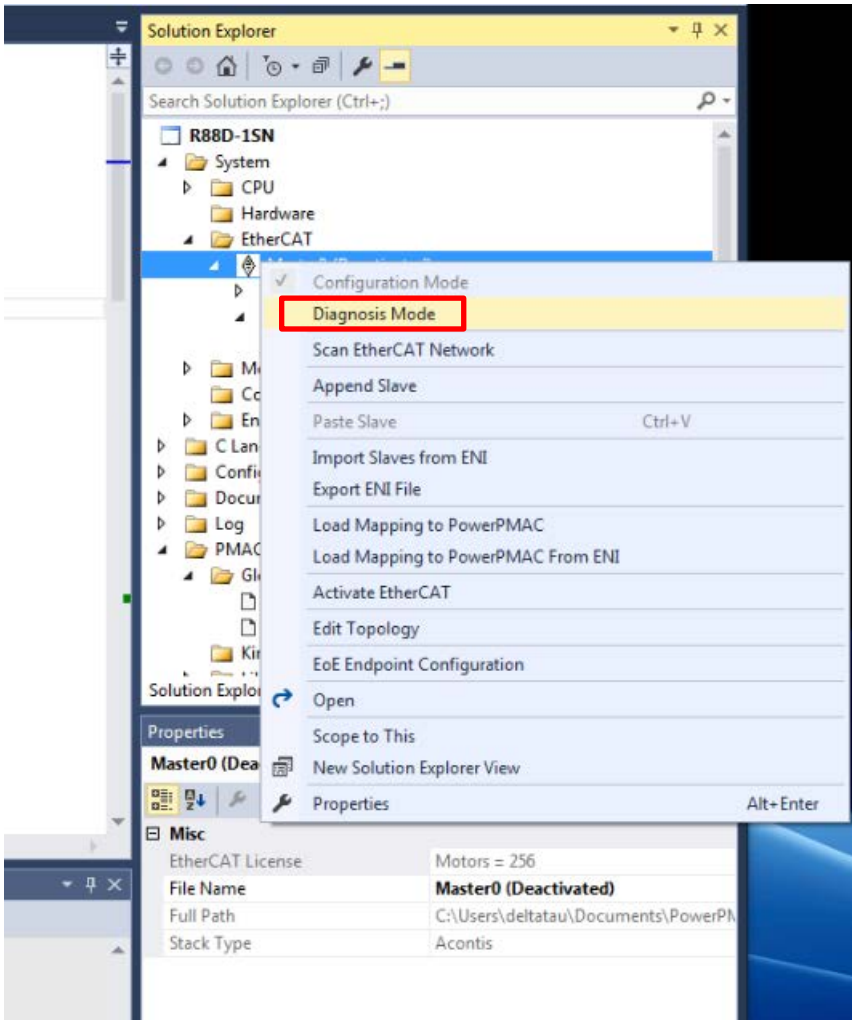
Description	Factor	Corrective Action
The link is not established.	The Ethernet cable is broken or the specified cable is not being used.	If the Ethernet cable is broken or if the specified cable was not used, replace the cable.
	A connector on the Ethernet cable used for EtherCAT communications is disconnected, the contact is faulty, or parts are faulty.	Reconnect the connector and make sure it is mated correctly.
	A slave within the EtherCAT network configuration failed.	Replace the slave.
EtherCAT communications do not start.	ECAT[0].Enable is set to *0*.	From the Terminal pane, run the ECAT[0].Enable=1 command to start EtherCAT communications.
	The EtherCAT network configuration in the Controller does not agree with the physical network configuration.	Review the settings according to the procedures provided in *6.5 EtherCAT Communications Setup*.
	The Ethernet cable is broken at a slave in the network, or a connector is disconnected.	Connect the Ethernet cable correctly.
	Some errors have occurred, and the ECAT[0].error is set to a value other than *0*.	Check the ECAT[0].error value.
A synchronization error occurs at a slave.	The distribution clock is not set correctly.	Review the settings according to the procedures provided in *6.5.2 Distributed Clock Setup*.
	A slave in Free-Run Mode is set to the reference clock.	
	The servo task processing time exceeds the set period.	Review the program or servo frequency to adjust it, so that the servo task processing time does not exceed the period.

