

Machine Automation Controller NJ/NX-series

Motion Device Connection Guide (EtherCAT(R) Connection)

YASKAWA Electric Corporation

AC Servo Drive
(Σ -7-Series)

Network
Connection
Guide

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1. Related Manuals

To ensure system safety, make sure to always read and follow the information provided in all Safety Precautions and Precautions for Safe Use in the manuals for each device which is used in the system.

The table below lists the manuals provided by YASKAWA Electric Corporation (hereinafter referred to as YASKAWA) and OMRON Corporation (hereinafter referred to as OMRON), which pertain to this guide.

Manufacturer	Cat. No.	Model	Manual name
OMRON	W500	NJ501-□5□□ NJ501-□4□□ NJ501-□3□□ NJ301-12□□ NJ301-11□□ NJ101-10□□	NJ-series CPU Unit Hardware User's Manual
OMRON	W535	NX701-17□□ NX701-16□□	NX-series CPU Unit Hardware User's Manual
OMRON	W578	NX1P2-11□□□□ NX1P2-10□□□□ NX1P2-90□□□□	NX-series NX1P2 CPU Unit Hardware User's Manual
OMRON	W501	NX701-17□□ NX701-16□□	NJ/NX-series CPU Unit Software User's Manual
OMRON	W502	NX1P2-11□□□□	NJ/NX-series Instructions Reference Manual
OMRON	W505	NX1P2-10□□□□ NX1P2-90□□□□	NJ/NX-series CPU Unit Built-in EtherCAT(R) Port User's Manual
OMRON	W507	NJ501-□5□□ NJ501-□4□□	NJ/NX-series CPU Unit Motion Control User's Manual
OMRON	W508	NJ501-□3□□ NJ301-12□□	NJ/NX-series Motion Control Instructions Reference Manual
OMRON	W503	NJ301-11□□ NJ101-10□□	NJ/NX-series Troubleshooting Manual
OMRON	W504	SYSMAC-SE2□□□	Sysmac Studio Version 1 Operation Manual
OMRON	I576	R88M-K□ R88D-KN□-ECT	AC SERVOMOTORS/SERVO DRIVES G5-series WITH BUILT-IN EtherCAT(R) COMMUNICATIONS User's Manual
YASKAWA	SIEP S800001 55	SGD7S-□□□□A0□	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual
YASKAWA	SIET S800001 34	-	AC Servo Drive Engineering Tool SigmaWin+ Operation Manual

2. Terms and Definitions

Term	Explanation and Definition
Slave unit	A slave unit is used to connect to EtherCAT. There are various types of slave units such as Servo Drives that handle position data and I/O terminals that handle bit signals.
Object	An object indicates information such as data and parameters in a slave unit.
PDO communications (Communications using Process Data Objects)	One type of EtherCAT communications that uses process data objects (PDOs) to exchange information in realtime with a fixed cycle. It is also called process data communications.
PDO mapping	Association of objects used for PDO communications.
PDO entry	A pointer to an object used for PDO mappings.
Function module	One of the functional units of the software configuration of CPU Unit.
Motion Control Function Module	One of the function modules. This module performs motion control according to the commands from motion control instructions that are executed in the user program. It sends data to EtherCAT Master Function Module. (Abbreviation: MC Function Module)
EtherCAT Master Function Module	One of the function modules. This function module communicates with EtherCAT slaves as an EtherCAT master.
PLC Function Module	One of the function modules. This module manages overall scheduling, executes the user program, sends commands to MC Function Module, and provides interfaces to USB and the SD Memory Card.
Motion control instruction	A function block instruction that executes motion control. There are two types of motion control instructions: one is based on function blocks for PLCopen(R) motion control and the other is specifically developed for MC Function Module. (Abbreviation: MC instruction)
PLCopen(R)	PLCopen(R) is an association that promotes IEC 61131-3. It has its headquarters in Europe and a world-wide membership. PLCopen(R) standardizes function blocks for motion control to define a program interface for the languages specified in IEC 61131-3. PLCopen(R) headquarter website: http://www.plcopen.org/
Axis	A functional unit within MC Function Module. An axis is assigned to the drive mechanism in an external Servo Drive or the sensing mechanism in an external Encoder Input Slave Unit.
Axis variable	A system-defined variable that is defined as a structure and provides status information and some of the axis parameters for an individual axis. An axis variable is used to specify an axis for MC instructions and to monitor the command position, error information, and other information for an axis.
ESI file (EtherCAT Slave Information file)	An ESI file contains information unique to EtherCAT slave units in XML format. You can load an ESI file into the Sysmac Studio, to allocate EtherCAT slave process data and make other settings. .

3. Precautions

- (1) Understand the specifications of devices which are used in the system. Allow some margin for ratings and performance. Provide safety measures, such as installing a safety circuit, in order to ensure safety and minimize the risk of abnormal occurrence.
- (2) To ensure system safety, make sure to always read and follow the information provided in all Safety Precautions and Precautions for Safe Use in the manuals for each device which 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, to reproduce, and to distribute a part or the whole of this guide without the permission of OMRON Corporation.
- (5) The information contained in this guide is current as of January 2017. It is subject to change for improvement without notice.

The following notations are used in this guide.



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 significant 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 proper operation and performance.



Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

Symbol



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

4. Overview

This guide describes the procedures for connecting YASKAWA Σ -7-Series AC Servo Drive (hereinafter referred to as Servo Drive) to operate using a motion control instruction (hereinafter referred to as MC instruction) for OMRON NJ/NX-series Machine Automation Controllers (hereinafter referred to as Controller) as well as the procedure for checking the connection. The explanations given in this guide assume the use of NJ-series Controllers. The Servo Drive is configured of a SERVOPACK and a Servomotor, and the name itself is used for explanations throughout this guide; however, the name SERVOPACK is also used if necessary to specify the configured device. Furthermore, Servo Drive is also referred to as "Motion Control Device" or "Slave Unit" in some descriptions.

Refer to *Section 6. EtherCAT Settings* and *Section 7. EtherCAT Connection Procedure* to understand setting methods and key points to operate Motion Control Device using EtherCAT PDO communications. The MC_Power (Power Servo) is given as an example of an MC instruction to check the operation in this guide.

The operation of motion control varies depending on a device you use. Make sure that you understand *Section 8. Restrictions on Motion Control* before you design a system.

Caution

The scope of this guide covers "connection check of the Motion Control Device connected via EtherCAT using the MC_Power instruction". To use MC instructions and design a system not described in this guide, make sure to always read and follow the information provided in all Safety Precautions and Precautions for Safe Use in the manuals for each device you intend to use in the system. Please note that some functions of MC Function Module may be "unavailable" or "available but different in behavior from OMRON Motion Control Devices" due to the different specifications between non-OMRON and OMRON Motion Control Devices. Make sure to check *Section 8. Restrictions on Motion Control* in this guide when you design a system.



Additional Information

Both the setting described in *7.4. Controller Setup* and the program to check the operation are set in advance in the Sysmac Studio project file (hereinafter referred to as project file) listed below. Refer to *Section 9. Appendix 1: Procedure Using the Project File* for information on how to use the project file. Obtain the project file with a latest version from OMRON Corporation. The project file listed below has been created for NJ-series Controllers. If you use NX-series Controller, change the device information in Sysmac Studio.

Name	File name	Version
Sysmac Studio project file (extension: csm2)	P627_NJ_ECAT_Yaskawa_SGD7S_V101.csm2	Ver.1.01

5. Applicable Devices and Device Configuration

5.1. Applicable Devices

The applicable devices are as follows:

Manufacturer	Name		Model	
OMRON	NJ/NX-series CPU Unit		NX701-17□□	
			NX701-16□□	
			NX1P2-11□□□□	
			NX1P2-10□□□□	
			NX1P2-90□□□□	
			NJ501-□5□□	
			NJ501-□4□□	
			NJ501-□3□□	
			NJ301-12□□	
			NJ301-11□□	
NJ101-10□□				
YASKAWA	AC Servo Drive Σ-7-series	Σ-7S SERVOPACK	SGD7S-□□□□A0A□□□	
		Servomotor	Rotary	SGM□□-□□□□□□□□
			Direct drive	SGM□□-□□□□□□□□
			Linear	SGL□□-□□□□□□□□□□



Precautions for Correct Use

In this guide, the devices with models and versions listed in 5.2. *Device Configuration* are used as examples of applicable devices to describe the procedures for connecting the devices and checking their connections.

You cannot use devices with versions lower than the versions listed in 5.2.

To use the above devices with models not listed in 5.2. or versions higher than those listed in 5.2., check the differences in the specifications by referring to the manuals before operating the devices.



Additional Information

This guide describes the procedures for establishing the network connections.

It does not provide information on operation, installation, wiring method, device functionality, or device operation, which is not related to the connection procedures.

Refer to the manuals or contact the device manufacturer.



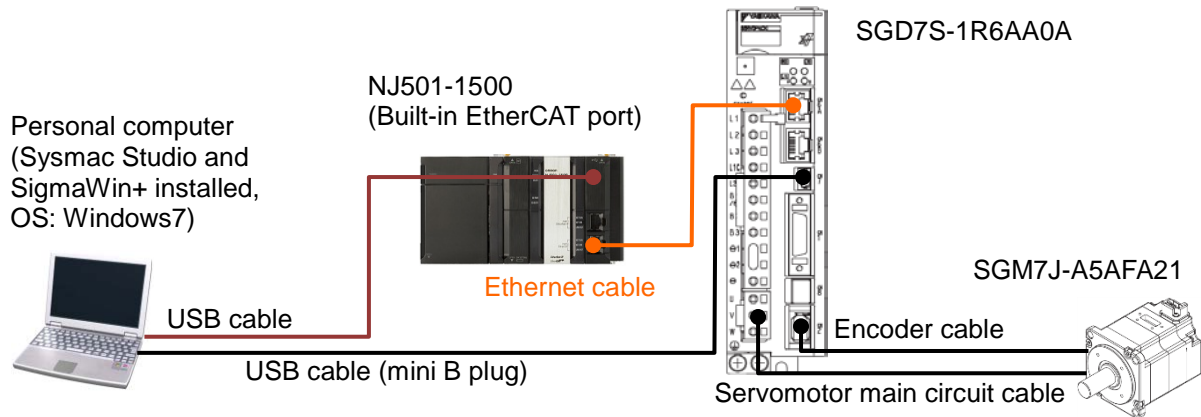
Additional Information

Contact YASKAWA Electric Corporation for servomotors connectable to SERVOPACK.

5.2. Device Configuration

This guide describes the connection procedures using NJ-series Controller.

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



Manufacturer	Name	Model	Version
OMRON	NJ-series CPU Unit	NJ501-1500	Ver.1.13
OMRON	Power Supply Unit	NJ-PA3001	
OMRON	Sysmac Studio	SYSMAC-SE2[]	Ver.1.17
-	Personal computer (OS: Windows 7)	-	
-	USB cable (USB 2.0 type B connector)	-	
OMRON	Ethernet cable (with industrial Ethernet connector)	XS5W-T421-[]M[]-K	
YASKAWA	SERVOPACK	SGD7S-1R6AA0A	Rev.0x0008 0000
YASKAWA	Servomotor	SGM7J-A5AFA21	
YASKAWA	Servomotor main circuit cable	JZSP-CSM01-03-E	
YASKAWA	Encoder cable	JZSP-CSP01-03-E	
YASKAWA	ESI file	Yaskawa_SGD7S-xxxxA 0x.xml	
YASKAWA	AC Servo Drive Engineering Tool	SigmaWin+	Ver.7.16
YASKAWA	Model information file (SigmaWin+ additional file for Σ-7S EtherCAT integration)	M_SGD7SA0_20161028 .swd	
YASKAWA	USB cable (USB 2.0 type mini B plug)	JZSP-CVS06-02-E	



Precautions for Correct Use

Prepare the ESI file listed above beforehand.

To obtain the ESI file, contact YASKAWA Electric Corporation.



Precautions for Correct Use

If you use Σ-7S EtherCAT integrated SERVOPACK in SigmaWin+, you need the model information file listed above.

To obtain the model information file, contact YASKAWA Electric Corporation.



Precautions for Correct Use

The connection line of EtherCAT communications cannot be shared with other Ethernet networks. Do not use devices for Ethernet such as a switching hub.

Use an Ethernet cable (double shielding with aluminum tape and braiding) of Category 5 or higher, and use a shielded connector of Category 5 or higher.

Connect the cable shield to the connector hood at both ends of the cable.



Precautions for Correct Use

Update Sysmac Studio to the version specified in this *Clause 5.2.* or to a higher version.

If you use a version higher than the one specified, the procedures and related screenshots described in *Section 7.* and subsequent sections may not be applicable.

In that case, use the equivalent procedures described in this guide by referring to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).



Additional Information

For specifications of Ethernet cables and network wiring, refer to *Section 4. EtherCAT Network Wiring* of the *NJ/NX-series CPU Unit Built-in EtherCAT(R) Port User's Manual* (Cat. No. W505).



Additional Information

The system configuration in this guide uses USB for the connection between the personal computer and Controller. For information on how to install the USB driver, refer to *A-1 Driver Installation for Direct USB Cable Connection* of the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).

For NX1P2 Controllers, there is no need to install the USB driver because they do not have a USB port.



Additional Information

If you use NX1P2 Controller, an Ethernet cable is used for the connection between your personal computer and NX1P2 Controller. For information on how to connect the cable, refer to *6-2 Going Online with a Controller* of the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).



Additional Information

The system configuration in this guide uses USB for the connection between the personal computer and Servo Drive. For information on how to install the USB driver, refer to the *Yaskawa's products and technical information website* or contact YASKAWA Electric Corporation.

6. EtherCAT Settings

This section describes the parameter settings for EtherCAT communications and motion control that are defined in this guide, and explains the relationship between motion control via EtherCAT and its parameter settings.

6.1. Parameters

The parameters to set in this guide are shown below.

6.1.1. EtherCAT Communications Settings

The parameters of Servo Drive required for EtherCAT communications are shown below. Use the following settings when you perform 7.3.1. *Hardware Settings* and 7.3.2. *Parameter Settings*.

■Hardware settings

Item	Set value	Setting
EtherCAT secondary address	S1	0
	S2	1
The node address is set to 1.		

■Parameter settings

No.	Name	Set value and description	Remarks
Pn002.0	Torque Limit Reference Section for Command Option Module	1:Enables the torque limit reference from the command option module.	Use default
Pn002.1	Speed Limit Reference Section for Command Option Module	0:Disables the speed limit reference when torque limit is used from the command option module.	Use default
Pn002.2	Absolute Encoder Usage	1:Use the absolute encoder as an incremental encoder.	Make setting
Pn50A.3	P-OT (Forward Drive Prohibit) Signal Allocation	8:Set the signal to always enable forward drive.	Make setting
Pn50B.0	N-OT (Reverse Drive Prohibit) Signal Allocation	8:Set the signal to always enable reverse drive.	Make setting
Pn511.1	Input Signal 4 Mapping for Command Option Module / Probe 1 (/SI4)	4:Inputs the signal from CN1-10 input terminal.	Use default
Pn511.2	Input Signal 5 Mapping for Command Option Module / Probe 2 (/SI5)	5:Inputs the signal from CN1-11 input terminal.	Use default
Pn511.3	Input Signal 6 Mapping for Command Option Module / Home (/SI6)	6:Inputs the signal from CN1-12 input terminal.	Use default



Precautions for Correct Use

The Servo Drive does not support "Write Slave Node Address" that can be set in Sysmac Studio. Set the node address using the EtherCAT secondary address (S1 and S2) as described in this guide.

6.1.2. PDO Mappings

To use motion control functions, you must map the objects that are required for those functions to PDOs.

The PDO entries (objects) used in this guide are shown below.

Use the settings when you perform 7.4.2. *PDO Map Settings*.

Caution

For PDO entries that are not assigned to the process data, the PDO communications is performed using unspecified values. This may cause unexpected operation of Motion Control Device, resulting in injury. Make sure that all the PDO entries listed in 6.1.2. *PDO Mappings* are assigned to the process data listed in 6.1.5. *Axis Settings for PDO Entries*.



Precautions for Correct Use

The number of objects to be mapped to the PDO must not be more than 8 objects each for both input and output.



Additional Information

For more details on the settings described in 6.1.2. *PDO Mappings* and 6.1.5. *Axis Settings for PDO Entries*, refer to Section 10. *Appendix 2: MC Instructions and PDO Entries*.

■Output (Controller to Servo Drive)

PDO Map				PDO entries included in 2nd Receive PDO mapping			
Process Data Size : Input 184 [bit] / 2048 [bit] Output 152 [bit] / 2048 [bit]				Index	Size	Data type	PDO entry name
Selection	Input/Output	Name	Flag	0x6040:00	16 [bit]	UINT	Control word
<input type="radio"/>	---	No option	---	0x607A:00	32 [bit]	DINT	Target position
<input type="radio"/>	Output	1st Receive PDO mapping	Editable	0x60FF:00	32 [bit]	DINT	Target velocity
<input checked="" type="radio"/>	Output	2nd Receive PDO mapping	Editable	0x6071:00	16 [bit]	INT	Target torque
<input type="radio"/>	Output	3rd Receive PDO mapping	Editable	0x6060:00	8 [bit]	SINT	Modes of operation
<input type="radio"/>	Output	4th Receive PDO mapping	Editable	0x60B8:00	16 [bit]	UINT	Touch probe function
<input type="radio"/>	---	No option	---	0x60E0:00	16 [bit]	UINT	Positive Torque Limit Value
				0x60E1:00	16 [bit]	UINT	Negative Torque Limit Value

■Input (Servo Drive to Controller)

PDO Map				PDO entries included in 2nd Transmit PDO mapping			
Process Data Size : Input 184 [bit] / 2048 [bit] Output 152 [bit] / 2048 [bit]				Index	Size	Data type	PDO entry name
Selection	Input/Output	Name	Flag	0x6041:00	16 [bit]	UINT	Status word
<input type="radio"/>	---	No option	---	0x6064:00	32 [bit]	DINT	Position actual value
<input type="radio"/>	Output	1st Receive PDO mapping	Editable	0x6077:00	16 [bit]	INT	Torque actual value
<input checked="" type="radio"/>	Output	2nd Receive PDO mapping	Editable	0x6061:00	8 [bit]	SINT	Modes of operation display
<input type="radio"/>	Output	3rd Receive PDO mapping	Editable	0x60B9:00	16 [bit]	UINT	Touch probe status
<input type="radio"/>	Output	4th Receive PDO mapping	Editable	0x60BA:00	32 [bit]	DINT	Touch probe 1 position value
<input type="radio"/>	---	No option	---	0x60BC:00	32 [bit]	DINT	Touch probe 2 position value
<input type="radio"/>	Input	1st Transmit PDO mapping	Editable	0x60FD:00	32 [bit]	UDINT	Digital inputs
<input checked="" type="radio"/>	Input	2nd Transmit PDO mapping	Editable				
<input type="radio"/>	Input	3rd Transmit PDO mapping	Editable				
<input type="radio"/>	Input	4th Transmit PDO mapping	Editable				

6.1.3. Digital Inputs for Motion Control

Digital inputs such as home proximity are required to perform motion control. The following shows the setting items for Servo Drive and the input connector setting that are both required to use digital inputs. In this guide, the operation is checked using settings that do not cause errors while Servo Drive is disconnected to the external inputs.

Use the following settings when you perform 7.3. YASKAWA Servo Drive Setup.

■CN1 connector setting

Pin No.	Signal name	Setting	Digital input setting
7	P-OT (Forward Drive Prohibit Input Signal)	Set the signal to always enable forward drive.	Bit17: SI1
8	N-OT (Reverse Drive Prohibit Input Signal)	Set the signal to always enable reverse drive.	Bit18: SI2
10	/Probe1 (Probe 1 Latch Input Signal)	Active when CN1-10 input signal is ON (closed).	Bit20: SI4
11	/Probe2 (Probe 2 Latch Input Signal)	Active when CN1-11 input signal is ON (closed).	Bit21: SI5
12	/Home (Home Switch Input Signal)	Active when CN1-12 input signal is ON (closed).	Bit22: SI6

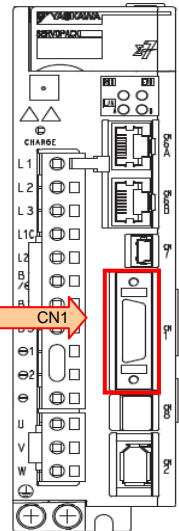
A digital input is set to a digital input object via the CN1 connector on Servo Drive. The relationship is listed below.

■Specifications of the digital inputs object

Index	Sub-index	Name	Data type	Access	PDO mapping	Saving to EEPROM
60FDh	0	Digital Inputs	UDINT	RO	Possible	Not possible

■Relationship between the digital inputs object and CN1 connector pin assignment

Digital Inputs		CN1 pin assignment	Description
Bit	Name		
0	N-OT: Negative limit switch	SI2 status	0: OFF, 1: ON
1	P-OT: Positive limit switch	SI1 status	0: OFF, 1: ON
2	Home: Home switch	SI6 status	0: OFF, 1: ON
3 to 15	-	-	Reserved
16	SI0	CN1 - Pin 13	0: OFF (opened) 1: ON (closed)
17	SI1	CN1 - Pin 7	0: OFF (opened) 1: ON (closed)
18	SI2	CN1 - Pin 8	0: OFF (opened) 1: ON (closed)
19	SI3	CN1 - Pin 9	0: OFF (opened) 1: ON (closed)
20	SI4	CN1 - Pin 10	0: OFF (opened) 1: ON (closed)
21	SI5	CN1 - Pin 11	0: OFF (opened) 1: ON (closed)
22	SI6	CN1 - Pin 12	0: OFF (opened) 1: ON (closed)
23	-	-	Reserved
24	HWBB1	-	Hardwired base block signal input 1 (0: Open, 1: Close)
25	HWBB2	-	Hardwired base block signal input 2 (0: Open, 1: Close)
26 to 31	-	-	Reserved



The operation statuses of SI2, SI1 and SI6 are applied to bits 0 to 2, respectively. For details, refer to the Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual (SIEP S800001 55).

6.1.4. Motion Control Axis

The axis number of Servo Drive required for motion control is shown below.

The axis number is set in 7.4.3. *Axis Settings for Motion Control*.

Axis variable name	Axis number	Displayed in Sysmac Studio
MC_Axis000	0	MC_Axis000(0)*

*For NX-series Controllers, the axis name displayed in Sysmac Studio is "MC_Axis000(0,MC1)".

6.1.5. Axis Settings for PDO Entries

The axis settings for Servo Drive required for motion control are shown below.

For details on each object, refer to the *Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual* (SIEP S800001 55).

Use the following settings when you perform 7.4.3. *Axis Settings for Motion Control*.

■MC_Axis000(0)

Function Name	Device	Process Data
- Output (Controller to Device)		
★ 1. Controlword	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6040h-00.0(2nd Receive PDO mapping_Control word_6040_00)
★ 3. Target position	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	607Ah-00.0(2nd Receive PDO mapping_Target position_607A_00)
5. Target velocity	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FFh-00.0(2nd Receive PDO mapping_Target velocity_60FF_00)
7. Target torque	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6071h-00.0(2nd Receive PDO mapping_Target torque_6071_00)
9. Max profile Velocity	<Not assigned>	<Not assigned>
11. Modes of operation	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6060h-00.0(2nd Receive PDO mapping_Modes of operation_6060_00)
15. Positive torque limit value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60E0h-00.0(2nd Receive PDO mapping_Positive Torque Limit Value_60E0_00)
16. Negative torque limit value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60E1h-00.0(2nd Receive PDO mapping_Negative Torque Limit Value_60E1_00)
21. Touch probe function	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6088h-00.0(2nd Receive PDO mapping_Touch probe function_6088_00)
44. Software Switch of Encoder's Input Slave	<Not assigned>	<Not assigned>
- Input (Device to Controller)		
★ 22. Statusword	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6041h-00.0(2nd Transmit PDO mapping_Status word_6041_00)
★ 23. Position actual value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6064h-00.0(2nd Transmit PDO mapping_Position actual value_6064_00)
24. Velocity actual value	<Not assigned>	<Not assigned>
25. Torque actual value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6077h-00.0(2nd Transmit PDO mapping_Torque actual value_6077_00)
27. Modes of operation display	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6061h-00.0(2nd Transmit PDO mapping_Modes of operation display_6061_00)
40. Touch probe status	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6089h-00.0(2nd Transmit PDO mapping_Touch probe status_6089_00)
41. Touch probe pos1 pos value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	608Ah-00.0(2nd Transmit PDO mapping_Touch probe 1 position valu_608A_00)
42. Touch probe pos2 pos value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	608Ch-00.0(2nd Transmit PDO mapping_Touch probe 2 position valu_608C_00)
43. Error code	<Not assigned>	<Not assigned>
45. Status of Encoder's Input Slave	<Not assigned>	<Not assigned>
46. Reference Position for csp	<Not assigned>	<Not assigned>
- Digital inputs		
28. Positive limit switch	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.17(2nd Transmit PDO mapping_Digital inputs_60FD_00)
29. Negative limit switch	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.18(2nd Transmit PDO mapping_Digital inputs_60FD_00)
30. Immediate Stop Input	<Not assigned>	<Not assigned>
32. Encoder Phase Z Detection	<Not assigned>	<Not assigned>
33. Home switch	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.22(2nd Transmit PDO mapping_Digital inputs_60FD_00)
37. External Latch Input 1	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.20(2nd Transmit PDO mapping_Digital inputs_60FD_00)
38. External Latch Input 2	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.21(2nd Transmit PDO mapping_Digital inputs_60FD_00)

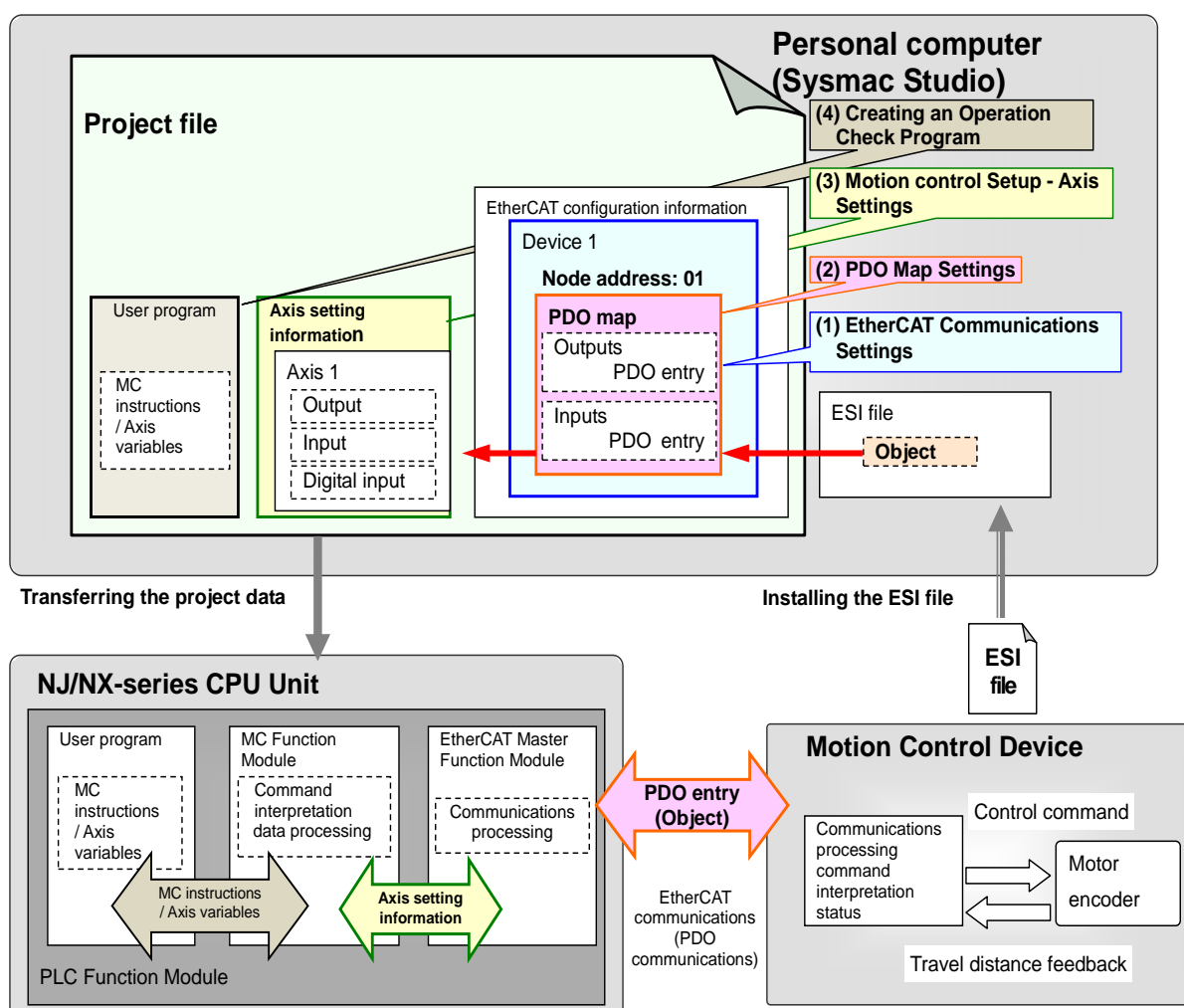
6.2. Relationship Between Motion Control via EtherCAT and its Parameter Settings

The following describes the relationship between motion control via EtherCAT and its parameter settings.

The four types of parameters listed below are set in this guide.

Parameter setting	Description
(1)EtherCAT Communications Settings	EtherCAT communications settings between Motion Control Device and Controller
(2)PDO Map Settings	Data settings for motion control with Controller
(3)Motion Control Setup - Axis Settings	Axis variable settings (MC_Axis000) for MC instructions
(4)Creating an Operation Check Program	Program creation and task settings to operate Motion Control Device

[Relationship Between Motion Control via EtherCAT and its Parameter Settings]



*This figure shows the configuration elements in each file/device related to this guide only.

7. EtherCAT Connection Procedure

This section describes the procedures for connecting Controller and Servo Drive via EtherCAT and the setting procedures for the Motion Control Device operation using an MC instruction for Controller. The explanations of the procedures for setting up Controller and Servo Drive given in this guide are based on the factory default settings.

WARNING

Depending on the Controller status, if you use an uninitialized Controller, unexpected operation of Motion Control Device may result in injury when you turn ON the power.

To prevent unexpected operation of Motion Control Device, make sure to initialize Controller before connecting Motion Control Device and Controller with an Ethernet cable.



Additional Information

For information on how to initialize Servo Drive parameter settings, refer to *5.1.5 Initializing SERVOPACK Parameter Settings* of the *Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual* (SIEP S800001 55).

7.1. Work Flow

Take the following steps to connect Controller and Servo Drive via EtherCAT and to make settings for the Motion Control Device operation using an MC instruction for Controller.

7.2. Preparation for Controller Setup

Prepare to set up Controller.

7.2.1. Starting Sysmac Studio and Going Online

Start Sysmac Studio and go online with Controller.

7.2.2. Initializing Controller

Initialize Controller.

7.2.3. Installing the ESI File

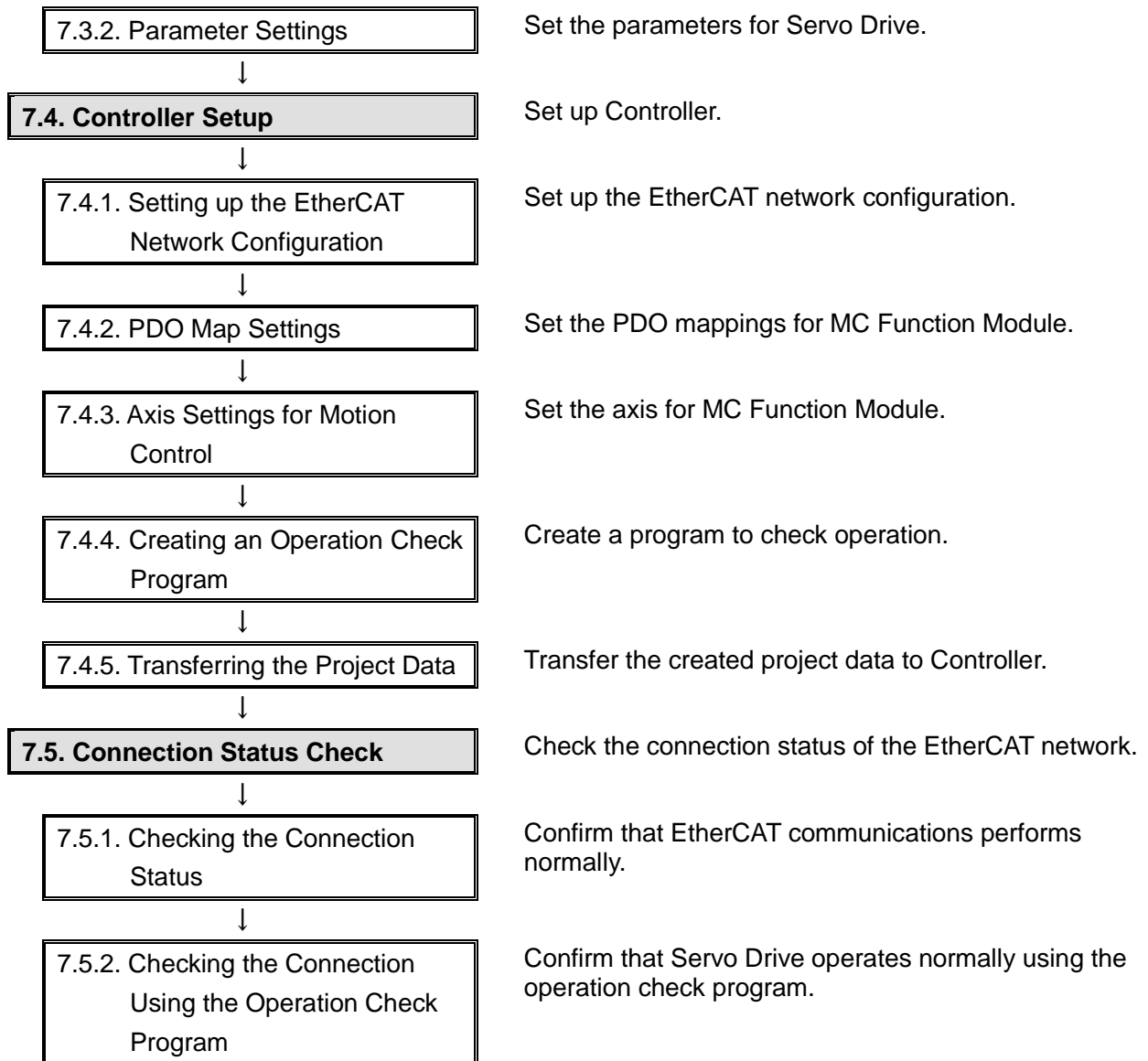
Install the ESI file for Servo Drive in Sysmac Studio.

7.3. YASKAWA Servo Drive Setup

Set up YASKAWA Servo Drive.

7.3.1. Hardware Settings

Set the hardware switches on Servo Drive and connect the cables.



7.2. Preparation for Controller Setup

Prepare to set up Controller.

Install Sysmac Studio and the USB driver on your personal computer beforehand.

⚠ WARNING

Depending on the Controller status, if you perform the procedures in this *Clause* 7.2. in the state where Controller is connected to an Ethernet cable, unexpected operation of Motion Control Device may result in injury when you turn ON Controller.

Do not connect an Ethernet cable to Controller when you perform the procedures.

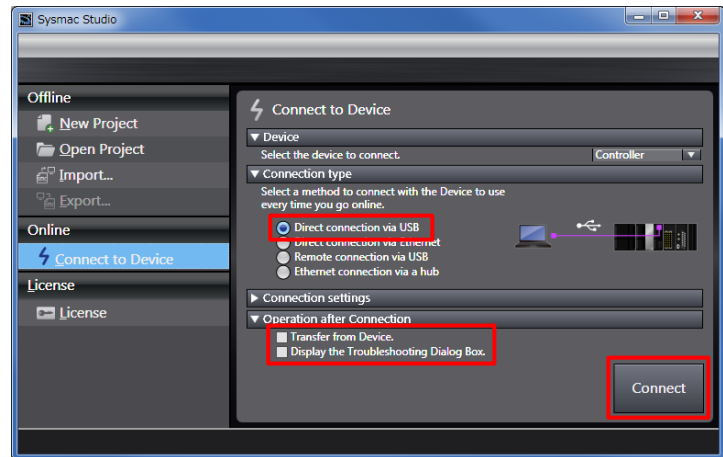


7.2.1. Starting Sysmac Studio and Going Online

Start Sysmac Studio and go online with Controller.

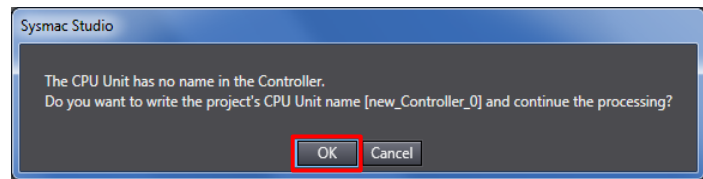
1	<p>Connect Personal computer to Controller with a USB cable. Check that an Ethernet cable is disconnected from PORT2 EtherCAT on Controller.</p>	
2	Turn ON Controller.	
3	<p>Start Sysmac Studio.</p> <p>*If the User Account Control Dialog Box is displayed at start, make a selection to start Sysmac Studio.</p>	
4	<p>Sysmac Studio starts. Click Connect to Device.</p>	

- 5 The Connect to Device Dialog Box is displayed.
Select *Direct connection via USB* in the *Connection type* Field.
Uncheck both *Transfer from Device* and *Display the Troubleshooting Dialog Box* in the *Operation after Connection* Field.



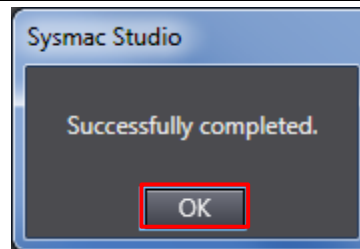
Click **Connect**.

- 6 A confirmation dialog box is displayed. Check the contents and click **OK**.



*The contents of the dialog box vary depending on the status of Controller. Check the contents and click on an appropriate button to proceed with the processing.

- 7 The dialog box on the right is displayed. Check the contents and click **OK**.



- 8 The Auto Connect Project Dialog Box is displayed online. When an online connection is established, a yellow bar is displayed under the toolbar.

The following panes are displayed in this window.

Left: Multiview Explorer

Top right: Toolbox

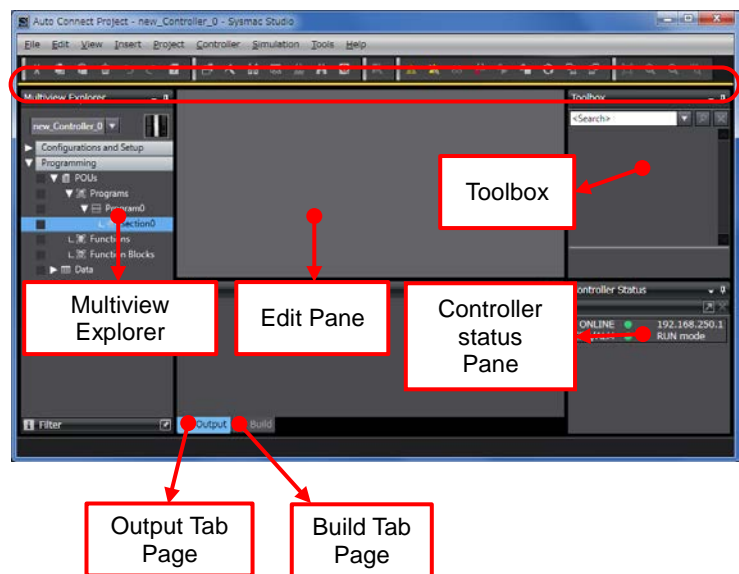
Bottom right: Controller Status Pane

Top middle: Edit Pane

The following tabs are displayed in the bottom middle of this window.

Output Tab Page

Build Tab Page





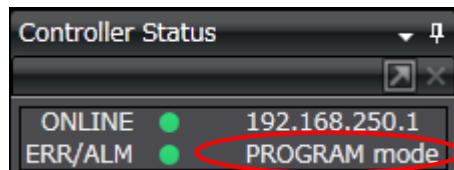
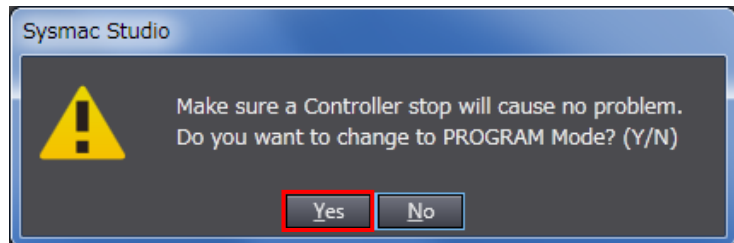
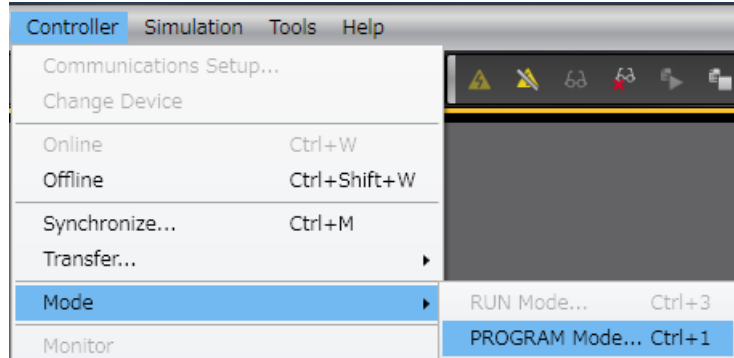
Additional Information

For details on the online connections to Controller, refer to *Section 6. Online Connections to a Controller* of the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).

- 9 Select **Mode - PROGRAM Mode** from the Controller Menu.

The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**.

The operating mode of Controller displayed in the Controller Status Pane changes to PROGRAM mode.



7.2.2. Initializing Controller

Initialize Controller.



Precautions for Correct Use

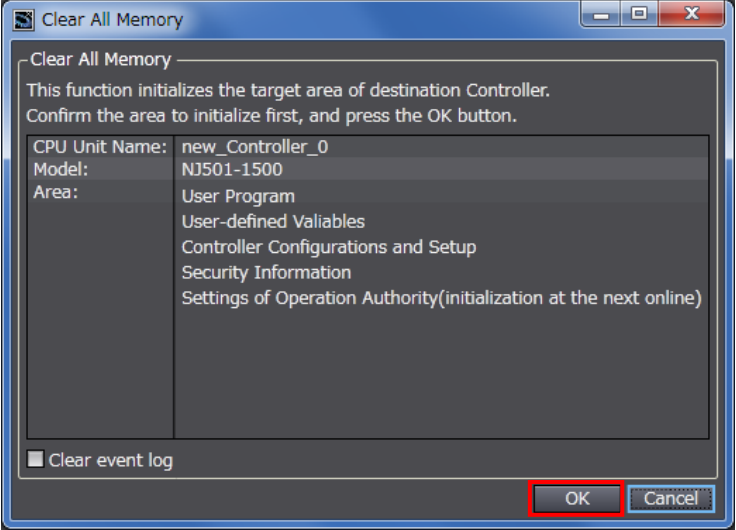
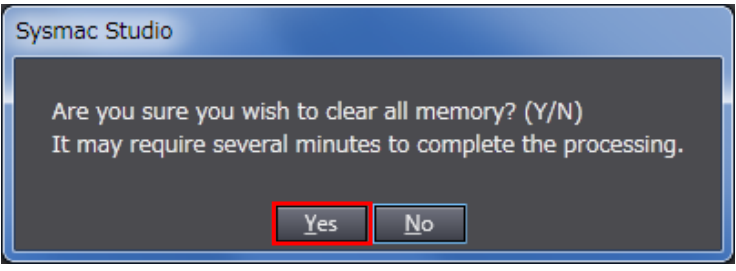
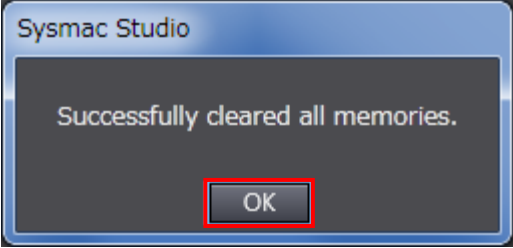
All memory will be cleared after initialization.

If there is necessary data in Controller, save the data.

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on operating Sysmac Studio.

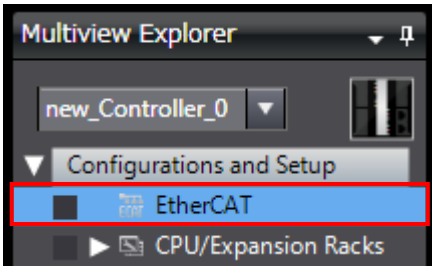
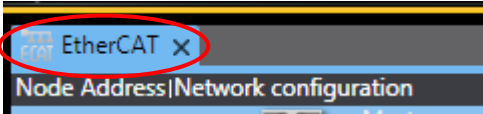
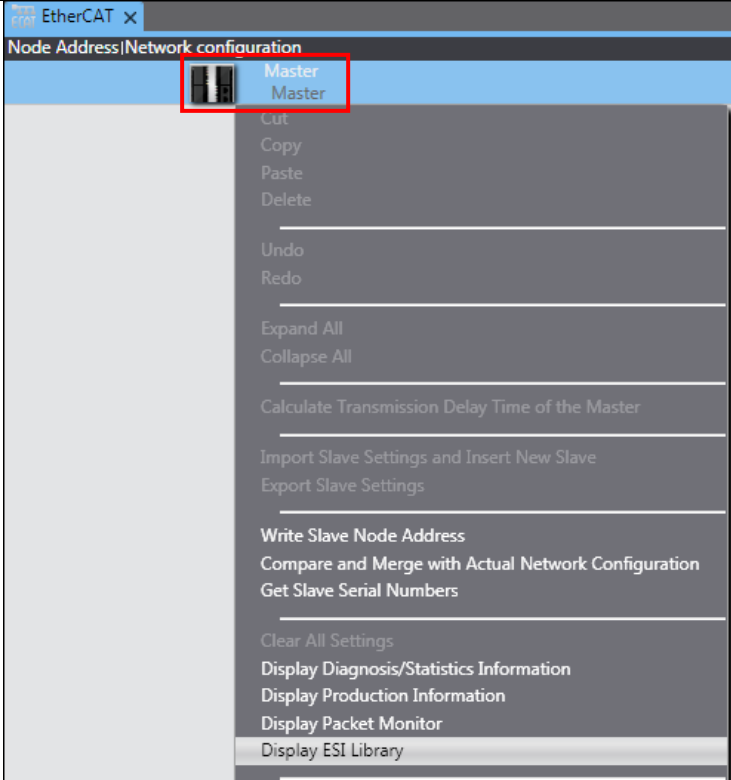
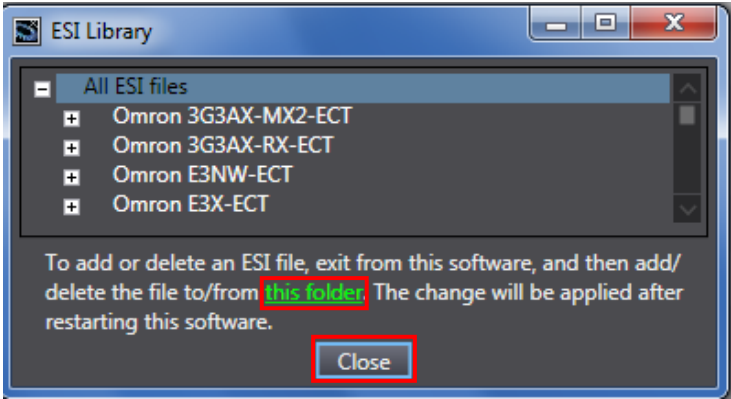
- 1 Select **Clear All Memory** from the Controller Menu.



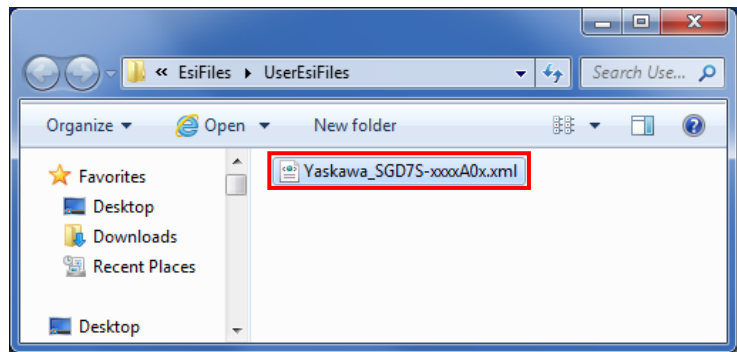
<p>2</p>	<p>The Clear All Memory Dialog Box is displayed. Click OK.</p>	
<p>3</p>	<p>A confirmation dialog box is displayed. Check the contents and click Yes.</p>	
<p>4</p>	<p>The dialog box on the right is displayed. Check the contents and click OK.</p>	

7.2.3. Installing the ESI File

Install the ESI file for Servo Drive in Sysmac Studio.