8.2. How to Check for Errors

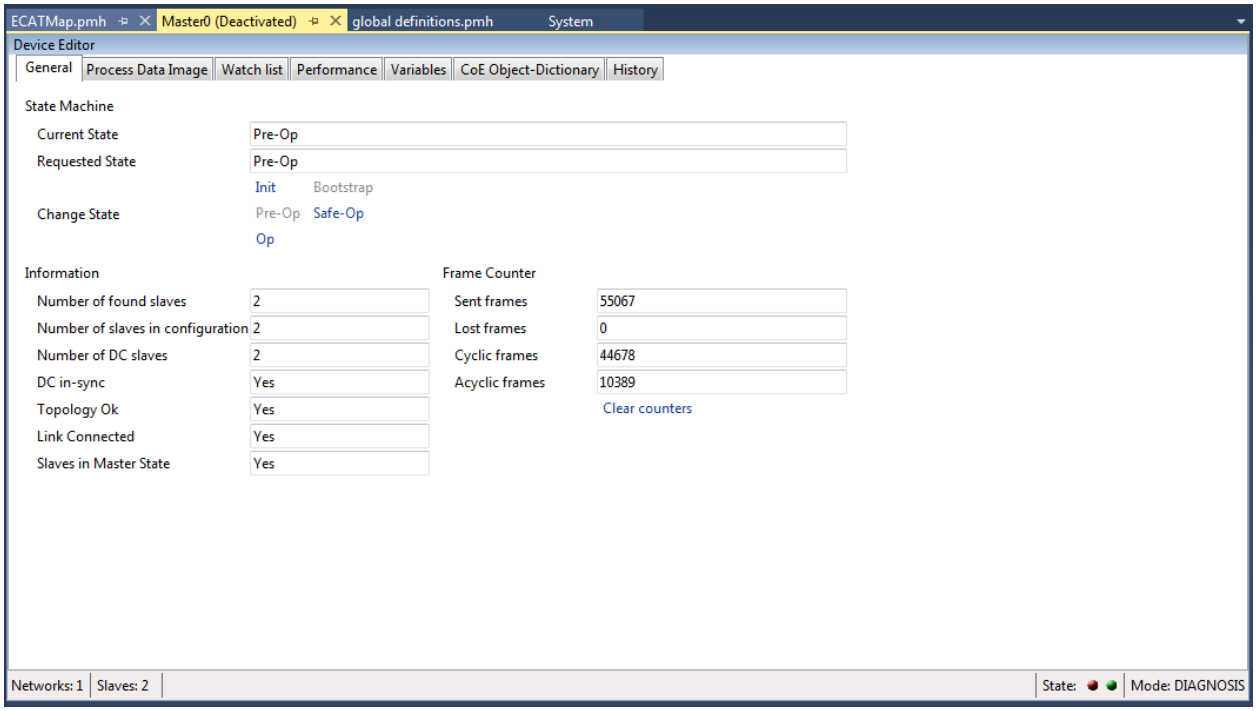
8.2.1. Checking the EtherCAT Status

You can check the EtherCAT status from **Diagnosis Mode** of Power PMAC IDE.

Right-click on **Master0 (Deactivated)** under **EtherCAT** in the Solution Explorer, then select **Diagnosis Mode** to open the Diagnosis Mode page



You can check the status of the slaves in the Diagnosis Mode page.