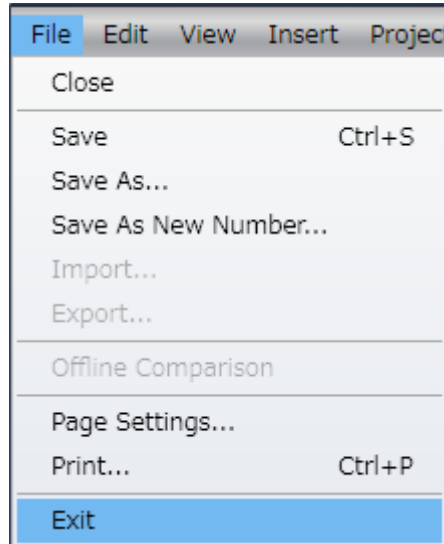
1	Double-click EtherCAT under Configurations and Setup in the Multiview Explorer.	
2	The EtherCAT Tab Page is displayed in the Edit Pane.	
3	Right-click Master and select Display ESI Library .	
4	<p>The ESI Library Dialog Box is displayed.</p> <p>Click the this folder link.</p> <p>When the Explorer starts, click Close to close the dialog box.</p>	

- 5 The Explorer starts, and a folder is opened, allowing you to install the ESI file. Copy the prepared *Yaskawa_SGD7S-xxxxA0x.xml* to this folder.

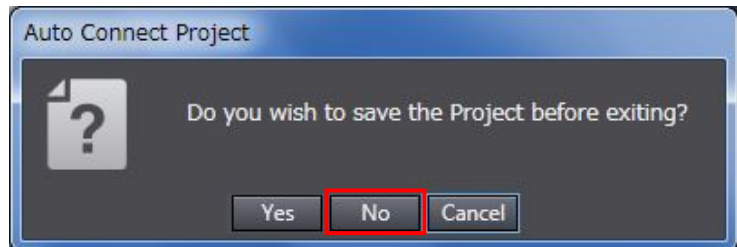


- 6 Select **Exit** from the File Menu to exit Sysmac Studio.

*You need to restart Sysmac Studio after installing the ESI file.



A dialog box is displayed confirming whether to save the project. If you do not need to save it, click **No**.



- 7 Restart Sysmac Studio.
(Perform steps 3 to 8 of 7.2.1.
*Starting Sysmac Studio and
Going Online.*)

- 8 In the same way as steps 1 to 3, display the ESI Library Dialog Box.

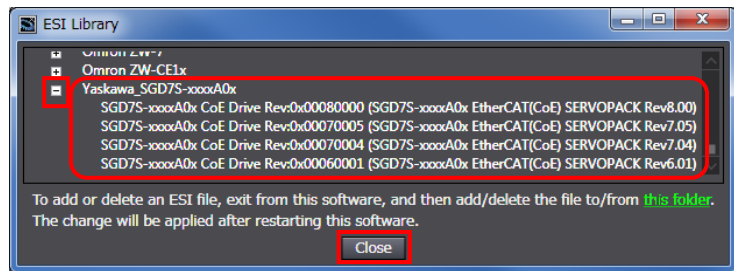
Check that Yaskawa_SGD7S-xxxxA0x is displayed, and click the + Button to the left of it.

A list of devices that can be used for the ESI file is displayed.

Check that the device used is listed in there.

Check that an exclamation mark (warning) is not displayed.

Click **Close**.



*The device used in this guide is "SGD7S-xxxxA0x CoE Drive Rev:0x00080000 (SGD7S-xxxxA0x EtherCAT(CoE) SERVOPACK Rev8.00)".

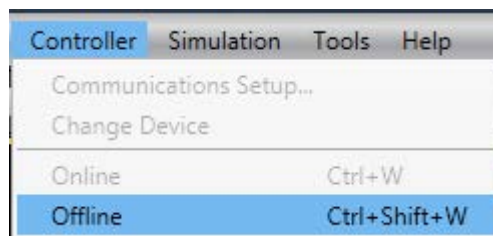


Precautions for Correct Use

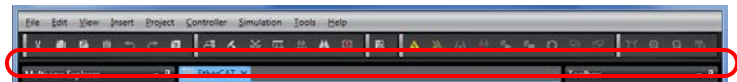
If an exclamation mark (warning) is displayed for the ESI file, check the name of the ESI file and obtain the ESI file with a correct name. If an exclamation mark (warning) is displayed even when the name of the ESI file is correct, the file may be corrupted.

In that case, contact the device manufacturer.

- 9 Select **Offline** from the Controller Menu.



Check that the yellow bar under the toolbar disappears.



- 10 Turn OFF Controller.

- 11 Connect an Ethernet cable to PORT2 EtherCAT on Controller.

*Make sure that the Controller power supply remains OFF.

USB
cable



Ethernet
cable

PORT2 EtherCAT

7.3. YASKAWA Servo Drive Setup

Set up YASKAWA Servo Drive.



Additional Information

For details on the external I/O wiring and parameter settings for Servo Drive, refer to the *Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual* (SIEP S800001 55).

7.3.1. Hardware Settings

Set the hardware switches on Servo Drive and connect the cables.

Caution

The scope of this guide covers the "connection check of the Motion Control Device connected via EtherCAT using the MC_Power instruction". Accordingly, the overtravel functions (forward and reverse drives) are always set to be disabled. Make a setting according to the device used when you actually design a system. In this guide, the external I/O to input the overtravel signals (P-OT and N-OT) to the CN1 connector (I/O signals) is not connected.



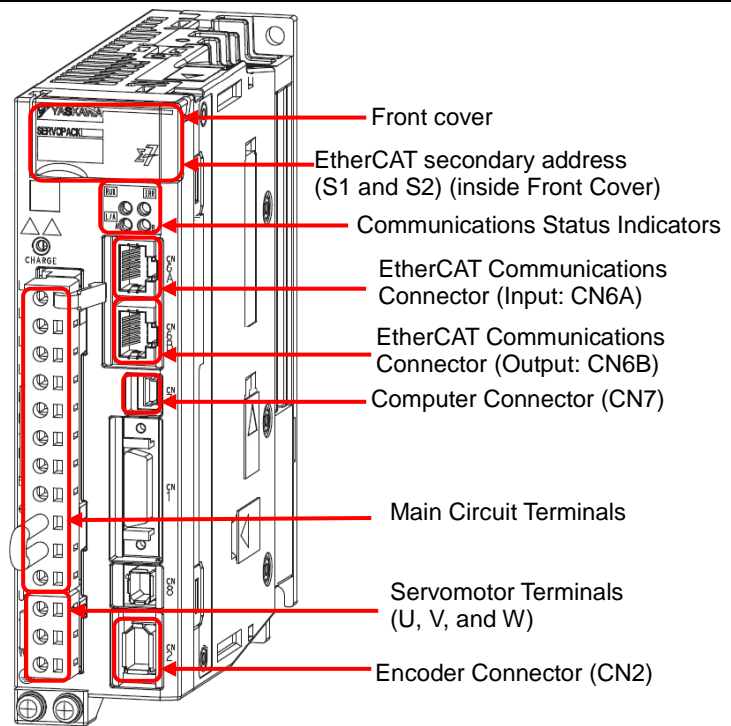
Precautions for Correct Use

Make sure that Servo Drive is powered OFF when you set up.

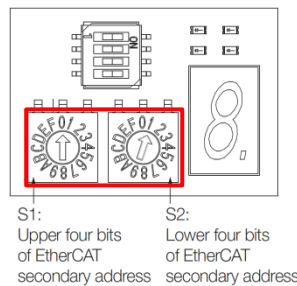
If it is ON, the settings described in the following steps and subsequent procedures may not be applicable.

- 1 Make sure that Servo Drive is powered OFF.

- 2 Check the positions of the hardware switches and the connectors on Servo Drive by referring to the figure on the right.

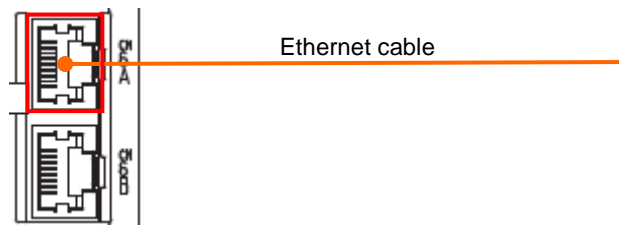


- 3 Open Front Cover and set EtherCAT secondary address (S1 and S2) as follows:
- S1: 0
- S2: 1

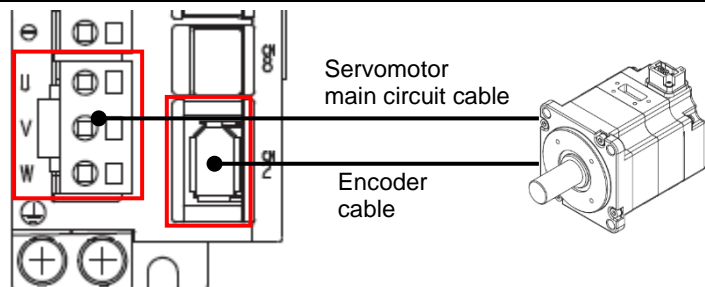


*The node address is set to 1.

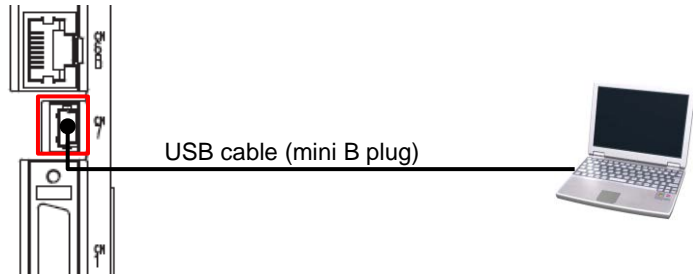
- 4 Connect the other end of the Ethernet cable to EtherCAT Communications Connector (Input: CN6A).



- 5 Connect both a Servomotor main circuit cable and an Encoder cable to Servomotor. Connect the other end of the Servomotor main circuit cable to Servomotor Terminals (U, V, and W) and the other end of the Encoder cable to Encoder Connector (CN2).

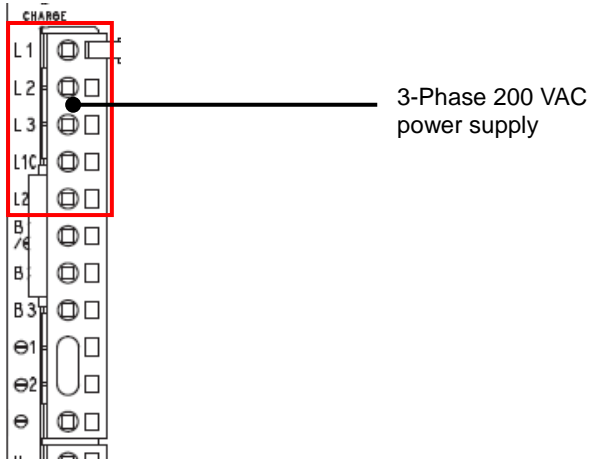


- 6 Connect Computer Connector (CN7) to the USB port on Personal computer with a USB cable (mini B plug).



- 7 Connect 3-Phase 200 VAC power supply to Main Circuit Terminals.

*For details on the power supply wiring and specifications, refer to 4.3. *Wiring the Power Supply to the SERVOPACK* of the Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual (SIEP S800001 55).



7.3.2. Parameter Settings

Set the parameters for Slave Drive.

The parameters are set in SigmaWin+.

Install SigmaWin+ and the USB driver on your personal computer beforehand.

To connect Σ -7S EtherCAT integrated SERVOPACK to SigmaWin+, you need a model information file for Σ -7S EtherCAT integration.

Add the model information file for Σ -7S EtherCAT integration to SigmaWin+ beforehand.

Caution

The scope of this guide covers the "connection check of the Motion Control Device connected via EtherCAT using the MC_Power instruction".

Accordingly, the overtravel functions (forward and reverse drives) are always set to be disabled. Make a setting according to the device used when you actually design a system.

The overtravel functions will be disabled by setting Forward and Reverse Drive Prohibit Input Signals (P-OT and N-OT) to "Set the signal to always enable forward drive" and "Set the signal to always enable reverse drive", respectively. No error therefore occurs even without connecting the overtravel signals (P-OT and N-OT).



Precautions for Correct Use

Refer to 4.3.3 Power ON Sequence of the Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual (SIEP S800001 55) for information on the power ON sequence of the control and main circuit power supplies to Servo Drive.



Additional Information

For information on how to install SigmaWin+ and the USB driver, refer to the *Yaskawa's products and technical information website* or contact YASKAWA Electric Corporation.




Additional Information


For information on how to add a model information file to SigmaWin+, refer to 9.2 Adding a Model Information File of the AC Servo Drive Engineering Tool SigmaWin+ Operation Manual (SIET S800001 34).

1 Turn ON Servo Drive.

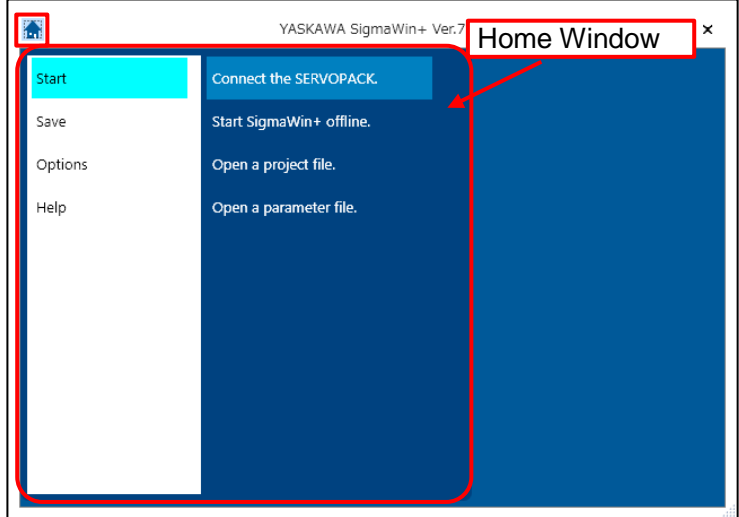
- 2 Start SigmaWin+.


- 3 SigmaWin+ starts, and the Main Window is displayed with the Home Window open.

Click **Start** and then Connect the SERVOPACK.

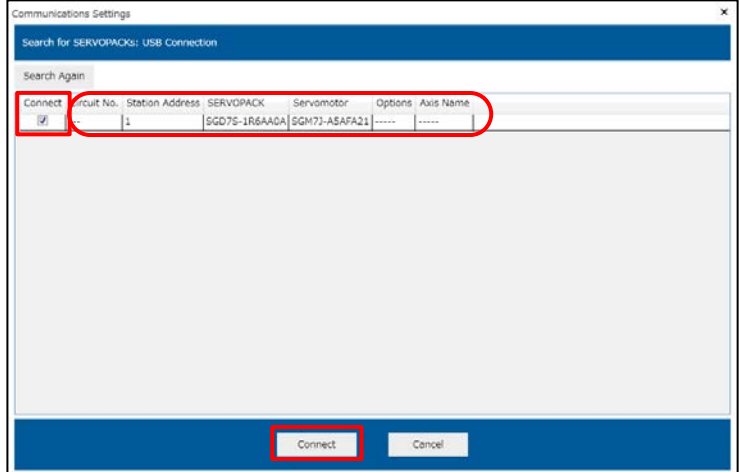
**If the Home Window is not displayed, click  at the top left of the Main Window. The Home Window is displayed.*

<Main Window>

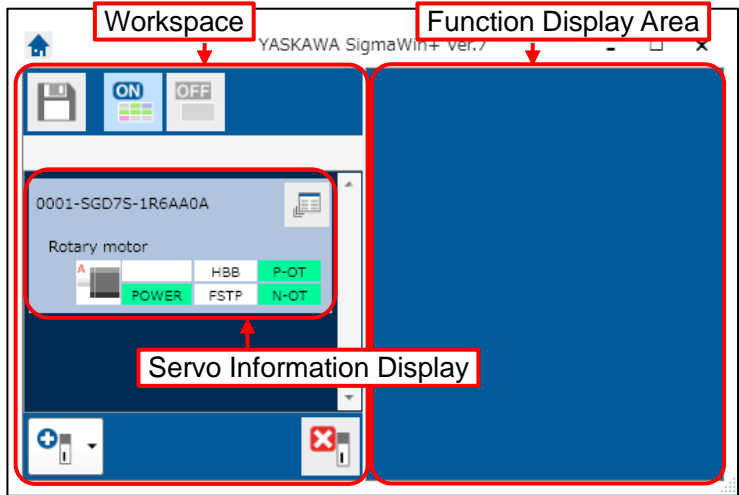

- 4 SigmaWin+ searches for Servo Drive that is connected to Personal computer, and displays the search result in the Communications Settings Dialog Box.

Check that the target Servo Drive is displayed and that a check mark is shown in the *Connect* Column.

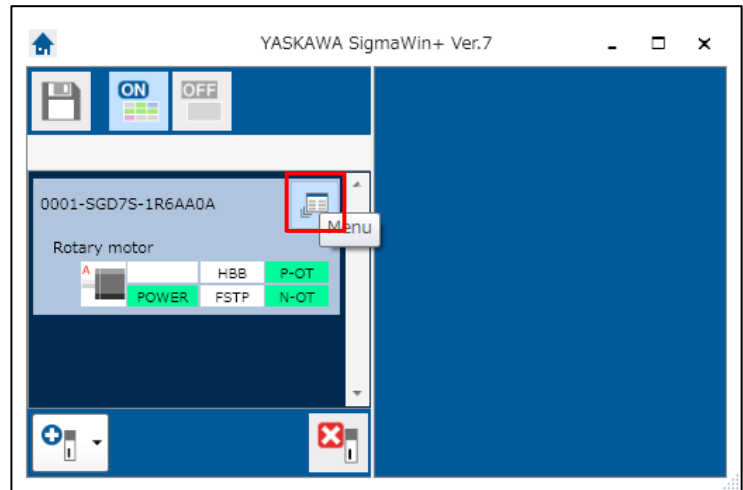
Click **Connect**.


- 5 The Servo Information Display of the connected Servo Drive is displayed in the Workspace of the Main Window. Check that the information of the target Servo Drive is shown there.

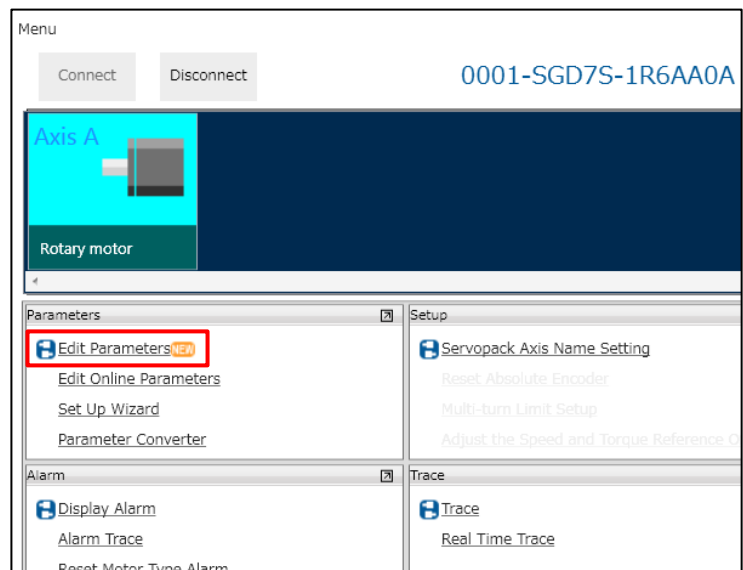
**The display area on the left side of the Main Window is named "Workspace", and the area on the right side is named "Function Display Area".*



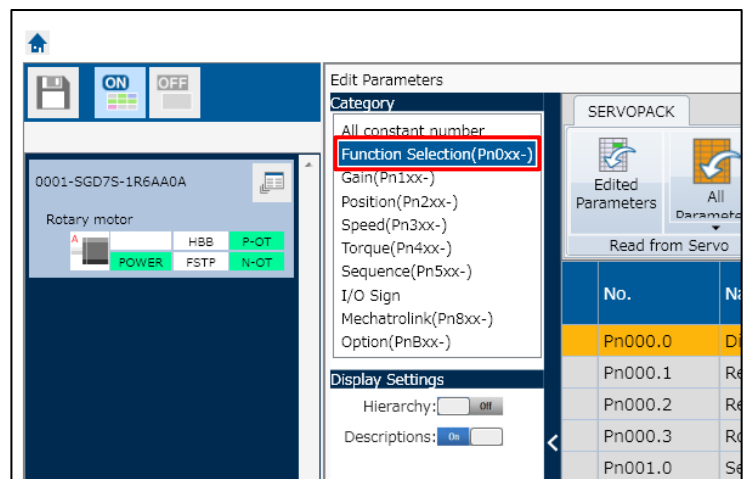
- 6 Click the **Menu** Button in Servo Information Display for the target Servo Drive.



- 7 The Menu Dialog Box is displayed. Click **Edit Parameters** in Parameters.



- 8 The Edit Parameters Window is displayed in the Function Display Area of the Main Window. Select *Function Selection(Pn0xx-)* from the Category Group.



- 9 A list of the parameters only related to Function Selection(Pn0xx-) is displayed. Check that the parameters
- Pn002.0 (Torque Limit Reference Selection for Command Option Module)
- and
- Pn002.1 (Speed Limit Reference Selection for Command Option Module)
- are set to the following options (settings of the parameters) in the Axis A Column, respectively.

No.	Name	Unit	0001-SGD7S-1R6AA0A
Pn000.0	Direction Selection	—	0 : Use CCW as the forward direction.
Pn000.1	Reserved parameter (Do not change.)	—	0 : Reserved parameter (Do not change.)
Pn000.2	Reserved parameter (Do not change.)	—	0 : Reserved parameter (Do not change.)
Pn000.3	Rotary/Linear Startup Selection When Encoder Is Not Connected	—	0 : Start as a rotary encoder.
Pn001.0	Servo OFF or Alarm Group 1 Stopping Method	—	0 : Stop the motor by applying the dynamic brake.
Pn001.1	Overtravel Stopping Method	—	0 : Apply the dynamic brake or coast the motor to a stop (use the stoppi
Pn001.2	Main Circuit Power Supply AC/DC Input Selection	—	0 : Input AC power as the main circuit power supply using the L1, L2, an
Pn001.3	Reserved parameter (Do not change.)	—	0 : Reserved parameter (Do not change.)
Pn002.0	Torque Limit Reference Selection for Command Option Module	—	1 : Enables the torque limit reference from the command option module.
Pn002.1	Speed Limit Reference Selection for Command Option Module	—	0 : Disables the speed limit reference when torque limit is used from the
Pn002.2	Absolute Encoder Usage	—	0 : Use the absolute encoder as an absolute encoder.
Pn002.3	External Encoder Usage	—	0 : Do not use an external encoder.

- Pn002.0
1: Enables the torque limit reference from the command option module.
- Pn002.1
0: Disables the speed limit reference when torque limit is used from the command option module.

*If the settings of the parameters are different from the ones described on the left, change them in the following way.
Double-click the setting of the parameter you want to change. The options are displayed. Click the option to which you want to set, to change the setting.

Pn002.0	Torque Limit Reference Selection for Command Option Module	—	0 : The torque limit(s) from Command-Option module are unavailable.
Pn002.1	Speed Limit Reference Selection for Command Option Module	—	0 : The torque limit(s) from Command-Option module are unavailable.
Pn002.2	Absolute Encoder Usage	—	1 : Enables the torque limit reference from the command option module.
Pn002.3	External Encoder Usage	—	2 : Reserved parameter (Do not change.)
			3 : The torque limit from Command-Option module are available while P-

- 10 Double-click the setting of the following parameter to change.
- Pn002.2 (Absolute Encoder Usage)

No.	Name	Unit	0001-SGD7S-1R6AA0A
Pn000.0	Direction Selection	—	0 : Use CCW as the forward direction.
Pn000.1	Reserved parameter (Do not change.)	—	0 : Reserved parameter (Do not change.)
Pn000.2	Reserved parameter (Do not change.)	—	0 : Reserved parameter (Do not change.)
Pn000.3	Rotary/Linear Startup Selection When Encoder Is Not Connected	—	0 : Start as a rotary encoder.
Pn001.0	Servo OFF or Alarm Group 1 Stopping Method	—	0 : Stop the motor by applying the dynamic brake.
Pn001.1	Overtravel Stopping Method	—	0 : Apply the dynamic brake or coast the motor to a stop
Pn001.2	Main Circuit Power Supply AC/DC Input Selection	—	0 : Input AC power as the main circuit power supply using the L1, L2, an
Pn001.3	Reserved parameter (Do not change.)	—	0 : Reserved parameter (Do not change.)
Pn002.0	Torque Limit Reference Selection for Command Option Module	—	1 : Enables the torque limit reference from the command option module.
Pn002.1	Speed Limit Reference Selection for Command Option Module	—	0 : Disables the speed limit reference when torque limit is used from the
Pn002.2	Absolute Encoder Usage	—	0 : Use the absolute encoder as an absolute encoder.
Pn002.3	External Encoder Usage	—	0 : Do not use an external encoder.
Pn002.4	External Encoder Usage	—	0 : Do not use an external encoder.

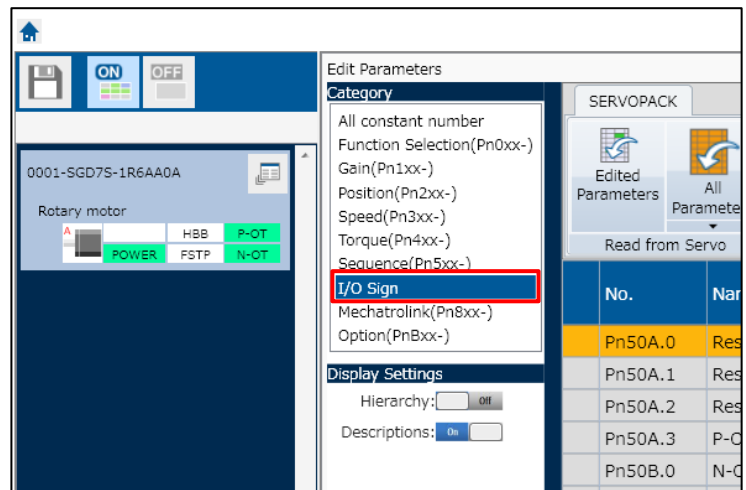
- 11 The options are displayed. Select 1: Use the absolute encoder as an incremental encoder.

Pn002.2	Absolute Encoder Usage	—	0 : Use the absolute encoder as an absolute encoder.
Pn002.3	External Encoder Usage	—	0 : Use the absolute encoder as an absolute encoder.
Pn006.0-1	Analog Monitor 1 Signal Selection	—	1 : Use the absolute encoder as an incremental encoder.

- 12 Check that the setting of the parameter Pn002.2 is changed as selected. The background color of the changed setting of the parameter changes to green.

Pn002.2	Absolute Encoder Usage	—	1 : Use the absolute encoder as an incremental encoder.
Pn002.3	External Encoder Usage	—	0 : Do not use an external encoder.

- 13 Change the I/O signal settings by following the steps below. Select *I/O Sign* from the Category Group.



- 14 A list of the parameters only related to I/O signals is displayed. Double-click the setting of the following parameter.
- Pn50A.3 (P-OT (Forward Drive Prohibit) Signal Allocation)

No.	Name	Unit	
Pn50A.0	Reserved parameter (Do not change.)	-	1 : Reserved parameter (Do not change.)
Pn50A.1	Reserved parameter (Do not change.)	-	8 : Reserved parameter (Do not change.)
Pn50A.2	Reserved parameter (Do not change.)	-	8 : Reserved parameter (Do not change.)
Pn50A.3	P-OT (Forward Drive Prohibit) Signal Allocation	-	1 : Enable forward drive when CN1-7 input signal is ON (closed).
Pn50B.0	N-OT (Reverse Drive Prohibit) Signal Allocation	-	2 : Enable reverse drive when CN1-8 input signal is ON (closed).
Pn50B.1	Reserved parameter (Do not change.)	-	8 : Reserved parameter (Do not change.)
Pn50B.2	/P-CL (Forward External Torque Limit Input) Signal Allocation	-	8 : The signal is always inactive.

- 15 The options are displayed. Select *8. Set the signal to always enable forward drive.*

Pn50A.3	P-OT (Forward Drive Prohibit) Signal Allocation	-	1 : Enable forward drive when CN1-7 input signal is ON (closed).
Pn50B.0	N-OT (Reverse Drive Prohibit) Signal Allocation	-	4 : Enable forward drive when CN1-10 input signal is ON (closed).
Pn50B.1	Reserved parameter (Do not change.)	-	5 : Enable forward drive when CN1-11 input signal is ON (closed).
Pn50B.2	/P-CL (Forward External Torque Limit Input) Signal Allocation	-	6 : Enable forward drive when CN1-12 input signal is ON (closed).
Pn50B.3	/N-CL (Reverse External Torque Limit Input) Signal Allocation	-	7 : Set the signal to always enable forward drive.
Pn50E.0	/COIN (Positioning Completion Output) Signal Allocation	-	8 : Set the signal to always enable forward drive.
Pn50E.1	/M/FMB (Forward/Reverse Drive Pattern Output) Signal Allocation	-	9 : Enable forward drive when CN1-12 input signal is OFF (open).
			A : Enable forward drive when CN1-7 input signal is OFF (open).
			B : Enable forward drive when CN1-8 input signal is OFF (open).

- 16 Check that the setting of the parameter Pn50A.3 is changed as selected.

Pn50A.3	P-OT (Forward Drive Prohibit) Signal Allocation	-	8 : Set the signal to always enable forward drive.
Pn50B.0	N-OT (Reverse Drive Prohibit) Signal Allocation	-	2 : Enable reverse drive when CN1-8 input signal is ON (closed).

- 17 In the same way as steps 14 to 16, change the setting of the parameter Pn50B.0 (N-OT (Reverse Drive Prohibit) Signal Allocation) to *8: Set the signal to always enable reverse drive.*

Pn50A.0	Reserved parameter (Do not change.)	-	1 : Reserved parameter (Do not change.)
Pn50A.1	Reserved parameter (Do not change.)	-	8 : Reserved parameter (Do not change.)
Pn50A.2	Reserved parameter (Do not change.)	-	8 : Reserved parameter (Do not change.)
Pn50A.3	P-OT (Forward Drive Prohibit) Signal Allocation	-	8 : Set the signal to always enable forward drive.
Pn50B.0	N-OT (Reverse Drive Prohibit) Signal Allocation	-	8 : Set the signal to always enable reverse drive.
Pn50B.1	Reserved parameter (Do not change.)	-	8 : Reserved parameter (Do not change.)
Pn50B.2	/P-CL (Forward External Torque Limit Input) Signal Allocation	-	8 : The signal is always inactive.

18 Scroll down the list of parameters in the Edit Parameters Window and display the following parameters.

- Pn511.1 (Input Signal 4 Mapping for Command Option Module / Probe1 (/SI4))
- Pn511.2 (Input Signal 5 Mapping for Command Option Module / Probe 2 (/SI5))
- Pn511.3 (Input Signal 6 Mapping for Command Option Module / Home (/SI6))

Check that the setting of each parameter is as shown below.

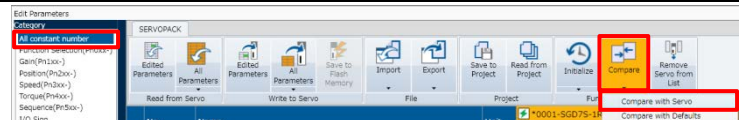
- Pn511.1
4: Inputs the signal from CN1-10 input terminal.
- Pn511.2
5: Inputs the signal from CN1-11 input terminal.
- Pn511.3
6: Inputs the signal from CN1-12 input terminal.

No.	Name	Unit	
Pn510.1	Reserved parameter (Do not change.)	—	0: Reserved parameter (Do not change.)
Pn510.2	Reserved parameter (Do not change.)	—	0: Reserved parameter (Do not change.)
Pn510.3	Reserved parameter (Do not change.)	—	0: Reserved parameter (Do not change.)
Pn511.0	Reserved parameter (Do not change.)	—	3: Reserved parameter
Pn511.1	Input Signal 4 Mapping for Command Option Module / Probe1 (/SI4)	—	4: Inputs the signal from CN1-10 input terminal.
Pn511.2	Input Signal 5 Mapping for Command Option Module / Probe2 (/SI5)	—	5: Inputs the signal from CN1-11 input terminal.
Pn511.3	Input Signal 6 Mapping for Command Option Module / Home (/SI6)	—	6: Inputs the signal from CN1-12 input terminal.
Pn512.0	Output Signal Inversion for CN1-1 and CN1-2 Terminals	—	0: The signal is not inverted.

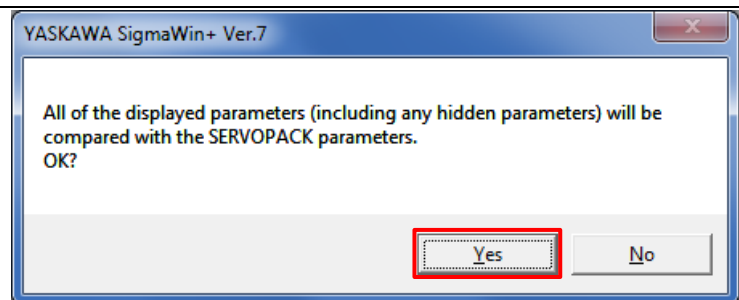
*If the settings are different from the ones shown on the left, double-click the setting of the parameter for change, and select the same option as shown on the left.

19 Select *All constant number* from the Category Group.

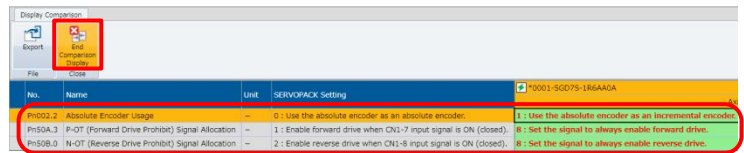
Click **Compare** in the Function Group shown at the top of the Edit Parameters Window, and select **Compare with Servo** from the displayed menu.



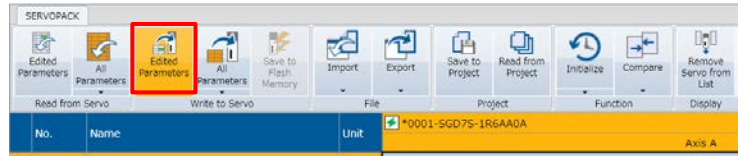
20 The dialog box on the right is displayed. Check the contents and click **Yes**.



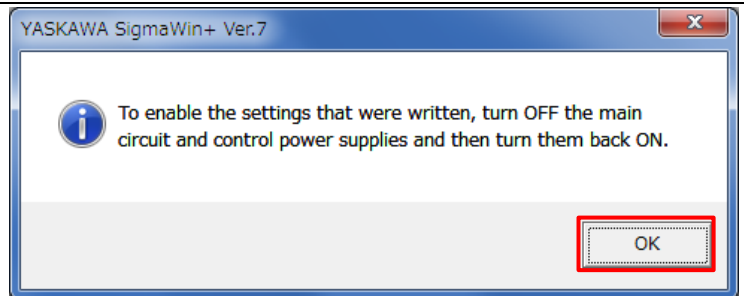
- 21 A list of the parameters changed in steps 9 to 18 is displayed. Check that there is no problem with the settings, and click **End Comparison Display** in the Close Group.



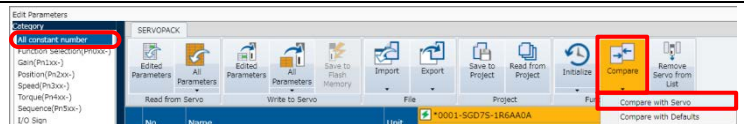
- 22 The changed parameters are written to Servo Drive by following the steps below. Click **Edited Parameters** in the Write to Servo Group.



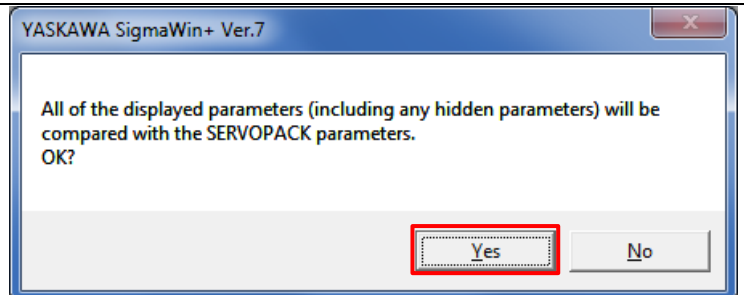
- 23 The dialog box on the right is displayed. Check the contents and click **OK**.



- 24 Check that All constant number in the Category Group is selected. Click **Compare** in the Function Group and select **Compare with Servo** from the displayed menu.



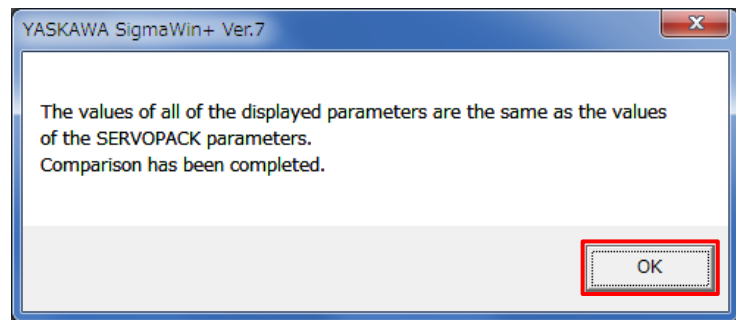
- 25 The dialog box on the right is displayed. Check the contents and click **Yes**.




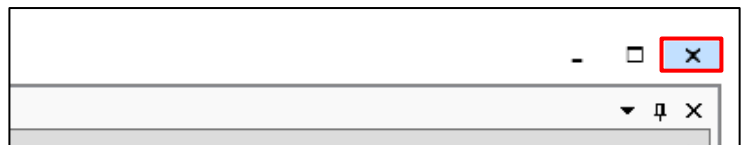
- 26 The dialog box on the right is displayed when the changed parameters are correctly written to Servo Drive. Check the contents and click **OK**.

*If a dialog box is displayed stating that there is a discrepancy in the parameters, check the settings and reset the parameter that has a different setting or, if necessary, initialize Servo Drive and set the parameters again from the start.

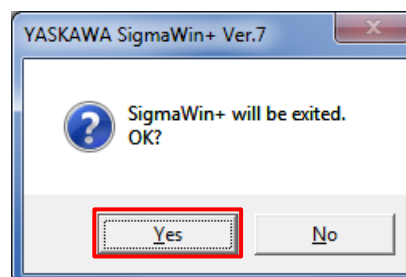
*For information on how to initialize the Servo Drive parameters, refer to 5.1.5 *Initializing SERVOPACK Parameter Settings of the Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual (SIEP S800001 55).*



- 27 Close SigmaWin+ by clicking  at the top right of the Main Window.

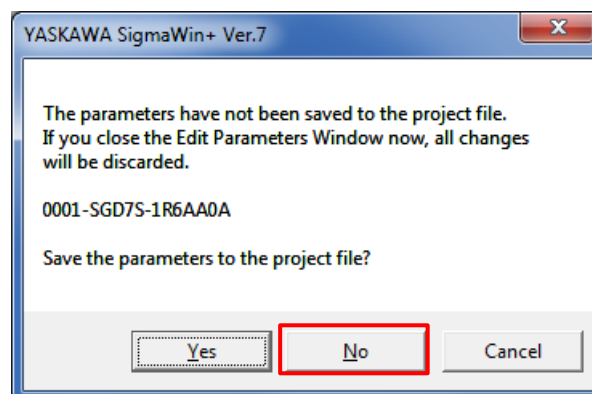


- 28 The dialog box on the right is displayed. Check the contents and click **Yes**.



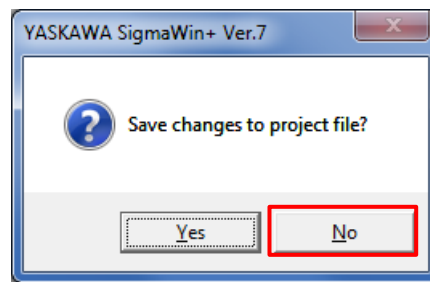
- 29 The dialog box on the right is displayed. Check the contents and click **No**.

*Click **Yes** if you need to save the parameters to the project file.



30 The dialog box on the right is displayed. Check the contents and click **No**.

*Click **Yes** if you need to save the parameters to the project file.



31 Power cycle Servo Drive.

*The changed parameter settings will be enabled after power cycling Servo Drive.

7.4. Controller Setup

Set up Controller.

The settings described in this *Clause 7.4* are made beforehand in the project file listed in *Section 9. Appendix 1: Procedure Using the Project File*.

WARNING

Depending on the Controller status, unexpected operation of Motion Control Device may result in injury when you turn ON Controller.
Ensure safety before you turn ON the power.

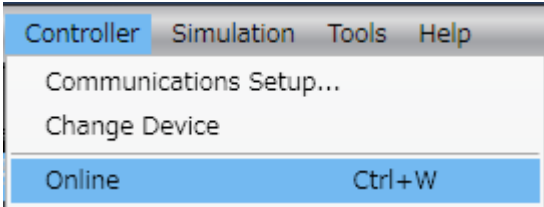
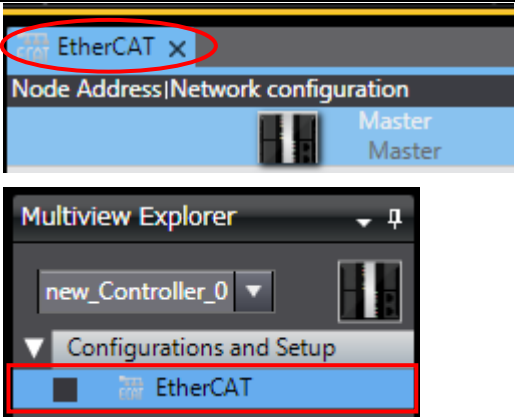


Precautions for Correct Use

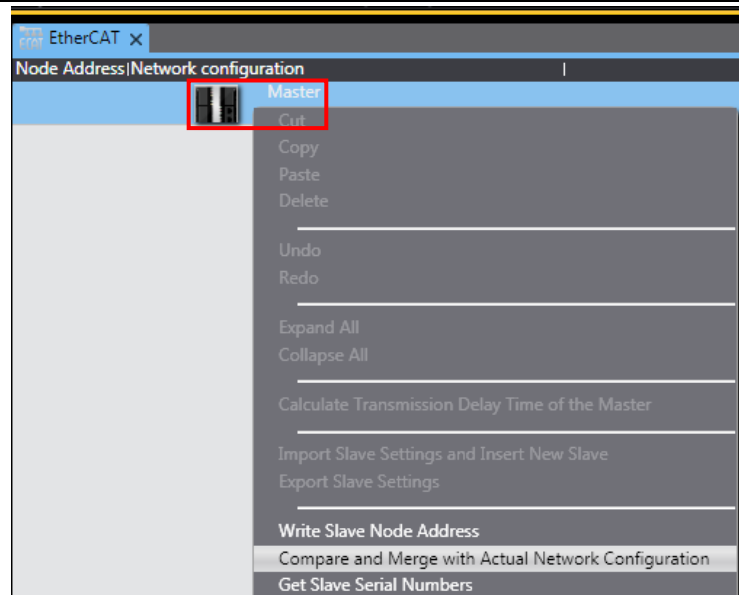
Check that the Ethernet cable is connected to both devices before performing the following procedure. If not, turn OFF the devices, and then connect the Ethernet cable.

7.4.1. Setting up the EtherCAT Network Configuration

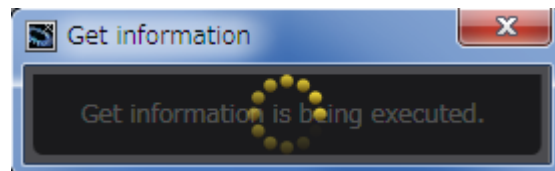
Set up the EtherCAT network configuration.

1	Turn ON Controller.	
2	Select Online from the Controller Menu in Sysmac Studio.	
3	<p>Sysmac Studio goes online. Check that the EtherCAT Tab Page is displayed in the Edit Pane.</p> <p>*if not displayed, double-click EtherCAT under Configurations and Setup in the Multiview Explorer.</p>	

- 4 Right-click **Master** on the EtherCAT Tab Page and select **Compare and Merge with Actual Network Configuration**.

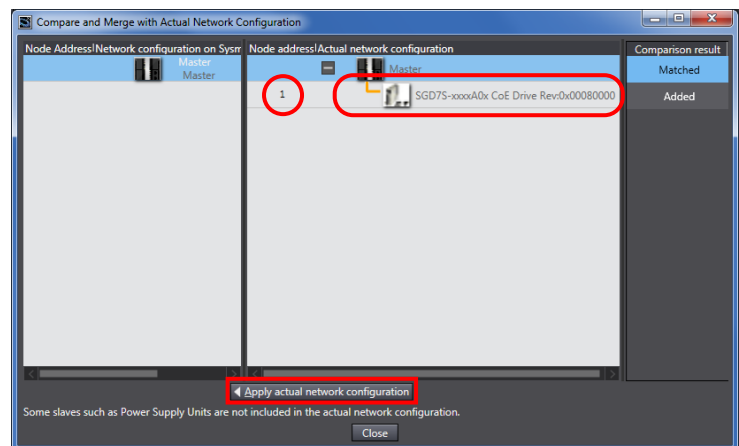


A screen is displayed stating "Get information is being executed".

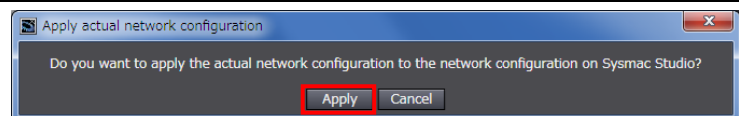


- 5 The Compare and Merge with Actual Network Configuration Dialog Box is displayed. The node address 1 and SGD7S-xxxxA0x CoE Drive Rev:0x00080000 are added to the Actual network configuration after the comparison.

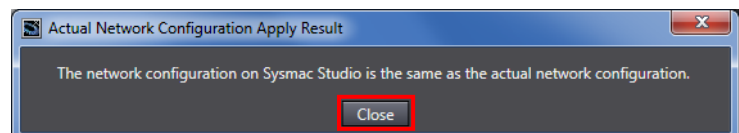
Click **Apply actual network configuration**.



- 6 A confirmation dialog box is displayed. Check the contents and click **Apply**.

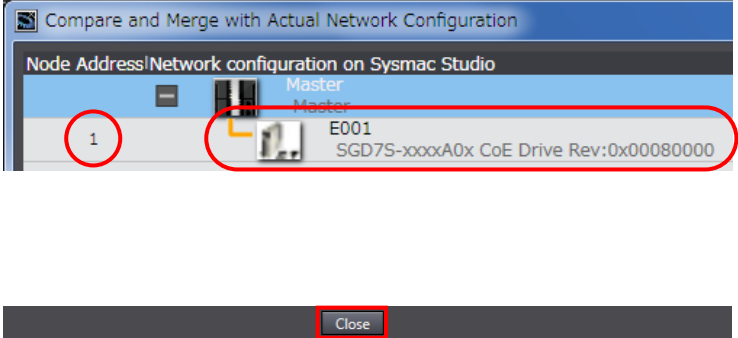


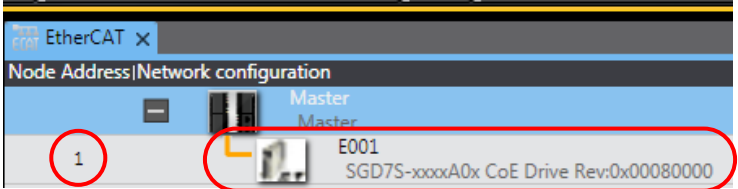
The dialog box on the right is displayed. Check the contents and click **Close**.

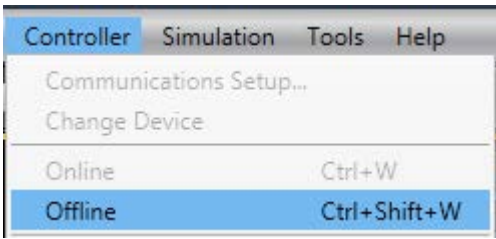


- 7 As the node address 1 slave, E001 SGD7S-xxxxA0x CoE Drive Rev:0x00080000 is added to the Network configuration on Sysmac Studio.

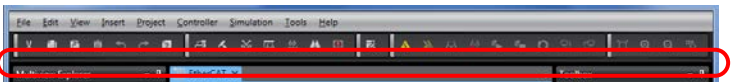
Check that the data above is added. Click **Close**.


- 8 The node address 1 and E001 SGD7S-xxxxA0x CoE Drive Rev:0x00080000 are added to the EtherCAT Tab Page of the Edit Pane.


- 9 Select **Offline** from the Controller Menu.



The yellow bar under the toolbar disappears.



7.4.2. PDO Map Settings

Set the PDO mappings for MC Function Module.

Caution

For PDO entries without axis settings, PDO communications is performed using unspecified values. This may cause unexpected operation of Motion Control Device, resulting in injury.

Make sure that only the objects set in 7.4.3. *Axis Settings for Motion Control* are mapped to PDOs.



Additional Information

Among the objects supported by Motion Control Device, the objects available for MC Function Module of Controller are described in 6.1.2. *PDO Mappings*.

For details on the objects available for MC Function Module, refer to *Section 10. Appendix 2: MC Instructions and PDO Entries*.

- 1 Select the node address 1 slave added on the EtherCAT Tab Page in the previous procedure 7.4.1.

Check that Enabled (DC for synchronization) is set for Enable Distributed Clock.