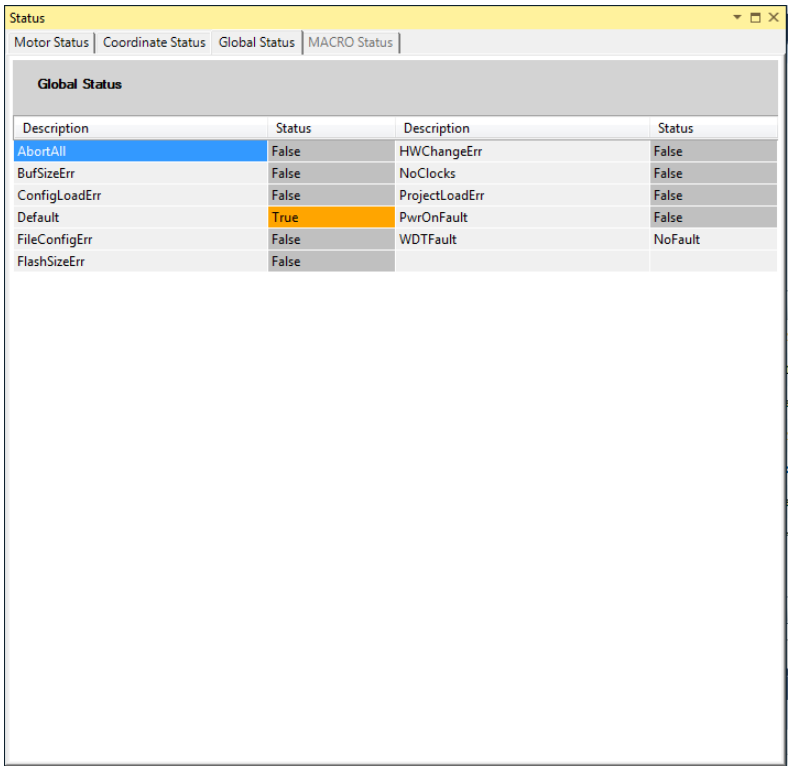
8.2.2. Checking the Controller Status

In the Status page of Power PMAC IDE, you can check the status of the motor, coordinate system, and system.

To display the Status page, click **Status** on the toolbar.

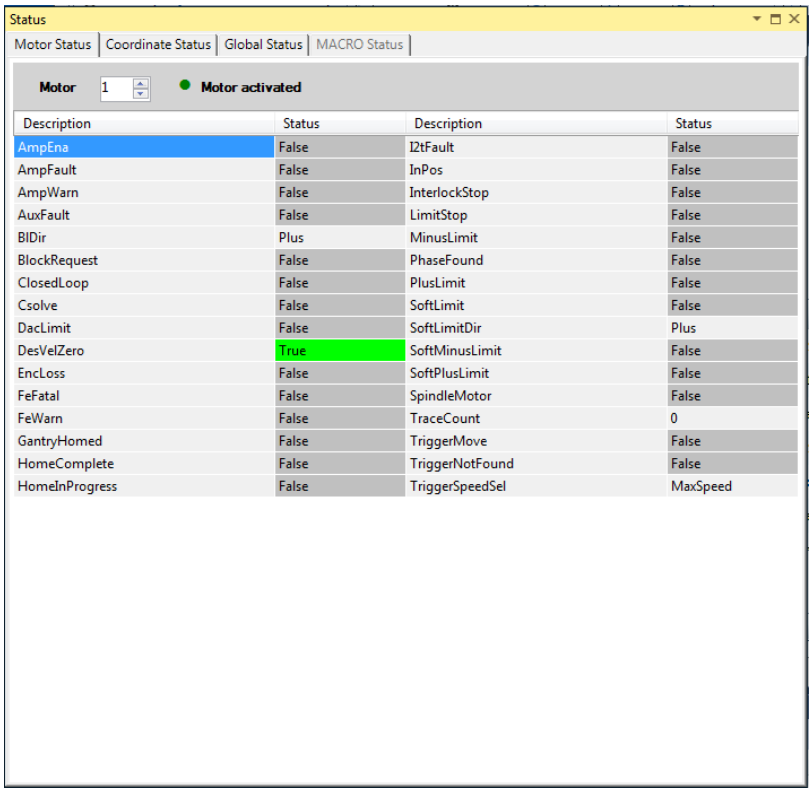
■ Global Status

You can check system errors such as the WDT error.