Item name	Value
Device name	E001
Model name	SGD7S-xxxxA0x CoE Drive
Product name	SGD7S-xxxxA0x EtherCAT(CoE) S...
Revision	0x00080000
Node Address	1
Enable/Disable Settings	Enabled
Serial Number	0x00000000
0x6040:00 2nd Receive PDO ma...	
0x607A:00 2nd Receive PDO ma...	
0x6041:00 2nd Transmit PDO ma...	
0x6064:00 2nd Transmit PDO ma...	
Enable Distributed Clock	Enabled (DC for synchronization)

- 2 Click **Edit PDO Map Settings** in the *PDO Map Settings* Field.

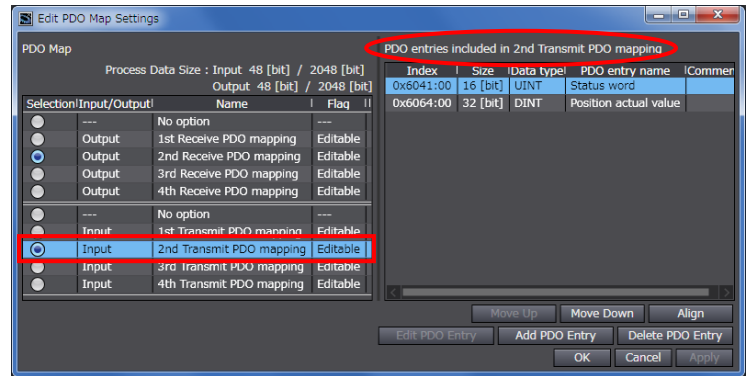
Item name	Value
Device name	E001
Model name	SGD7S-xxxxA0x CoE Drive
Product name	SGD7S-xxxxA0x EtherCAT(CoE) S...
Revision	0x00080000
Node Address	1
Enable/Disable Settings	Enabled
Serial Number	0x00000000
0x6040:00 2nd Receive PDO ma...	
0x607A:00 2nd Receive PDO ma...	
0x6041:00 2nd Transmit PDO ma...	
0x6064:00 2nd Transmit PDO ma...	
Enable Distributed Clock	Enabled (DC for synchronization)
Shift Time Setting	Disabled

3 The Edit PDO Map Settings Dialog Box is displayed.

*The PDO Map by default setting is used for the explanation in this guide. You can also select a mapping different from the one in this guide.

Select *2nd Transmit PDO mapping*.

"PDO entries included in 2nd Transmit PDO mapping" is displayed on the right side of the dialog box.



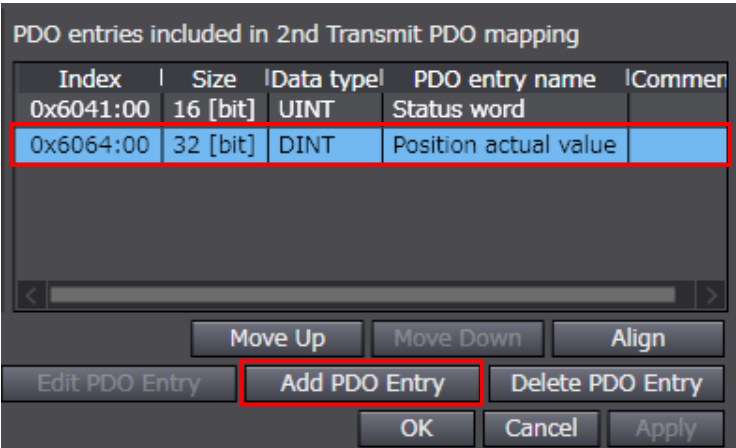
4 Check that the following objects are set.

- 0x6041:00
- 0x6064:00

PDO entries included in 2nd Transmit PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6041:00	16 [bit]	UINT	Status word	
0x6064:00	32 [bit]	DINT	Position actual value	

5 Select the index in the bottom row and click **Add PDO Entry**.

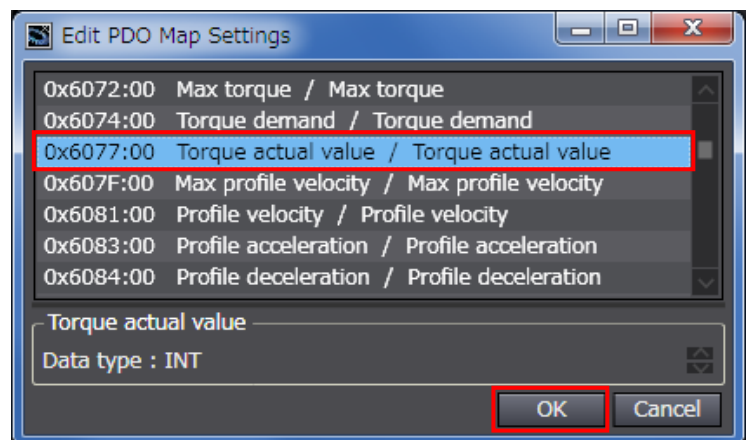


6 The Edit PDO Map Settings Dialog Box is displayed.

Among the objects listed in 6.1.2. *PDO Mappings*, select the following object that is not yet set.

- 0x6077:00

Click **OK**.



7

Check that the added object is displayed.

PDO entries included in 2nd Transmit PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6041:00	16 [bit]	UINT	Status word	
0x6064:00	32 [bit]	DINT	Position actual value	
0x6077:00	16 [bit]	INT	Torque actual value	---

8

In the same way as steps 5 and 6, add the following objects.

- 0x6061:00
- 0x60B9:00
- 0x60BA:00
- 0x60BC:00
- 0x60FD:00

PDO entries included in 2nd Transmit PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6041:00	16 [bit]	UINT	Status word	
0x6064:00	32 [bit]	DINT	Position actual value	
0x6077:00	16 [bit]	INT	Torque actual value	---
0x6061:00	8 [bit]	SINT	Modes of operation display	---
0x60B9:00	16 [bit]	UINT	Touch probe status	---
0x60BA:00	32 [bit]	DINT	Touch probe 1 position value	---
0x60BC:00	32 [bit]	DINT	Touch probe 2 position value	---
0x60FD:00	32 [bit]	UDINT	Digital inputs	---

9

Select *2nd Receive PDO mapping*.
"PDO entries included in 2nd Receive PDO mapping" is displayed on the right side of the dialog box.

Edit PDO Map Settings

PDO Map

Process Data Size : Input 184 [bit] / 2048 [bit]
Output 48 [bit] / 2048 [bit]

Selection/Output/

Name

Flag

Output

No option

Editable

Output

1st Receive PDO mapping

Editable

Output

2nd Receive PDO mapping

Editable

Output

3rd Receive PDO mapping

Editable

Output

4th Receive PDO mapping

Editable

Input

No option

Input

1st Transmit PDO mapping

Editable

Input

2nd Transmit PDO mapping

Editable

Input

3rd Transmit PDO mapping

Editable

Input

4th Transmit PDO mapping

Editable

PDO entries included in 2nd Receive PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6040:00	16 [bit]	UINT	Control word	
0x607A:00	32 [bit]	DINT	Target position	

Move Up

Move Down

Align

Edit PDO Entry

Add PDO Entry

Delete PDO Entry

OK

Cancel

Apply

10

Check that the following objects are set.

- 0x6040:00
- 0x607A:00

PDO entries included in 2nd Receive PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6040:00	16 [bit]	UINT	Control word	
0x607A:00	32 [bit]	DINT	Target position	

11

In the same way as steps 5 and 6, add the following objects.

- 0x60FF:00
- 0x6071:00
- 0x6060:00
- 0x60B8:00
- 0x60E0:00
- 0x60E1:00

PDO entries included in 2nd Receive PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6040:00	16 [bit]	UINT	Control word	
0x607A:00	32 [bit]	DINT	Target position	
0x60FF:00	32 [bit]	DINT	Target velocity	---
0x6071:00	16 [bit]	INT	Target torque	---
0x6060:00	8 [bit]	SINT	Modes of operation	---
0x60B8:00	16 [bit]	UINT	Touch probe function	---
0x60E0:00	16 [bit]	UINT	Positive Torque Limit Value	---
0x60E1:00	16 [bit]	UINT	Negative Torque Limit Value	---

12

Click **OK**.

Edit PDO Map Settings

PDO Map

Process Data Size : Input 184 [bit] / 2048 [bit]
Output 152 [bit] / 2048 [bit]

Selection/Output/

Name

Flag

Output

No option

Output

1st Receive PDO mapping

Editable

Output

2nd Receive PDO mapping

Editable

Output

3rd Receive PDO mapping

Editable

Output

4th Receive PDO mapping

Editable

Input

No option

Input

1st Transmit PDO mapping

Editable

Input

2nd Transmit PDO mapping

Editable

Input

3rd Transmit PDO mapping

Editable

Input

4th Transmit PDO mapping

Editable

PDO entries included in 2nd Receive PDO mapping

Index	Size	Data type	PDO entry name	Comment
0x6040:00	16 [bit]	UINT	Control word	
0x607A:00	32 [bit]	DINT	Target position	
0x60FF:00	32 [bit]	DINT	Target velocity	---
0x6071:00	16 [bit]	INT	Target torque	---
0x6060:00	8 [bit]	SINT	Modes of operation	---
0x60B8:00	16 [bit]	UINT	Touch probe function	---
0x60E0:00	16 [bit]	UINT	Positive Torque Limit Value	---
0x60E1:00	16 [bit]	UINT	Negative Torque Limit Value	---

Move Up

Move Down

Align

Edit PDO Entry

Add PDO Entry

Delete PDO Entry

OK

Cancel

Apply

- 13 The same PDO entries as listed in 6.1.2. *PDO Mappings* are displayed in the *PDO Map Settings* Field.

Item name	Value
Device name	E001
Model name	SGD7S-xxxxA0x CoE Drive
Product name	SGD7S-xxxxA0x EtherCAT(CoE) SERVOPACK Rev8.00
Revision	0x00080000
Node Address	1
Enable/Disable Settings	Enabled
Serial Number	0x00000000
PDO Map Settings	<div> 0x6040:00 2nd Receive PDO mapping/Control word 0x607A:00 2nd Receive PDO mapping/Target position 0x60FF:00 2nd Receive PDO mapping/Target velocity 0x6071:00 2nd Receive PDO mapping/Target torque 0x6060:00 2nd Receive PDO mapping/Modes of operation 0x6088:00 2nd Receive PDO mapping/Touch probe function 0x60E0:00 2nd Receive PDO mapping/Positive Torque Limit Value 0x60E1:00 2nd Receive PDO mapping/Negative Torque Limit Value 0x6041:00 2nd Transmit PDO mapping/Status word 0x6064:00 2nd Transmit PDO mapping/Position actual value 0x6077:00 2nd Transmit PDO mapping/Torque actual value 0x6061:00 2nd Transmit PDO mapping/Modes of operation display 0x6089:00 2nd Transmit PDO mapping/Touch probe status 0x608A:00 2nd Transmit PDO mapping/Touch probe 1 position value 0x608C:00 2nd Transmit PDO mapping/Touch probe 2 position value 0x60FD:00 2nd Transmit PDO mapping/Digital inputs </div>
	Edit PDO Map Settings
Enable Distributed Cl...	Enabled (DC for synchronization)

7.4.3. Axis Settings for Motion Control

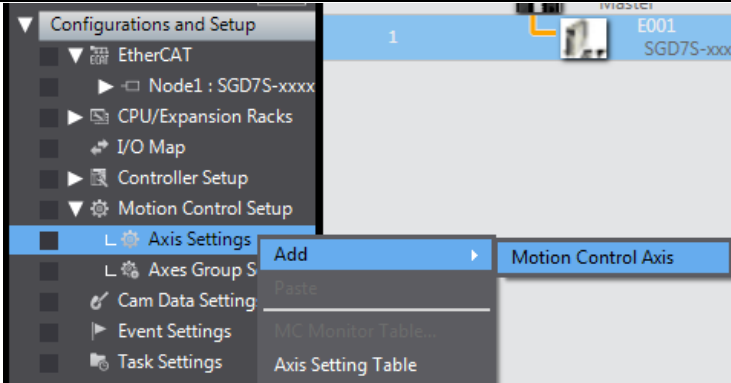
Set the axis for MC Function Module.

Caution

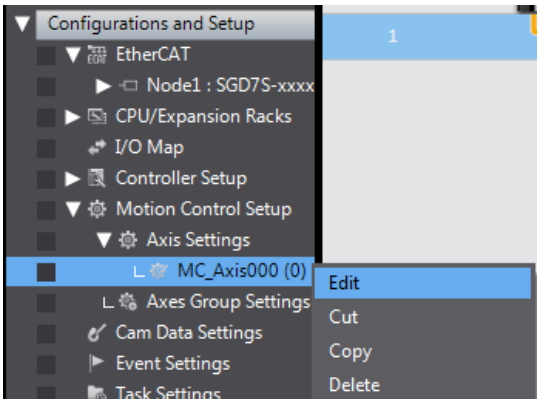
For PDO entries without axis settings, PDO communications is performed using unspecified values. This may cause unexpected operation of Motion Control Device, resulting in injury.
Be sure to make the axis settings for all the PDO entries (objects) listed in 6.1.2. *PDO Mappings*.



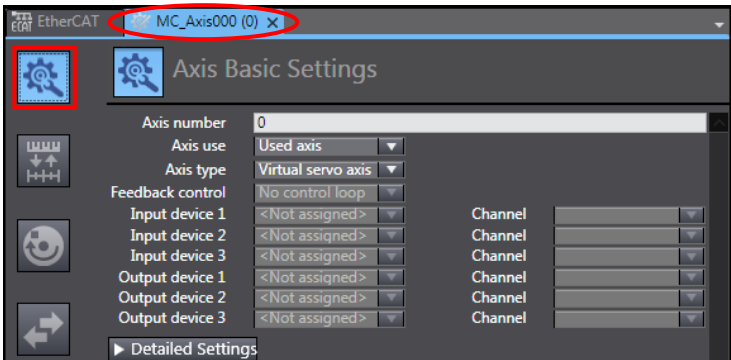
- 1 Select **Configurations and Setup - Motion Control Setup - Axis Settings** in the Multiview Explorer.
Right-click **Axis Settings** and select **Add - Motion Control Axis** from the menu.


- 2 MC_Axis000 (0) is added under Motion Control Setup - Axis Settings.
Right-click **MC_Axis000 (0)** and select **Edit** from the menu.

*The MC_Axis000(0,MC1) is displayed for NX-series Controllers.


- 3 The MC_Axis000 (0) Tab Page is displayed in the Edit Pane.

Click the **Axis Basic Settings** Button.



- 4 Enter or select each of the following values from the pull-down list to make the Axis Basic Settings on the MC_Axis000 (0) Tab Page.
- Axis number: 0
 - Axis use: **Used axis**
 - Axis type: **Servo axis**
 - Feedback control: **No control loop**
 - Output device 1: **Node: 1 SGD7S-xxxxA0x CoE Drive(E001)**

- 5 Click **Detailed Settings**.

Click the three of + Buttons next to each function name to expand the configuration elements.

Function Name	Device	Process Data
Output (Controller to Device)		
Input (Device to Controller)		
Digital inputs		

- 6 The Detailed Settings is expanded.

Function Name	Device	Process Data
Output (Controller to Device)		
Input (Device to Controller)		
Digital inputs		

- 7 Open the pull-down list in the *Device Column* for 1.Controlword.

Select **Node: 1**

SGD7S-xxxxA0x CoE Drive(E001).

Select the following object from the pull-down list in the *Process Data Column*.

- 6040h-00.0

Function Name	Device	Process Data
- Output (Controller to Device)		
★ 1. Controlword	<Not assigned>	<Not assigned>
★ 3. Target position	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	assigned>
5. Target velocity	<Not assigned>	assigned>



Function Name	Device	Process Data
- Output (Controller to Device)		
★ 1. Controlword	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	<Not assigned>
★ 3. Target position	6040h-00.0(2nd Receive PDO mapping_Control word_6040_00)	
5. Target velocity	607Ah-00.0(2nd Receive PDO mapping_Target position_607A_00)	



Function Name	Device	Process Data
- Output (Controller to Device)		
★ 1. Controlword	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6040h-00.0(2nd Receive PDO)
★ 3. Target position	<Not assigned>	<Not assigned>

- 8 Likewise, set the devices and the process data as shown below by referring to 6.1.5. *Axis Settings for PDO Entries*.

Select **Node: 1 SGD7S-xxxxA0x CoE Drive(E001)** for the device that process data needs to be assigned.

Select **<Not assigned>** for the device that no process data needs to be assigned.

Function Name	Device	Process Data
- Output (Controller to Device)		
★ 1. Controlword	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6040h-00.0(2nd Receive PDO mapping_Control word_6040_00)
★ 3. Target position	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	607Ah-00.0(2nd Receive PDO mapping_Target position_607A_00)
5. Target velocity	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FFh-00.0(2nd Receive PDO mapping_Target velocity_60FF_00)
7. Target torque	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6071h-00.0(2nd Receive PDO mapping_Target torque_6071_00)
9. Max profile Velocity	<Not assigned>	<Not assigned>
11. Modes of operation	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6060h-00.0(2nd Receive PDO mapping_Modes of operation_6060_00)
15. Positive torque limit value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60E0h-00.0(2nd Receive PDO mapping_Positive Torque Limit Value_60E0_00)
16. Negative torque limit value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60E1h-00.0(2nd Receive PDO mapping_Negative Torque Limit Value_60E1_00)
21. Touch probe function	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6088h-00.0(2nd Receive PDO mapping_Touch probe function_6088_00)
44. Software Switch of Encoder's	<Not assigned>	<Not assigned>
- Input (Device to Controller)		
★ 22. Statusword	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6041h-00.0(2nd Transmit PDO mapping_Status word_6041_00)
★ 23. Position actual value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6064h-00.0(2nd Transmit PDO mapping_Position actual value_6064_00)
24. Velocity actual value	<Not assigned>	<Not assigned>
25. Torque actual value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6077h-00.0(2nd Transmit PDO mapping_Torque actual value_6077_00)
27. Modes of operation display	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6061h-00.0(2nd Transmit PDO mapping_Modes of operation display_6061_00)
40. Touch probe status	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	6089h-00.0(2nd Transmit PDO mapping_Touch probe status_6089_00)
41. Touch probe pos1 pos value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	608Ah-00.0(2nd Transmit PDO mapping_Touch probe 1 position value_608A_00)
42. Touch probe pos2 pos value	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	608Ch-00.0(2nd Transmit PDO mapping_Touch probe 2 position value_608C_00)
43. Error code	<Not assigned>	<Not assigned>
45. Status of Encoder's Input Slave	<Not assigned>	<Not assigned>
46. Reference Position for csp	<Not assigned>	<Not assigned>
- Digital inputs		
28. Positive limit switch	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.17(2nd Transmit PDO mapping_Digital inputs_60FD_00)
29. Negative limit switch	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.18(2nd Transmit PDO mapping_Digital inputs_60FD_00)
30. Immediate Stop Input	<Not assigned>	<Not assigned>
32. Encoder Phase Z Detection	<Not assigned>	<Not assigned>
33. Home switch	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.22(2nd Transmit PDO mapping_Digital inputs_60FD_00)
37. External Latch Input 1	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.20(2nd Transmit PDO mapping_Digital inputs_60FD_00)
38. External Latch Input 2	Node : 1 SGD7S-xxxxA0x CoE Drive(E001)	60FDh-00.21(2nd Transmit PDO mapping_Digital inputs_60FD_00)

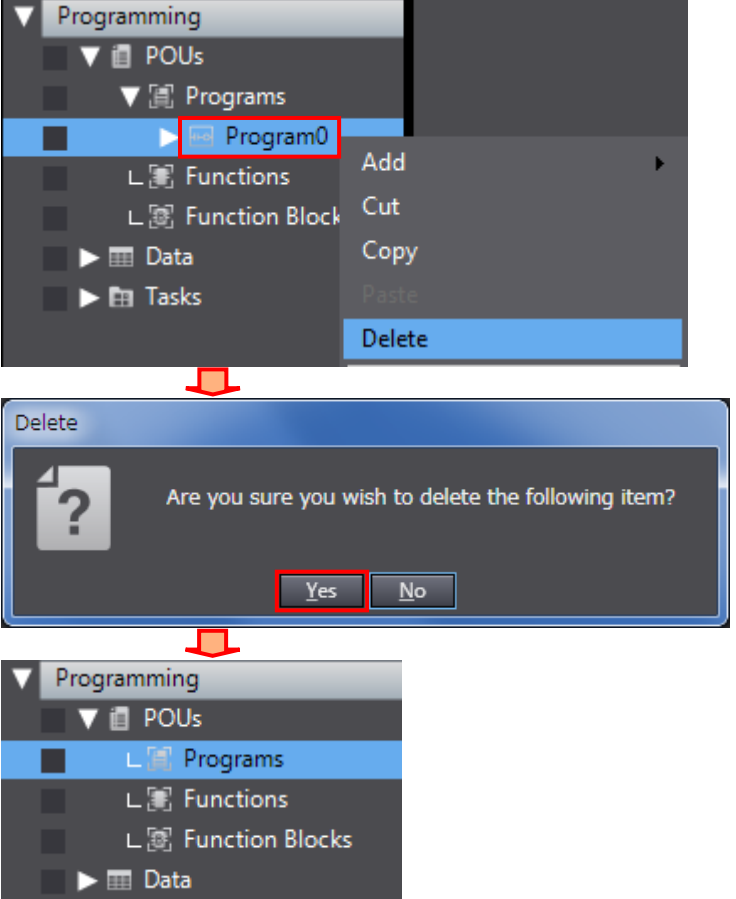
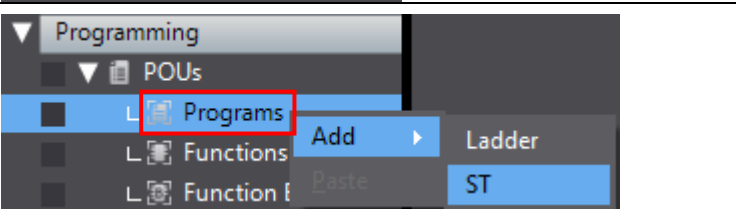
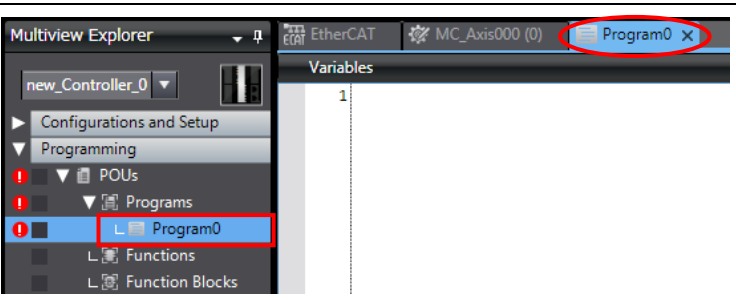
7.4.4. Creating an Operation Check Program

Create a program to check operation.

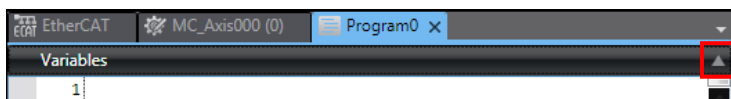
The MC_Power instruction is used as an example in this program.

For details on MC instructions, refer to the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508)

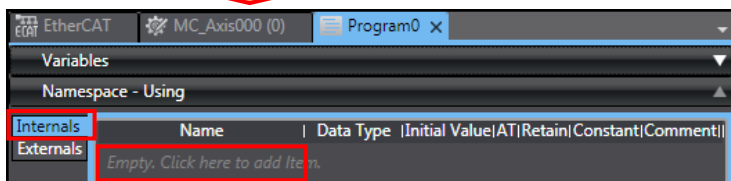
For details on the ST (structured text) language program, refer to *Section 11. Appendix 3: Program*.

<p>1 Select Programming - Programs - Program0 in the Multiview Explorer.</p> <p>Right-click Program0 and select Delete from the menu.</p> <p>*The default Program0 is automatically created in the ladder language. It is not used in this guide because a ST language program is manually created and is used in the following steps.</p> <p>The Delete Dialog Box is displayed. Click Yes.</p> <p>Program0 is deleted from Programming in the Multiview Explorer.</p>	
<p>2 Right-click Programs under Programming and select Add - ST from the menu.</p>	
<p>3 Double-click Program0 added in the Multiview Explorer.</p> <p>The Program0 Tab Page is displayed in the Edit Pane.</p>	

4 Click the **Up Arrow** Button of Variables to expand the variable table.

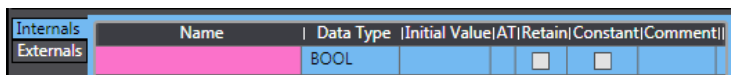


Click on a space to create an entry cell in the *Name* Column on the Internals Side Tab Page.

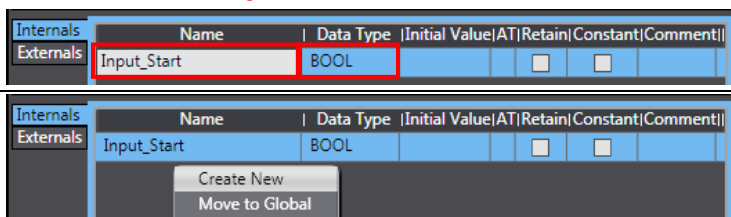


A new variable can be entered.

Enter *Input_Start* in the *Name* Column and *BOOL* in the *Data Type* Column.

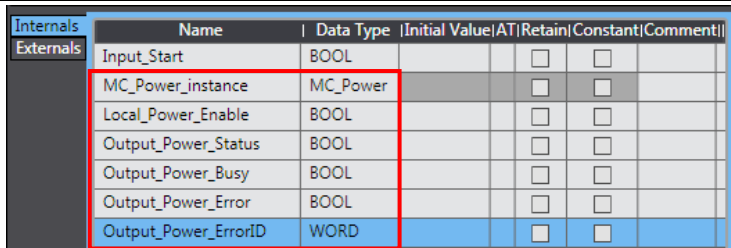


5 After entering, right-click and select **Create New** from the menu.

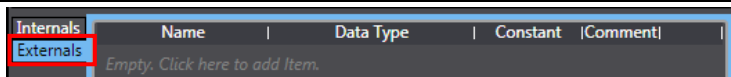


6 In the same way as steps 4 and 5, enter the following data in newly created cells of the columns on the Internals Side Tab Page.

- *MC_Power_instance*: *MC_Power*
- *Local_Power_Enable*: *BOOL*
- *Output_Power_Status*: *BOOL*
- *Output_Power_Busy*: *BOOL*
- *Output_Power_Error*: *BOOL*
- *Output_Power_ErrorID*: *WORD*

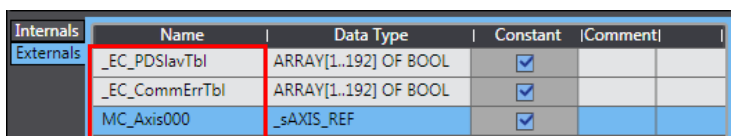


7 Select the **Externals** Side Tab.

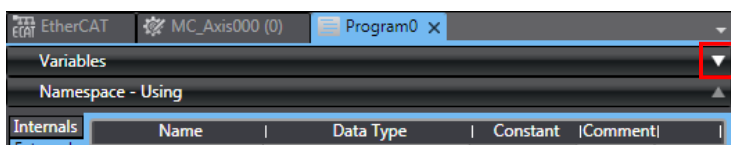


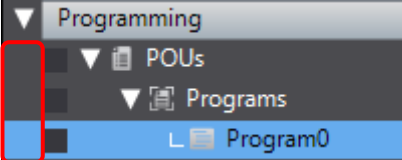
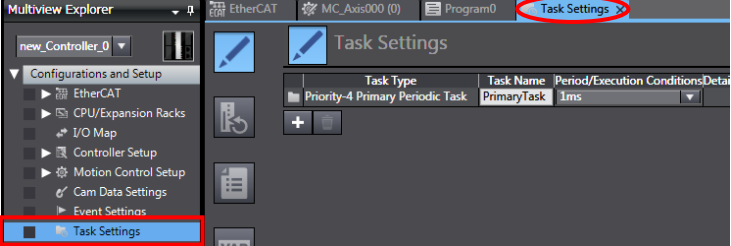
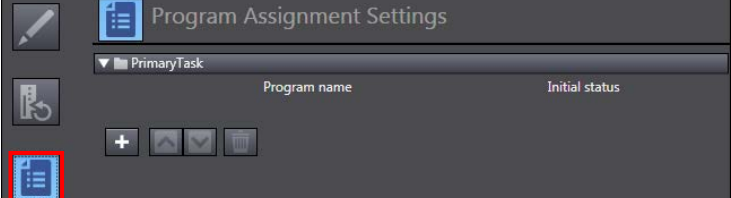
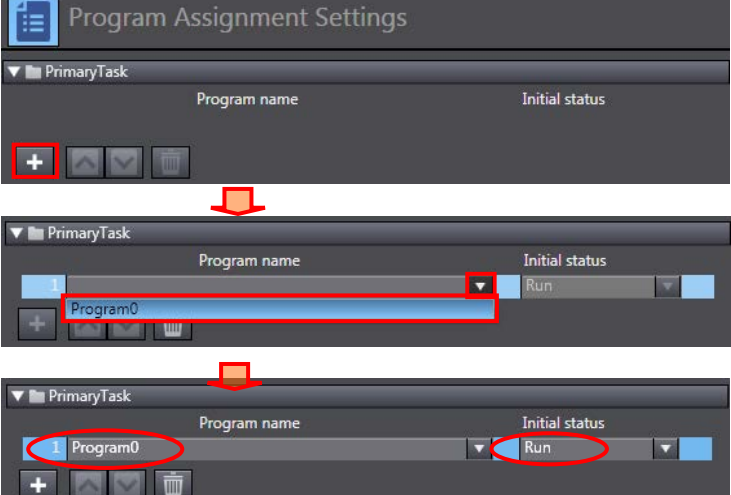
In the same way as steps 4 and 5, enter the following variable names in newly created cells of the *Name* Column on the Externals Side Tab Page. The data types are automatically set.

- *_EC_PDSlavTbl*
- *_EC_CommErrTbl*
- *MC_Axis000*



Click the **Down Arrow** Button of Variables to close the variable table.



<p>8</p>	<p>The programming area on the Program0 Tab Page is displayed again. Write the program with the MC instruction.</p> <p>*For details on how to use MC instructions, refer to the <i>NJ/NX-series Motion Control Instructions Reference Manual</i> (Cat. No. W508).</p> <p>*The program on the right is only given as an example. You must write a program according to the specifications of Motion Control Device. Refer to <i>Section 11. Appendix 3: Program</i> for details on the program shown on the right.</p>	<pre>(* Section 01: Motion Control Device Start/Stop *) IF Input_Start AND _EC_PDSlavTbI[MC_Axis000.Cfg.NodeAddress] AND NOT _EC_CommErrTbI[MC_Axis000.Cfg.NodeAddress] THEN IF NOT MC_Axis000.DrvStatus.ServoOn THEN Local_Power_Enable:= TRUE; END_IF; ELSE Local_Power_Enable:= FALSE; END_IF; (* Section 02: Error Operation *) IF MC_Axis000.MFaultLvl.Active THEN Local_Power_Enable:= FALSE; END_IF; (* Section 03: MC Instruction Execute *) MC_Power_instance(Axis:= MC_Axis000, Enable := Local_Power_Enable, Status => Output_Power_Status, Busy => Output_Power_Busy, Error => Output_Power_Error, ErrorID => Output_Power_ErrorID);</pre>
<p>9</p>	<p>Check that the exclamation marks (warnings) disappear from the Multiview Explorer.</p>	
<p>10</p>	<p>Double-click Task Settings under Configurations and Setup in the Multiview Explorer. The Task Settings Tab Page is displayed in the Edit Pane.</p>	
<p>11</p>	<p>Click the Program Assignment Settings Button.</p>	
<p>12</p>	<p>Click the + Button of Primary Task.</p> <p>An entry cell is displayed in the <i>Program name</i> Column. Select Program0 from the pull-down list.</p> <p>Program0 is set. Check that the initial status is Run.</p>	

7.4.5. Transferring the Project Data

Transfer the created project data to Controller.

WARNING

When you transfer a user program, configuration data, setup data, device variables, or values in memory used for CJ-series Units from Sysmac Studio, the devices or machines may perform unexpected operation regardless of the operating mode of CPU Unit.

Always confirm safety at the destination node before you transfer the project data.



WARNING

If you use EtherCAT slaves, check the specifications of those slaves in manuals or other documentation and confirm that the system will not be adversely affected before you transfer parameters.



Caution

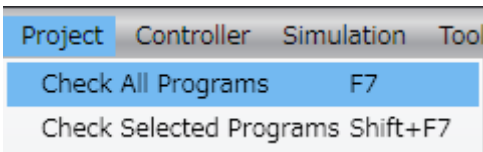
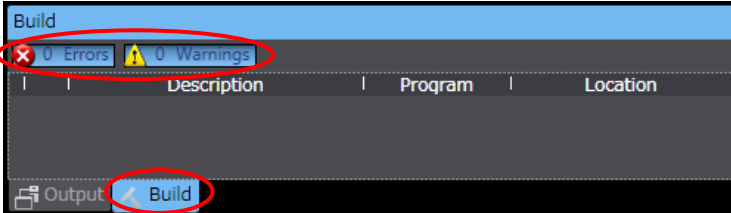
After you transfer the project data, the CPU Unit restarts, and communications with the slave unit is cut off. During the period, the outputs of the slave unit behave according to the slave unit settings. The time that communications is cut off depends on the EtherCAT network configuration.

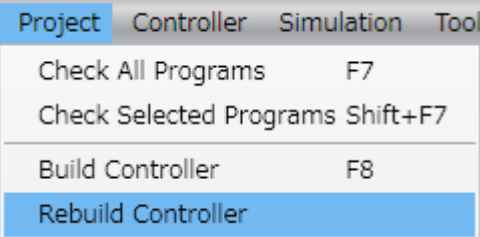
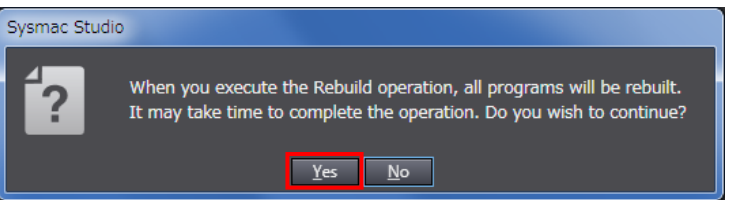
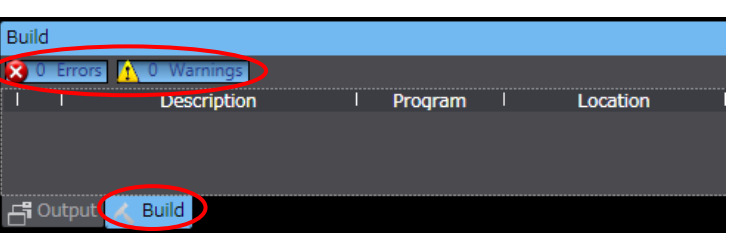
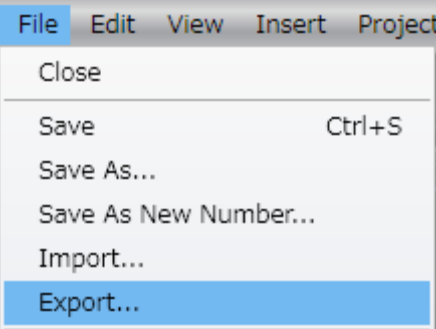
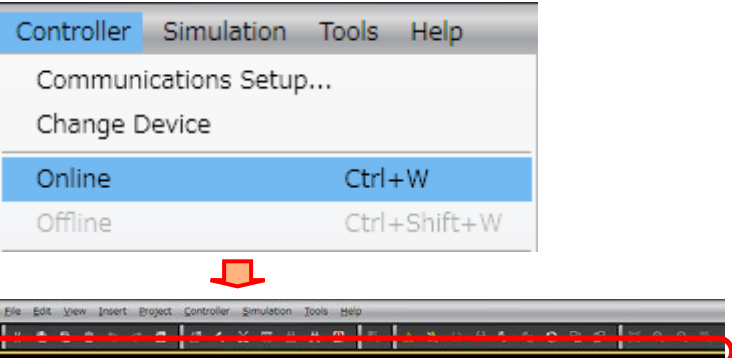
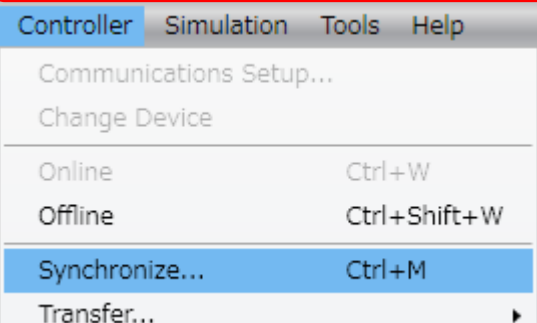
Before you transfer the project data, confirm that the slave unit settings will not adversely affect the device.



Additional Information

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on how to handle errors and warnings occurred as a result of a program check and building.

1	Select Check All Programs from the Project Menu.	
2	The Build Tab Page is displayed. Check that "0 Errors" and "0 Warnings" are displayed.	

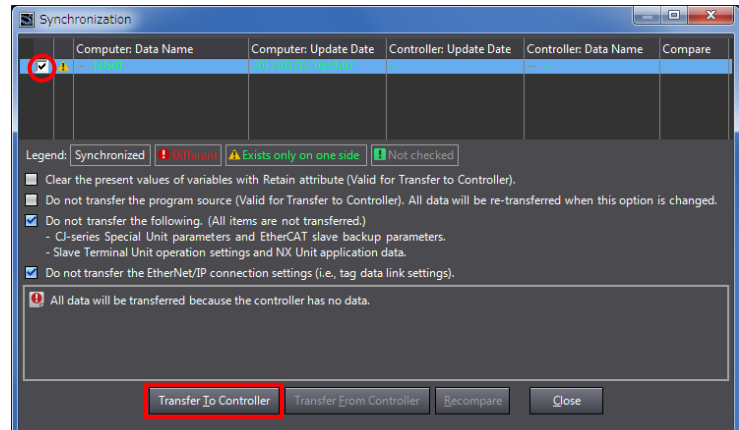
3	<p>Select Rebuild Controller from the Project Menu.</p>	
4	<p>The dialog box on the right is displayed. Confirm that there is no problem, and click Yes.</p>	
5	<p>Check that "0 Errors" and "0 Warnings" are displayed on the Build Tab Page.</p>	
6	<p>Save the created project file if required. Select Export from the File Menu to save it.</p> <p><i>*Refer to Section 9. Appendix 1: Procedure Using the Project File for use of the data you exported.</i></p>	
7	<p>Select Online from the Controller Menu.</p> <p>When an online connection is established, a yellow bar is displayed under the toolbar.</p>	
8	<p>Select Synchronize from the Controller Menu.</p>	

9 The Synchronization Dialog Box is displayed.

Check that the data to transfer (NJ501 shown on the right) is selected.

Click **Transfer To Controller**.

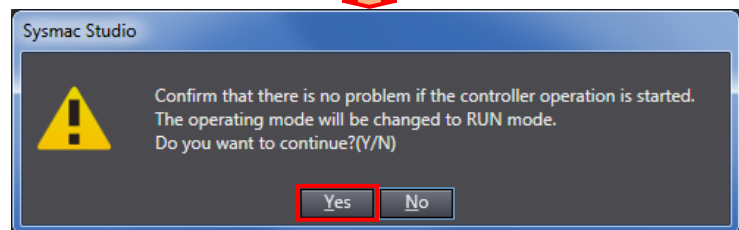
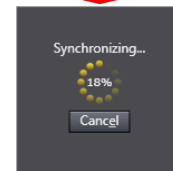
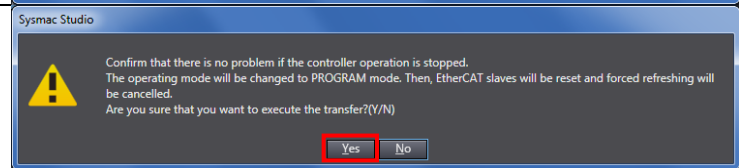
*After executing "Transfer To Controller", the Sysmac Studio data is transferred to Controller, and the data is synchronized.



10 A confirmation dialog box is displayed. Confirm that there is no problem, and click **Yes**.

A screen is displayed stating "Synchronizing".

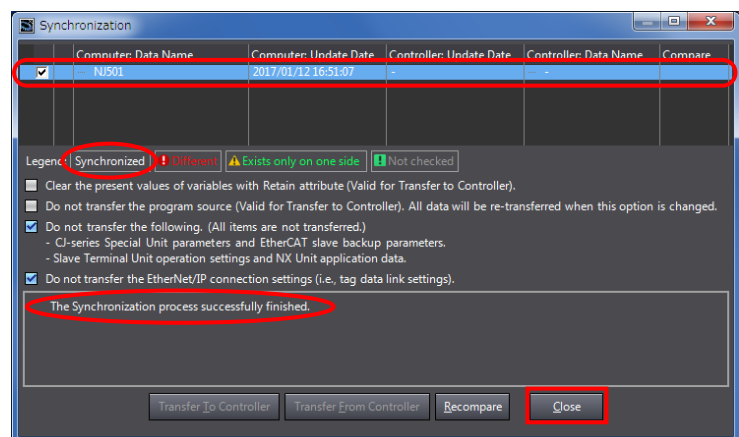
A confirmation dialog box is displayed. Confirm that there is no problem, and click **Yes**.



11 Check that the synchronized data is displayed with the color specified by "Synchronized" and that a message is displayed stating "The synchronization process successfully finished". Confirm that there is no problem, and click **Close**.

*A message is displayed stating "The synchronization process successfully finished" if the Sysmac Studio project data coincides with the Controller data.

*If the synchronization fails, check the wiring and repeat from step 1.



7.5. Connection Status Check

Check the connection status of the EtherCAT network.

7.5.1. Checking the Connection Status

Confirm that EtherCAT communications performs normally.

- 1 Check with LED indicators on Controller that PDO communications via EtherCAT performs normally.

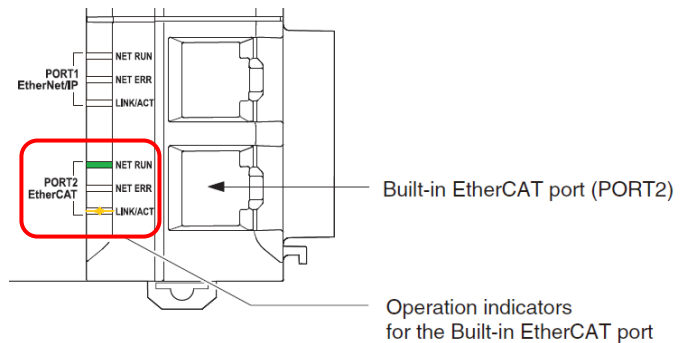
The LED indicators in normal status are as follows:

NET RUN: Green lit

NET ERR: Not lit

LINK/ACT: Yellow flashing

*The NX-series Controllers also have the same LED indicator status.



- 2 Check the LED indicators on Servo Drive.

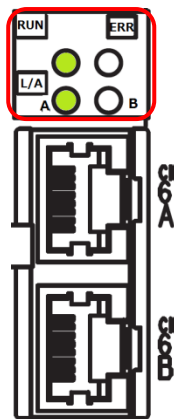
The LED indicators in normal status are shown on the right.

RUN: Green lit

ERR: Not lit

L/A(A): Green flashing

L/A(B): Not lit



7.5.2. Checking the Connection Using the Operation Check Program

Confirm that Servo Drive operates normally using the operation check program.

The MC_Power instruction is used in this program.

Caution

In this procedure, the operation of Motion Control Device is checked, which may perform unexpected operation.

Ensure safety before you proceed with this operation check described here. If you cannot ensure safety, do not proceed.

When you perform this operation check, make sure to complete all the steps and make the output of Servo Drive safe.



Caution

If you change the variable values on a Watch Tab Page when Sysmac Studio is online with CPU Unit, the devices connected to the output unit may operate regardless of the operating mode of CPU Unit.

Always ensure safety before you change the variable values on a Watch Tab Page when Sysmac Studio is online with CPU Unit.



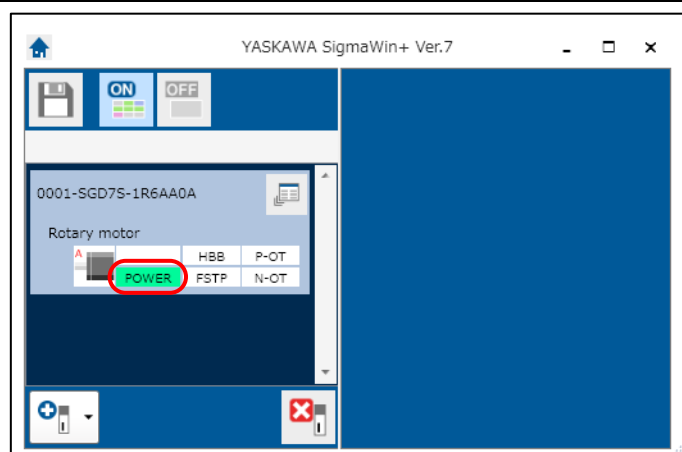
Caution

Please note that some functions of MC Function Module may be "unavailable" or "available but different in behavior from OMRON Motion Control Devices" due to the different specifications between non-OMRON and OMRON Motion Control Devices. Make sure to check *Section 8. Restrictions on Motion Control* in this guide when you design a system.



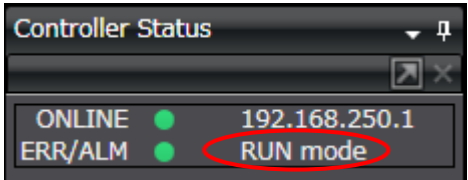
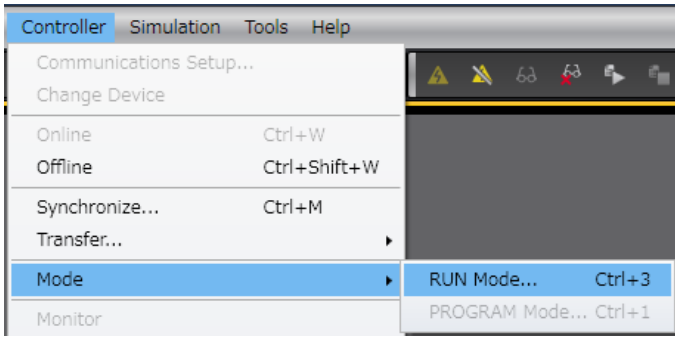
- 1 Start SigmaWin+ online and check that the status in Servo Information Display shows "POWER" (Servo OFF status).

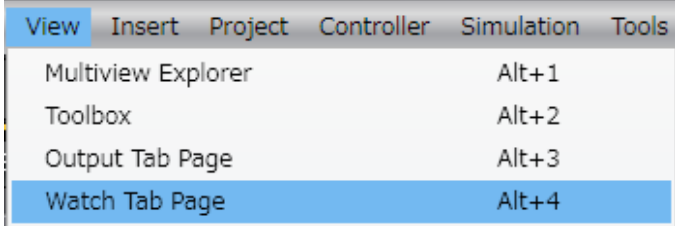
*For information on how to start SigmaWin+, refer to *steps 2 to 5* in *7.3.2. Parameter Settings*.

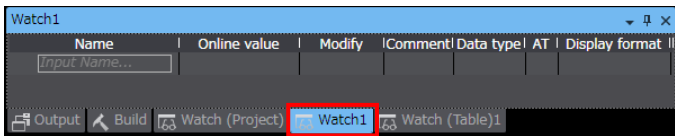


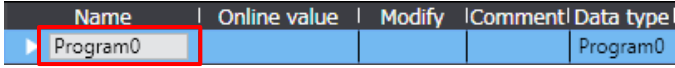
- 2 Check that the operating mode of Controller displayed in the Controller Status Pane of Sysmac Studio changes to RUN mode.

If not in RUN mode, select **Mode - RUN Mode** from the Controller Menu to change it to RUN mode.

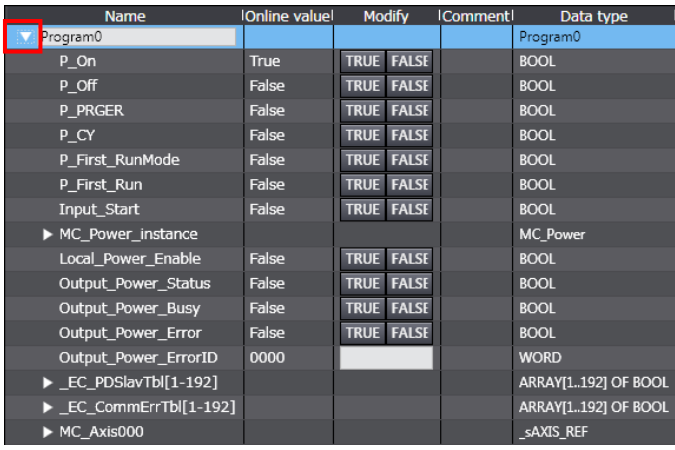


- 3 Select **Watch Tab Page** from the View Menu.


- 4 Select the **Watch1** Tab.