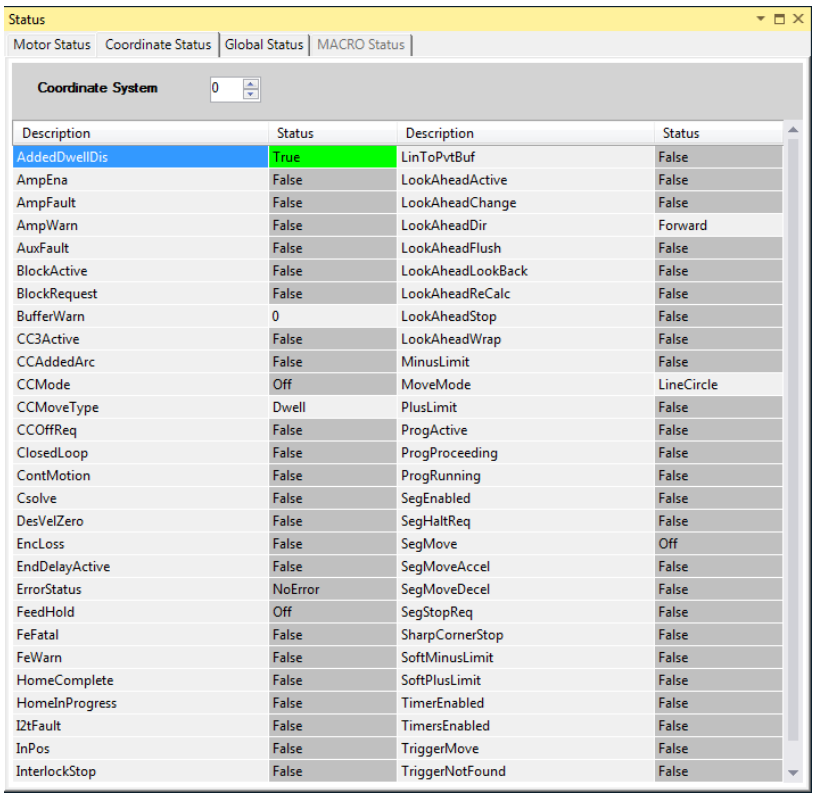
■ Motor Status

You can check deviation errors, limit errors, and other states of the motor.



■ Coordinate Status

You can check deviation errors, limit errors and other states of the coordinate system.



9. Appendix ECAT[i] Structure Elements

The Controller uses motion controller technology developed by Delta Tau Data Systems, Inc., (hereafter referred to as DT) in the U.S., however, the ECAT[i] structure elements differ from those of DT controllers. The following table shows the major changes that have been made from DT controllers.

Element name	Description	Change
ECAT[i].Enable	Enabling the EtherCAT network	0: Disable, 1: Enable (2 and 3 are not supported.)
ECAT[i].LPIO[k]	Elements of low priority I/O module	Not supported
ECAT[i].Slave[j]	Slave elements	Not supported
ECAT[i].Error	Error code of enabling EtherCAT network	$ 9811000C: Invalid network configuration $ 9811002E: Disconnected network connection
ECAT[i].LinkUp ECAT[i].LPDomainOutputState ECAT[i].LPDomainState ECAT[i].LPRxTime ECAT[i].LPTxTime ECAT[i].MasterStat ECAT[i].RTDomainOutputState ECAT[i].RTDomainState	Status data structure elements	Not supported

10. Revision History

Revision code	Revised date	Revised content
A	5-Apr, 2019	First edition

Note: Do not use this document to operate the Unit.

OMRON Corporation **Industrial Automation Company**

Tokyo, JAPAN

Contact: www.ia.omron.com

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON ASIA PACIFIC PTE. LTD.
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

Authorized Distributor:

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