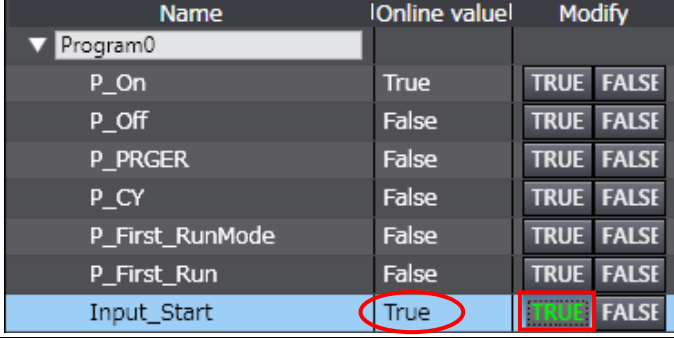

- 5 Enter *Program0* in the Name Column.


- 6 Click the **Down Arrow** Button to the left of Program0. The variables used in Program0 are displayed.

*The order of parameters changes depending on the operating environment.


- 7 Click **TRUE** in the *Modify* Column for *Input_Start*. The online value changes from False to True.

*The MC_Power instruction executes.



- 8 Check that the online value of each variable is as follows:

Local_Power_Enable: True

(Indicates the instruction is ready for execution.)

Output_Power_Status: True

(Indicates Servo Drive is ready for operation.)

Output_Power_Busy: True

(Indicates the instruction is executing.)

Output_Power_Error: False

(Indicates there is no error.)

Output_Power_ErrorID: 0000

(Indicates there is no error.)

*They indicate that the MC_Power instruction is operating normally.

Name	Online value	Modify	
▼ Program0			
P_On	True	TRUE	FALSE
P_Off	False	TRUE	FALSE
P_PRGER	False	TRUE	FALSE
P_CY	False	TRUE	FALSE
P_First_RunMode	False	TRUE	FALSE
P_First_Run	False	TRUE	FALSE
Input_Start	True	TRUE	FALSE
▶ MC_Power_instance			
Local_Power_Enable	True	TRUE	FALSE
Output_Power_Status	True	TRUE	FALSE
Output_Power_Busy	True	TRUE	FALSE
Output_Power_Error	False	TRUE	FALSE
Output_Power_ErrorID	0000		

- 9 Click the **Down Arrow** Button to the left of *MC_Axis000*.

DrvStatus is displayed.

Likewise, click the **Down Arrow** Button to the left of *DrvStatus*.

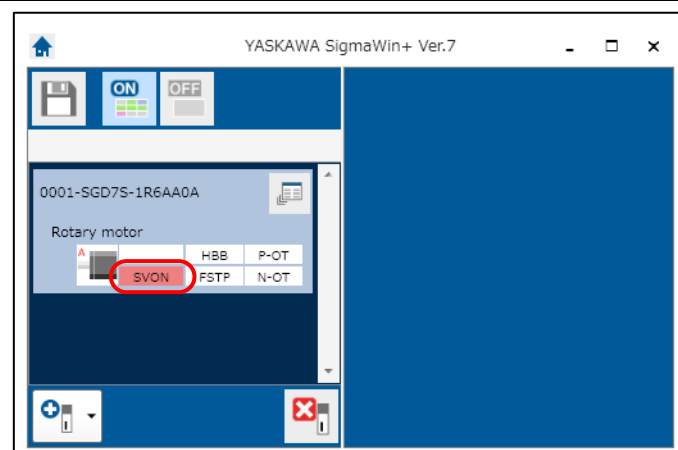
Name	Online value	Modify	
▼ MC_Axis000			
▶ Cfg			
▶ Scale			
▶ Status			
▶ Details			
▶ Dir			
▶ DrvStatus			
▶ Cmd			
▶ Act			
▶ MFaultLvl			
▶ Obsr			
▶ Reserved[0-255]			

- 10 Check that *ServoOn* is True.

*This indicates that the motor is energized.

Name	Online value	Modify	
▼ DrvStatus			
ServoOn	True	TRUE	FALSE
Ready	True	TRUE	FALSE
MainPower	True	TRUE	FALSE
P_OT	False	TRUE	FALSE

- 11 In SigmaWin+, check that the status in Servo Information Display shows "SVON" (Servo ON status).



- 12 Click **FALSE** in the *Modify* Column for *Input_Start* on the Watch1 Tab Page of Sysmac Studio.
- The online value changes from True to False.

*The MC_Power instruction ends.

Name	Online value	Modify	
▼ Program0			
P_On	True	TRUE	FALSE
P_Off	False	TRUE	FALSE
P_PRGER	False	TRUE	FALSE
P_CY	False	TRUE	FALSE
P_First_RunMode	False	TRUE	FALSE
P_First_Run	False	TRUE	FALSE
Input_Start	False	TRUE	FALSE

- 13 Check that the online value of each variable is as follows:

Local_Power_Enable: False

(Indicates the instruction is not executed.)

Output_Power_Status: False

(Indicates Servo Drive is not ready for operation.)

Output_Power_Busy: False

(Indicates the instruction is ready to execute.)

Output_Power_Error: False

(Indicates there is no error.)

Output_Power_ErrorID: 0000

(Indicates there is no error.)

*They indicate that the MC_Power instruction ended normally.

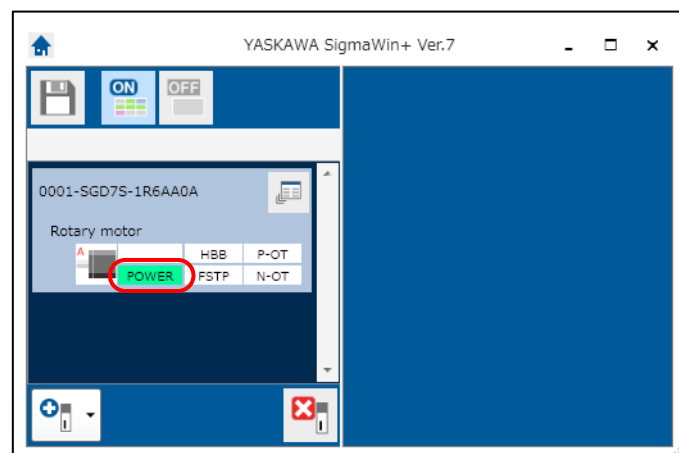
Name	Online value	Modify	
▼ Program0			
P_On	True	TRUE	FALSE
P_Off	False	TRUE	FALSE
P_PRGER	False	TRUE	FALSE
P_CY	False	TRUE	FALSE
P_First_RunMode	False	TRUE	FALSE
P_First_Run	False	TRUE	FALSE
Input_Start	False	TRUE	FALSE
▶ MC_Power_instance			
Local_Power_Enable	False	TRUE	FALSE
Output_Power_Status	False	TRUE	FALSE
Output_Power_Busy	False	TRUE	FALSE
Output_Power_Error	False	TRUE	FALSE
Output_Power_ErrorID	0000		

- 14 Check that 'MC_Axis000.DrvStatus.ServoOn' is False.

*This indicates that the motor is not energized.

Name	Online value	Modify	
▼ DrvStatus			
ServoOn	False	TRUE	FALSE
Ready	True	TRUE	FALSE
MainPower	True	TRUE	FALSE
P_OT	False	TRUE	FALSE

- 15 In SigmaWin+, check that the status in Servo Information Display shows "POWER" (Servo OFF status).



8. Restrictions on Motion Control

This section explains restrictions on when Servo Drive that is connected to Controller via EtherCAT is used as a motion control axis for MC Function Module of Controller.

Caution

Some functions of MC Function Module may be "unavailable" or "available but different in behavior from OMRON Motion Control Devices" due to the different specifications between non-OMRON and OMRON Motion Control Devices. These functions may cause unexpected operation of Motion Control Device, resulting in injury. Carefully check the differences before using the functions that are different in behavior from OMRON Motion Control Devices. Do not use the functions that are unavailable.



Additional Information

For NX1P2 Controllers, Servo Drive can be used as a single-axis position control axis. For information on the difference between the single-axis position control axis and the motion control axis, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

8.1. List of Restrictions

The following table shows restrictions on when you use Servo Drive connected to Controller.

Item	Restriction	Function with restriction and its status	Details
Axis Variables	Different in function	DrvStatus.ILA (Drive Internal Limiting) The condition to change to TRUE depends on specifications of Motion Control Device defined by a manufacturer.	Refer to 8.2.
	Unavailable	DrvStatus.Home (Home Input) This axis variable cannot be used when you set Z-phase as the home input signal in the setting of Homing Operation Mode. *The Z-phase is equivalent to the phase C of Σ -7-series.	
	Unavailable	DrvStatus.lmdStop (Immediate Stop Input) This axis variable cannot be used.	
MC Instructions	Unavailable	No Home Proximity Input/Holding Home Input for MC_Home or MC_HomeWithParameter "No home proximity input/holding home input" for the MC_Home or MC_HomeWithParameter instruction cannot be used when you set Z-phase as the home input signal in the setting of Homing Operation Mode.	Refer to 8.3.
	Unavailable	Automatic Torque Limit Function of MC_Home or MC_HomeWithParameter The automatic torque limit function of these MC instructions cannot be used.	
	Unavailable	Velocity Limit Function of MC_TorqueControl The velocity limit function of this MC instruction cannot be used.	
Others	Different in operation	Stop Processing during Torque Control When you perform a deceleration stop or an immediate stop that is triggered by the MC_Stop instruction or by an error during torque control CST (MC_TorqueControl instruction in execution), the deceleration stop or the immediate stop is performed differently from that of OMRON Motion Control Devices.	Refer to 8.4.
	Unavailable	Immediate Stop Function Using Immediate Stop Input Signal This function cannot be used.	
	Unavailable	MC Test Run This function cannot be used.	

8.2. Axis Variables

The following explains the restrictions on axis variables.

8.2.1. DrvStatus.ILA (Drive Internal Limiting)

The condition for DrvStatus.ILA to change to TRUE depends on specifications of Motion Control Device defined by a manufacturer.

For information on the operating condition for this axis variable, refer to *Statusword (6041 Hex) - Details on Bit 11 in 14.6 Device Control of the Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual (SIEP S800001 55)*.

8.2.2. DrvStatus.Home (Home Input)

The DrvStatus.Home cannot be used when you set Z-phase as the home input signal in the setting of Homing Operation Mode.

Since Servo Drive does not support the signal that monitors the ON/OFF status of Z-phase using PDO communications, the value of this axis variable is always FALSE.

8.2.3. DrvStatus.ImdStop (Immediate Stop Input)

DrvStatus.ImdStop cannot be used.

Since Servo Drive does not support the object that notifies Controller of an immediate stop of Servo Drive using PDO communications, the value of this axis variable is always FALSE.

8.3. MC Instructions

The following explains the restrictions on MC instructions.

8.3.1. No Home Proximity Input/Holding Home Input for MC_Home or MC_HomeWithParameter

If you set Z-phase as the home input signal in the setting of Homing Operation Mode "No home proximity input/holding home input" for the MC_Home or MC_HomeWithParameter instruction, you need the object that monitors the ON/OFF status of Z-phase using PDO communications.

However, since Servo Drive does not support this object, you cannot set the Z-phase in the setting of this Homing Operation Mode.



Additional Information

In other Homing Operation Modes except for "No home proximity input/holding home input", the ON/OFF status of Z-phase does not need to be monitored and hence you can set Z-phase as the home input signal.

8.3.2. Automatic Torque Limit Function of MC_Home or MC_HomeWithParameter

The automatic torque limit function of the MC_Home or MC_HomeWithParameter instruction is unique to OMRON products. This function cannot be used for non-OMRON Motion Control Devices.



Additional Information

When you perform the torque limit with the MC_Home or MC_HomeWithParameter instruction using a non-OMRON Motion Control Device, use the MC_SetTorqueLimit instruction instead, or if a motion control device has a function to perform the torque limit, create a program to activate the function using SDO communications.

8.3.3. Velocity Limit Function of MC_TorqueControl

The velocity limit function (velocity parameter) of the MC_TorqueControl instruction performs according to the unique specifications of OMRON products. This function cannot be used for non-OMRON Motion Control Devices.



Additional Information

When you perform the velocity limit with the MC_TorqueControl instruction using a non-OMRON Motion Control Device, monitor the command current velocity or the actual current velocity in the axis variable. In case that the velocity is high, create a program that corrects the target torque.

8.4. Others

The following explains the other restrictions.

8.4.1. Stop Processing during Torque Control

When you use a Non-OMRON Motion Control Device and perform a deceleration stop or an immediate stop that is triggered by the MC_Stop instruction or by an error during torque control CST (MC_TorqueControl instruction in execution), the deceleration stop or the immediate stop is performed differently from that of OMRON Motion Control Devices.

Motion Control Device	Stop Processing in CST mode
Non-OMRON	<ul style="list-style-type: none"> • The mode is changed into the CSP mode. • At start point of feedback position where a servo is shifted to the CSP mode, outputs the command position that allows the velocity to change to 0 according to the current velocity and the given deceleration rate. • Decelerates to a stop at the given deceleration rate.
OMRON	<ul style="list-style-type: none"> • Changes the velocity limit value immediately to 0. • After the velocity limit value is changed to 0, MC Function Module confirms that the feedback position is entered the stop condition. • After the confirmation, the CST mode is changed into the CSP mode. • Performs an immediate stop.

8.4.2. Immediate Stop Function Using Immediate Stop Input Signal

The Servo Drive does not support the object that notifies Controller of an immediate stop of Servo Drive using PDO communications; therefore, Controller cannot determine whether or not the instruction being executed needs to be stopped immediately. As such, Controller cannot execute the immediate stop function for the instruction being executed.

8.4.3. MC Test Run

The MC test run is a dedicated function of Sysmac Studio for OMRON Motion Control Devices. This function cannot be used for non-OMRON Motion Control Devices.

9. Appendix 1: Procedure Using the Project File

This section describes the procedures when using the following project file or the project file you exported in 7.4. *Controller Setup*.

Obtain the project file with a latest version from OMRON Corporation.

The project file listed below has been created for NJ-series Controllers.

If you use NX-series Controller, change the device information in Sysmac Studio.

Name	File name	Version
Sysmac Studio project file (extension: csm2)	P627_NJ_ECAT_Yaskawa_SGD7 S_V101.csm2	Ver.1.01

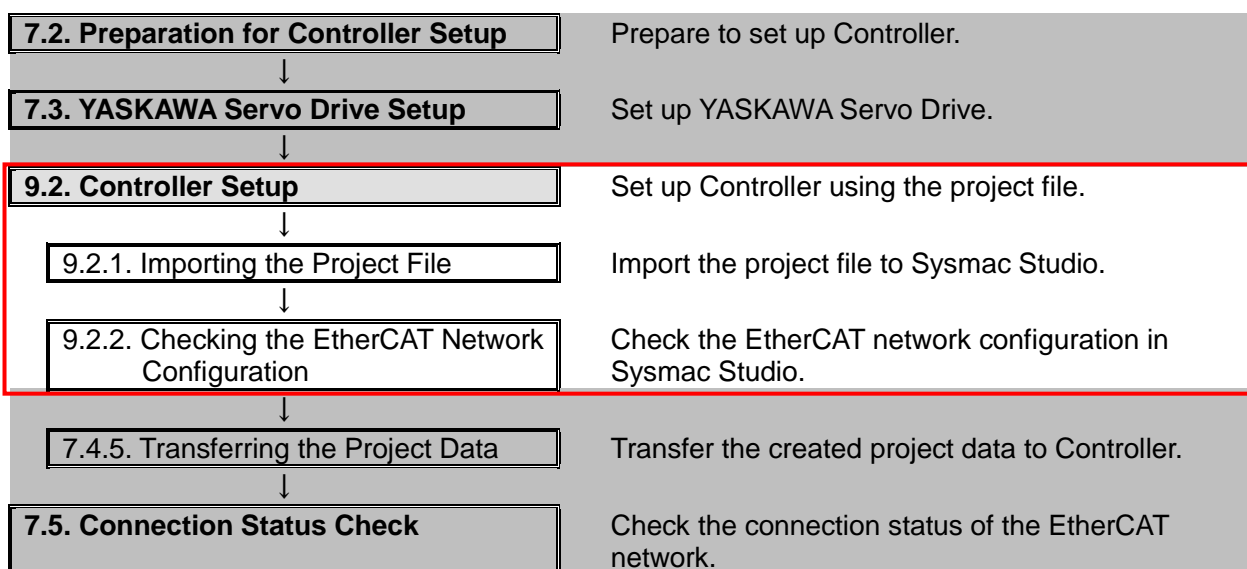
The following table lists references for the settings made in the project file.

Item	Reference
Communications parameter settings	6.1. Parameters
How to set the communications parameters	7.4. Controller Setup
Relationship between PDO entries and MC instructions	10.Appendix 2: MC Instructions and PDO Entries
Details on the operation check program	11.Appendix 3: Program

9.1. Work Flow

Take the following steps to connect to EtherCAT using the project file.

Refer back to each of the following procedures for details except for 9.2. *Controller Setup* marked with a red square.



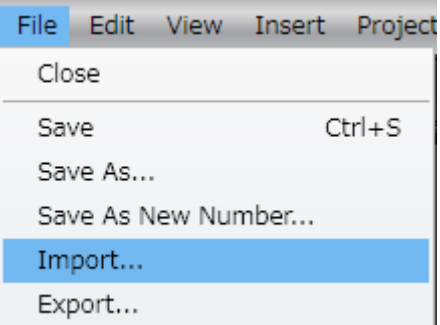
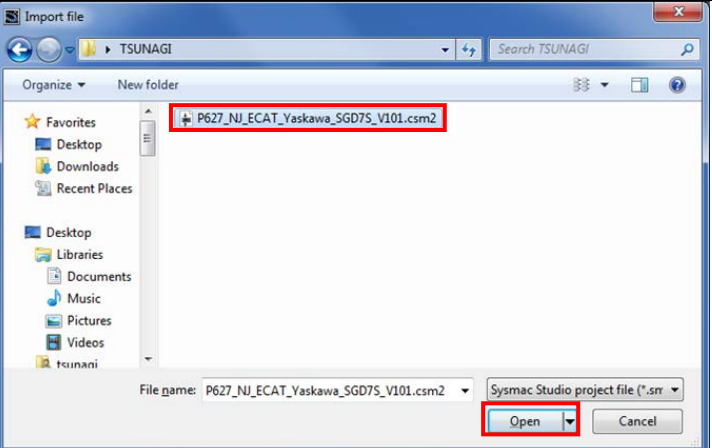
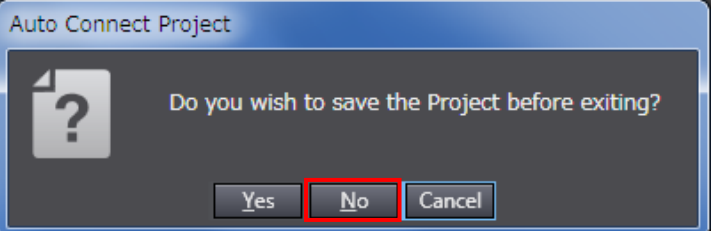
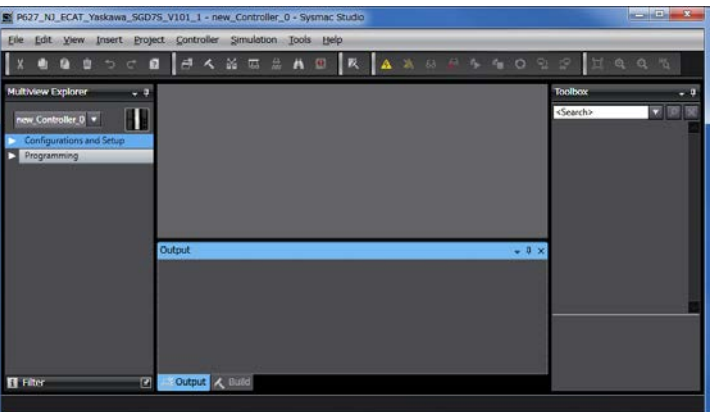
9.2. Controller Setup

Set up Controller using the project file.

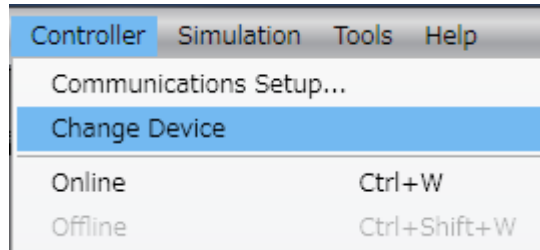
Perform 7.2. *Preparation for Controller Setup* and 7.3. *YASKAWA Servo Drive Setup* before following the steps.

9.2.1. Importing the Project File

Import the project file to Sysmac Studio.

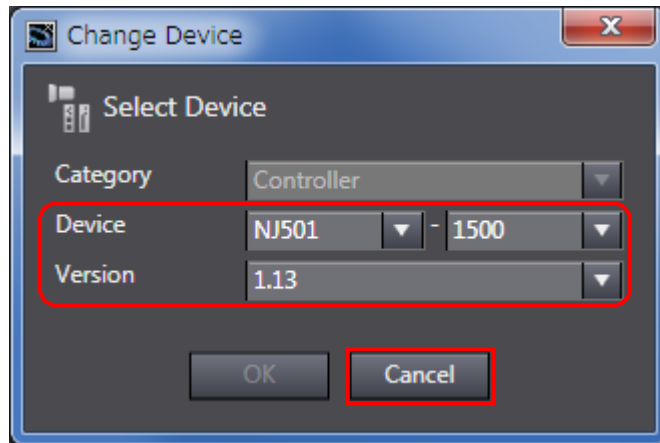
1	Select Import from the File Menu.	
2	<p>The Import file Dialog Box is displayed.</p> <p>Select P627_NJ_ECAT_Yaskawa_SGD7S_V101.csm2 (project file) or the project file you exported in 7.4. <i>Controller Setup</i>. Click Open.</p> <p>*Obtain the project file from OMRON.</p>	
3	<p>The Auto Connect Project Dialog Box is displayed.</p> <p>Check the contents and click No.</p>	
4	<p>The P627_NJ_ECAT_Yaskawa_SGD7S_V101 project is displayed.</p> <p>*If an error message is displayed stating "Failed to Load Descendants", change the version of Sysmac Studio to the version specified in 5.2. <i>Device Configuration</i> or to a higher version.</p>	

- 5 Select **Change Device** from the Controller Menu.



- 6 The Change Device Dialog Box is displayed.
Check that the *Device* and *Version* Fields are set as shown on the right.

Click **Cancel**.

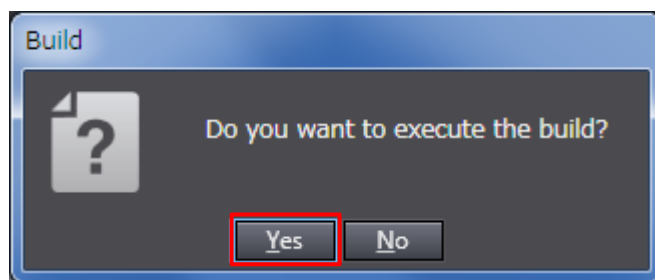


*If the settings are different, select the setting items from the pull-down list, and click **OK**.

*For NX-series Controllers, the settings and the range of supported values vary depending on the Controller model.
Refer to *A-10 Changing models among NJ-, NX-, and NY-series Controllers* in *Appendices of the Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for details.

*if you use NX1P2 Controller with this project file, the task period of primary periodic task changes from 1ms to 2ms.

- 7 If you change the settings in step 6, the Build Dialog Box is displayed. Check the contents and click **Yes**.





Precautions for Correct Use

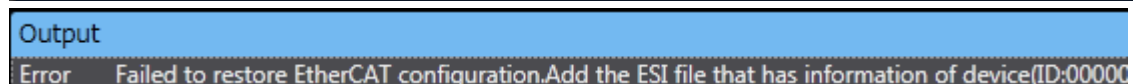
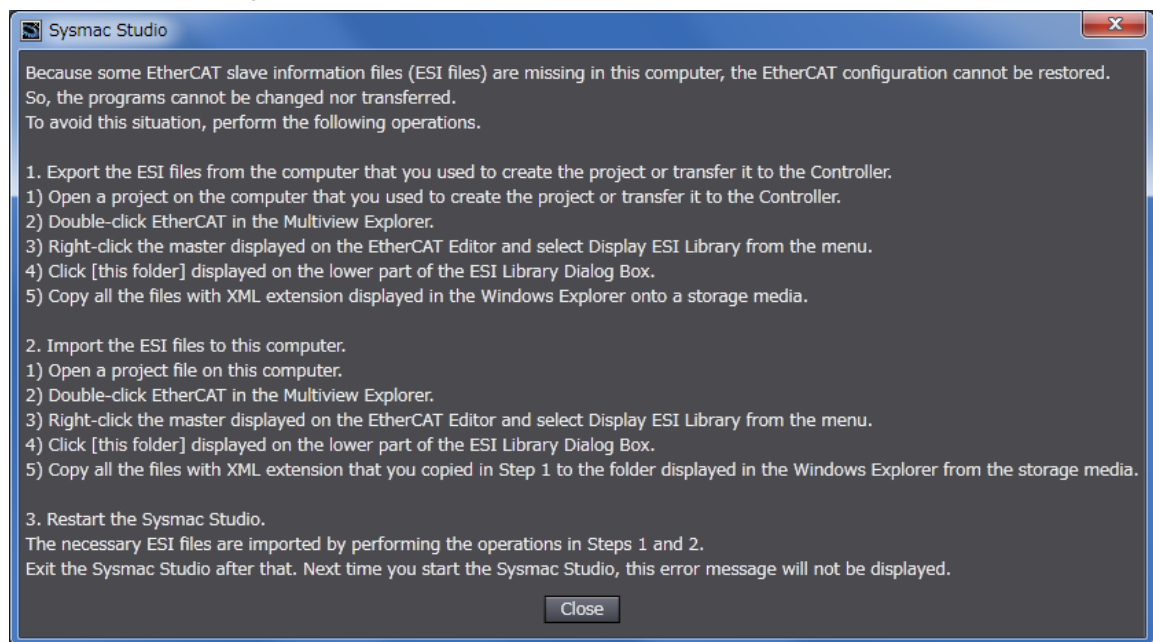
If an error occurs, refer to the troubleshooting tips below.

The following screenshots are given only for explanation purposes. The data in the screenshots are different from that obtained with the applicable devices listed in this guide.

■Error 1 (Project file error)

If the following error dialog box and the error message on the Output Tab Page are displayed, the project and ESI files used are not correct. Prepare the project file exported from Sysmac Studio with the version specified in 5.2. *Device Configuration*.

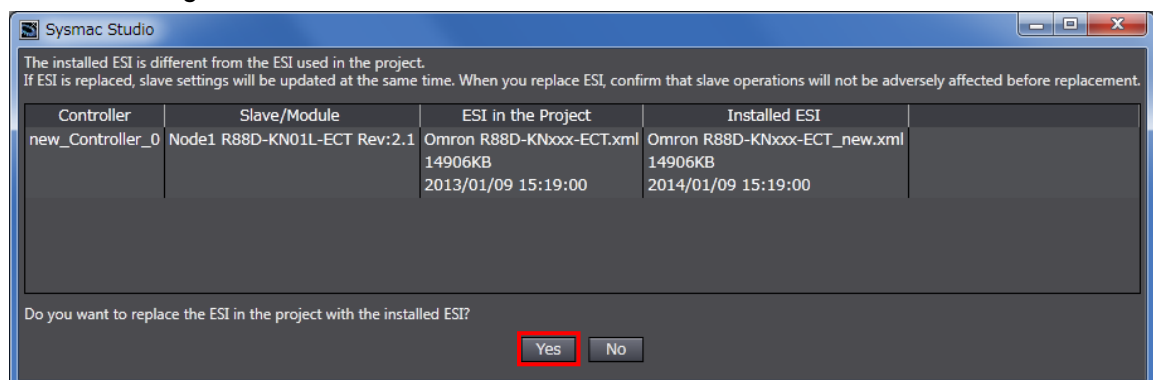
In addition, obtain a correct ESI file from the device manufacturer and repeat the procedures from 7.2.3. *Installing the ESI File*.



■Error 2 (ESI file error)

If the following dialog box is displayed, the ESI file specified in 5.2. *Device Configuration* is not installed. If the ESI file used is correct, click **Yes** and proceed to the next step.

If not, obtain a correct ESI file from the device manufacturer and repeat the procedures from 7.2.3. *Installing the ESI File*.



9.2.2. Checking the EtherCAT Network Configuration

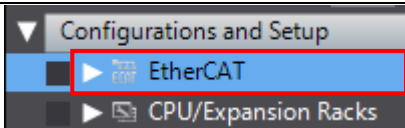
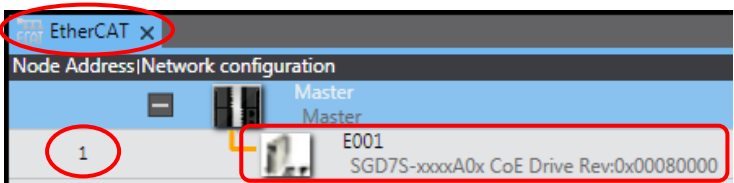
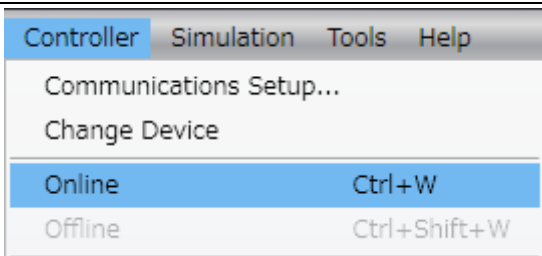
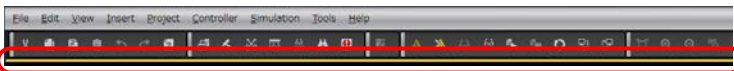
Check the EtherCAT network configuration in Sysmac Studio.

Perform the following steps, and then follow 7.4.5. *Transferring the Project Data* and 7.5. *Connection Status Check*.

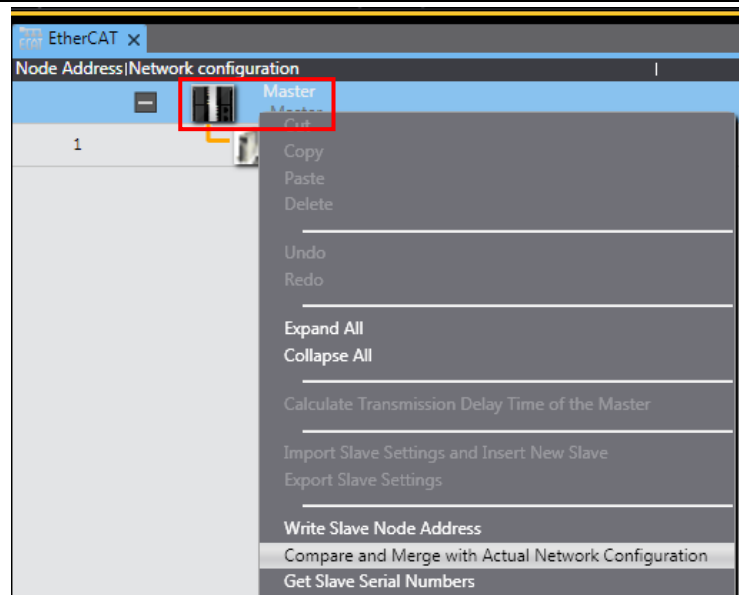


Precautions for Correct Use

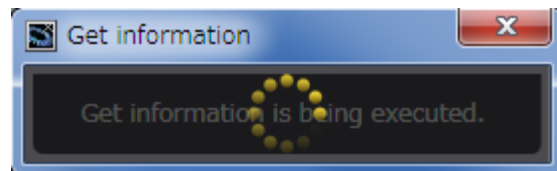
Check that the Ethernet cable is connected to both devices before performing the following procedure. If not, turn OFF the devices, and then connect the Ethernet cable.

1	Turn ON Controller.	
2	Double-click EtherCAT under Configurations and Setup in the Multiview Explorer.	
3	The EtherCAT Tab Page is displayed in the Edit Pane. As a node address 1 slave, E001 SGD7S-xxxxA0x CoE Drive Rev:0x00080000 is displayed.	
4	Select Online from the Controller Menu.	
5	Sysmac Studio goes online.	

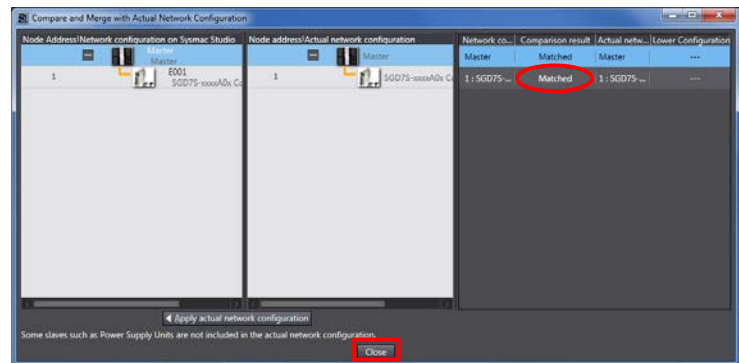
- 6 Right-click **Master** on the EtherCAT Tab Page and select **Compare and Merge with Actual Network Configuration**.



A screen is displayed stating "Get information is being executed".

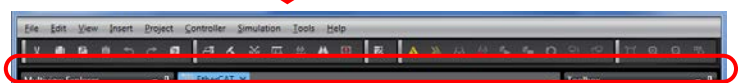
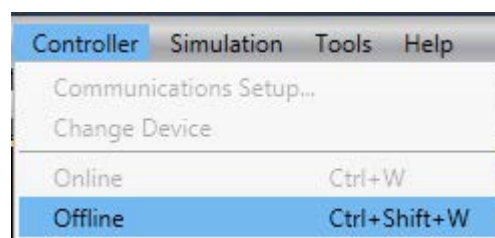


- 7 The Compare and Merge with Actual Network Configuration Dialog Box is displayed. Check that the comparison result is "Matched". Click **Close** to close the dialog box.



*If "Matched" is not displayed as the comparison result, follow the Precautions for Correct Use on the next page.

- 8 Select **Offline** from the Controller Menu. Check that the yellow bar under the toolbar disappears.





Precautions for Correct Use

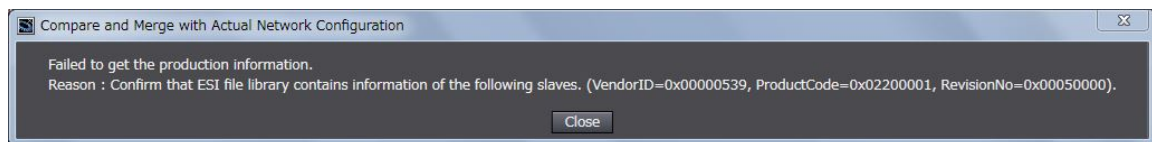
If "Matched" is not displayed as the comparison result, do not click the Apply actual network configuration Button in the Compare and Merge with Actual Network Configuration Dialog Box.

If you click the button, the settings including PDO map settings and axis settings in the project file will be cleared (initialized). If you accidentally click the button, repeat the procedures from 9.2.1. *Importing the Project File*. The following screenshots are given only for explanation purposes. The data in the screenshots are different from that obtained with the applicable devices listed in this guide.

If an error occurs, refer to the troubleshooting tips below.

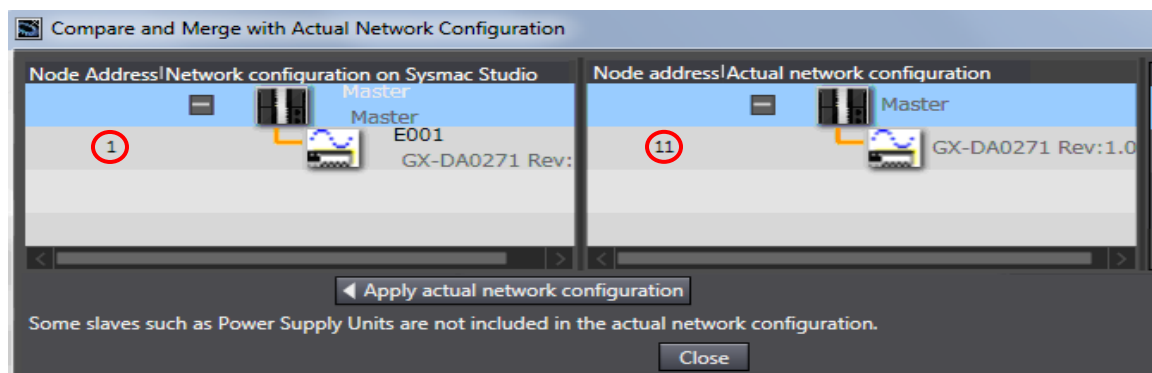
■Error 1 (ESI file error)

If the following dialog box is displayed, a correct ESI file for Motion Control Device is not installed. Obtain a correct ESI file from the device manufacturer and repeat the procedures from 7.2.3. *Installing the ESI File*.



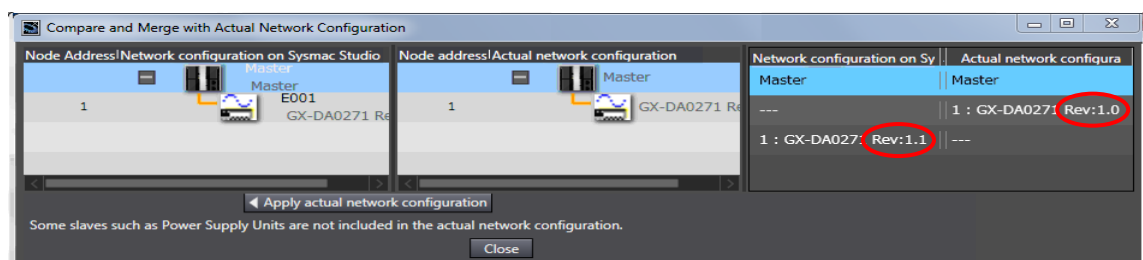
■Error 2 (Node address mismatch)

When the node addresses do not match as shown below, repeat the procedures from 7.3. *YASKAWA Servo Drive Setup*.



■Error 3 (Revision mismatch)

When the revisions do not match as shown below, contact the device manufacturer to see if the ESI file is correct for Motion Control Device. Or, prepare the device with the same revision as the ESI file and repeat the procedures from 7.2.3. *Installing the ESI File*.



10. Appendix 2: MC Instructions and PDO Entries

The objects (PDO entries) that can be used for MC instructions are assigned to axis variables in the project file used in this guide.

Some objects are neither required to be assigned to axis variables nor mapped to PDOs, depending on the MC instructions.

Refer to this section if you change the project file.

Caution

For PDO entries that are not assigned to the process data, the PDO communications is performed using unspecified values. This may cause unexpected operation of Motion Control Device, resulting in injury. Make sure that all the PDO entries listed in 6.1.2. *PDO Mappings* are assigned to the process data listed in 6.1.5. *Axis Settings for PDO Entries*.



Additional Information

For details on PDO mappings and information on MC instructions and parameter settings for motion control, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507) and the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508)

10.1. Required Objects for MC Instructions

To use the MC instructions, the following objects must be mapped to PDOs and assigned to axis variables. If any of the required objects are not set, an error "Required Process Data Object Not Set" (error code 3460 hex) occurs.

Input/Output	Function name of axis variable	Index	PDO entry name
Output	1.Controlword	0x6040	Control word
	3.Target position	0x607A	Target position
Input	22.Statusword	0x6041	Status word
	23.Position actual value	0x6064	Position actual value



Additional Information

If you use CPU Unit version 1.09 or earlier, "Modes of operation (6060 hex)" and "Modes of operation display (6061 hex)" are required to be set.

If you use CPU Unit version 1.10 or higher, the operation differs depending on whether or not "Modes of operation" (6060 hex) or "Modes of operation display" (6061 hex) is mapped.

Refer to the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508) for details.

10.2. Required Objects for Specific MC Instructions

If you use the following MC instructions, the required objects must be mapped to PDOs and be assigned to axis variables.

[Output setting]

MC instruction	Function name of axis variable	5.Target velocity	7.Target torque	21.Touch probe function (Latch function)	15.Forward torque limit	16.Reverse torque limit
	Index	0x60FF	0x6071	0x60B8	0x60E0	0x60E1
	PDO entry name	Target velocity	Target torque	Touch probe function	Positive torque limit value	Negative torque limit value
MC_Home				Conditionally required ^{*1}		
MC_HomeWithParameter				Conditionally required ^{*2}		
MC_MoveFeed				Conditionally required ^{*3}		
MC_MoveLink				Conditionally required ^{*3}		
MC_TorqueControl			Required			
MC_SetTorqueLimit					Required	Required
MC_TouchProbe				Conditionally required ^{*2}		
MC_SyncMoveVelocity			Required			

*1. Setting is required when Homing Operation Mode is not "Limit inputs only", "Proximity reverse turn/holding time", or "Zero position preset".

*2. Setting is required when Mode is set to Drive Mode.

*3. Setting is required when LinkOption (Synchronization Start Condition) is set to _mcTriggerDetection and Mode is set to Drive Mode.

[Input setting]

MC instruction	Function name of axis variable	25.Torque actual value	40.Touch probe status (Latch status)	41.Touch probe pos1 pos value	42.Touch probe pos2 pos value	Digital inputs
	Index	0x6077	0x60B9	0x60BA	0x60BC	0x60FD
	PDO entry name	Torque actual value	Touch probe status	Touch probe pos1 pos value	Touch probe pos2 pos value	Digital inputs
MC_Home			Conditionally required ^{*1}	Conditionally required ^{*1}		Conditionally required ^{*2}
MC_HomeWithParameter			Conditionally required ^{*3}	Conditionally required ^{*4}	Conditionally required ^{*5}	
MC_MoveFeed			Conditionally required ^{*6}	Conditionally required ^{*7}	Conditionally required ^{*8}	
MC_MoveLink			Conditionally required ^{*6}	Conditionally required ^{*7}	Conditionally required ^{*8}	
MC_TorqueControl			Required			
MC_TouchProbe			Conditionally required ^{*3}	Conditionally required ^{*4}	Conditionally required ^{*5}	

*1. Setting is required when Homing Operation Mode is not "Limit inputs only", "Proximity reverse turn/holding time", or "Zero position preset".

*2. Setting is required when Homing Operation Mode is not "Zero Position Preset".

*3. Setting is required when Mode is set to Drive Mode.

*4. Setting is required when Mode is set to Drive Mode and LatchID is set to _mcLatch1 (Latch 1).

*5. Setting is required when Mode is set to Drive Mode and LatchID is set to _mcLatch2 (Latch 2).

*6. Setting is required when LinkOption (Synchronization Start Condition) is set to _mcTriggerDetection and Mode is set to Drive Mode.

*7. Setting is required when LinkOption (Synchronization Start Condition) is set to _mcTriggerDetection, Mode is set to Drive Mode, and LatchID is set to _mcLatch1 (Latch 1).

*8. Setting is required when LinkOption (Synchronization Start Condition) is set to _mcTriggerDetection, Mode is set to Drive Mode, and LatchID is set to _mcLatch2 (Latch 2).

10.3. Digital Input Assignment

The following table describes the assignment of digital input objects to axis variables.

Please note that the assignment of the objects varies depending on the specifications of Motion Control Device.

For your reference, the table below shows an example of an assignment using OMRON G5 series Servo Drive.

For details on each function, refer to the *AC SERVOMOTORS/SERVO DRIVES G5-series WITH BUILT-IN EtherCAT(R) COMMUNICATIONS User's Manual* (Cat. No. I576).

Function name of axis variable	G5 series assignment (60FDh-00:Digital inputs)	Description	Assignment in this guide
28.Forward Drive Prohibition Input	60FDh-00bit1:Positive limit switch	This signal is used for the positive limit input.	60FDh-00.17
29.Reverse Drive Prohibition Input	60FDh-00bit 0:Negative limit switch	This signal is used for the negative limit input.	60FDh-00.18
30.Immediate Stop Input	60FDh-00bit 25:Immediate Stop Input	This signal is used for the immediate stop input.	Not assigned
32.Encoder Phase Z Detection	60FDh-00bit 16:Encoder Phase Z Detection	Shows the status of the signal that is used for checking the detection of Z-phase input.	Not assigned
33.Home Proximity Input	60FDh-00bit 2:Home switch	This signal is used for the home proximity input.	60FDh-00.22
37.External Latch Input 1	60FDh-00bit 17:External Latch Input 1	Shows the status of the signal that is used for the external latch input 1.	60FDh-00.20
38.External Latch Input 2	60FDh-00bit 18:External Latch Input 2	Shows the status of the signal that is used for the external latch input 2.	60FDh-00.21

11. Appendix 3: Program

This section explains the operation check program used in this guide.

11.1. Motion Control Instruction

The following explains the MC instruction used in the operation check program.

11.1.1. MC_Power instruction

The MC_Power instruction makes Servo Drive ready to operate.

Instruction	Meaning	ST expression
MC_Power	Power servo	MC_Power_instance Axis := Parameter, Enable := Parameter, Status => Parameter, Busy => Parameter, Error => Parameter, ErrorID =>Parameter);

•Input variables

Name	Meaning	Data type	Valid range	Default setting	Description
Enable	Enable	BOOL	TRUE FALSE	FALSE	The device is ready for operation when Enable is TRUE, and not ready when it is FALSE.

•Output variables

Name	Meaning	Data type	Valid range	Description
Status	Servo ON	BOOL	TRUE FALSE	TRUE when the device is ready for operation.
Busy	Executing	BOOL	TRUE FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	It contains the error code when an error occurs. A value of 16#0000 ^{*2} indicates normal execution.

*1: Refer to A-1 Error Codes in Appendices of the NJ/NX-series Motion Control Instructions Reference Manual (Cat. No. W508).

*2: 16#0000 indicates 0000 in hexadecimal.

•In-out variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	-	Specifies the axis. ^{*1}

*1: Specify an axis variable that was created in the Axis Basic Settings of Sysmac Studio. (The default axis variable names are MC_Axis***.)

11.2. Program (ST Language)

The following explains the program written in ST language to check the operation.

11.2.1. Details on the Program

The details on the operation check program are shown below.

●Processing

Section	Processing name	Processing
Section 01	Motion Control Device Start/Stop	Changes the start flag for MC_Power_instance to TRUE or FALSE according to the value (TRUE or FALSE) of <i>Input_Start</i> . In doing so, this processing determines, using system-defined variables, whether or not PDO communications performs normally.
Section 02	Error Operation	Checks system-defined variables, and detects if an error in the minor fault level occurs. This processing stops the execution of MC_Power when an error is detected.
Section 03	MC Instruction Execute	Executes MC_Power_instance.

●Source code

```
(* Section 01: Motion Control Device Start/Stop *)
IF Input_Start
  AND _EC_PDSlavTbl[MC_Axis000.Cfg.NodeAddress]
  AND NOT _EC_CommErrTbl[MC_Axis000.Cfg.NodeAddress] THEN
  IF NOT MC_Axis000.DrvStatus.ServoOn THEN
    Local_Power_Enable:= TRUE;
  END_IF;
ELSE Local_Power_Enable:= FALSE;
END_IF;

(* Section 02: Error Operation *)
IF MC_Axis000.MFaultLvl.Active THEN
  Local_Power_Enable:= FALSE;
END_IF;

(* Section 03: MC Instruction Execute *)
MC_Power_instance(
  Axis := MC_Axis000,
  Enable := Local_Power_Enable,
  Status => Output_Power_Status,
  Busy => Output_Power_Busy,
  Error => Output_Power_Error,
  ErrorID => Output_Power_ErrorID);
```

11.2.2. Lists of Variables

The variables used in the operation check program are listed below.

●Internal variables

Name	Data type	Description
Input_Start	BOOL	This flag is used to execute or stop the function provided by the operation check program. TRUE during the execution. FALSE during the stop.
MC_Power_instance	MC_Power	This is an instance to execute the MC_Power instruction (function block).
Local_Power_Enable	BOOL	This variable is assigned to the <i>Enable</i> input variable of the MC_Power instruction. The device is ready for operation when <i>Enable</i> is TRUE, and not ready when it is FALSE.
Output_Power_Status	BOOL	This variable is assigned to the <i>Status</i> (Servo ON) output variable of the MC_Power instruction. TRUE when the device is ready for operation.
Output_Power_Busy	BOOL	This variable is assigned to the <i>Busy</i> (Executing) output variable of the MC_Power instruction. TRUE when the instruction is acknowledged.
Output_Power_Error	BOOL	This variable is assigned to the <i>Error</i> output variable of the MC_Power instruction. TRUE while there is an error.
Output_Power_ErrorID	WORD	This variable is assigned to the <i>ErrorID</i> output variable of the MC_Power instruction. It contains the error code when an error occurs. A value of 16#0000 ^{*1} indicates normal execution.

*1: 16#0000 indicates 0000 in hexadecimal.

●External variables

Name	Meaning	Data type	Description
_EC_PDSlavTbl	Process Data Communicating Slave Table	ARRAY[1..192] OF BOOL	This table indicates the slaves that are performing process data communications. Slaves are given in the table in the order of slave node addresses. The element for a slave is TRUE if process data of the corresponding slave is enabled (operational) for both slave inputs and outputs.
_EC_CommErrTbl	Communications Error Slave Table	ARRAY[1..192] OF BOOL	Slaves are given in the table in the order of slave node addresses. The corresponding slave element is TRUE if the master detected an error for the slave.
MC_Axis000	Axis 0	sAXIS_REF	Axis variable for axis 0
DrvStatus	Servo Drive Status	sAXIS_REF_S TA_DRV	Gives the status of Servo Drive.
ServoOn	Servo ON	BOOL	TRUE when the servomotor is powered.

12. Revision History

Revision code	Date of revision	Description of revision
01	November 2, 2015	First edition
02	March 6, 2017	Added and changed the contents for the use of NX-series Controllers. Updated the contents due to the upgrades of the servo drive, SigmaWin+, ESI file, controller and Sysmac Studio.

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