OMRON

Automation Software

Sysmac Studio
Version 1

Operation Manual

SYSMAC-SE2□□□

SYSMAC
always in control

W504-E1-01

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Introduction

Thank you for purchasing the Sysmac Studio Automation Software.
The Sysmac Studio allows you to use a computer to program and set up NJ-series Controllers.
This manual describes the operating procedures of the Sysmac Studio. When you use the Sysmac Studio, refer also to the user manuals for the NJ-series Controller and peripheral devices.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- Personnel in charge of managing FA systems and facilities.

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B3503.

Notice

This manual contains information that is necessary to use the Sysmac Studio. Please read and understand this manual before using the Sysmac Studio. Keep this manual in a safe place where it will be available for reference during operation.

Manual Configuration

NJ-series CPU Unit Hardware User's Manual (Cat. No. W500)

Section	Description
Section 1 Introduction	This section provides an introduction to the NJ-series Controllers and their features, and gives the NJ-series Controller specifications.
Section 2 System Configuration	This section describes the system configuration used for NJ-series Controllers.
Section 3 Configuration Units	This section describes the parts and functions of the configuration devices in the NJ-series Controller configuration, including the CPU Unit and Configuration Units.
Section 4 Installation and Wiring	This section describes where and how to install the CPU Unit and Configuration Units and how to wire them.
Section 5 Troubleshooting	This section describes the event codes, error confirmation methods, and corrections for errors that can occur.
Section 6 Inspection and Maintenance	This section describes the contents of periodic inspections, the service life of the Battery and Power Supply Units, and replacement methods for the Battery and Power Supply Units.
Appendices	The appendices provide the specifications of the Basic I/O Units, Unit dimensions, load short-circuit protection detection, line disconnection detection, and measures for EMC Directives.

NJ-series CPU Unit Software User's Manual (Cat. No. W501)

Section	Description
Section 1 Introduction	This section provides an introduction to the NJ-series Controllers and their features, and gives the NJ-series Controller specifications.
Section 2 CPU Unit Operation	This section describes the variables and control systems of the CPU Unit and CPU Unit status.
Section 3 I/O Ports, Slave Configuration, and Unit Configuration	This section describes how to use I/O ports, how to create the slave configuration and unit configuration and how to assign functions.
Section 4 Controller Setup	This section describes the initial settings of the function modules.
Section 5 Designing Tasks	This section describes the task system and types of tasks.
Section 6 Programming	This section describes programming, including the programming languages and the variables and instructions that are used in programming.
Section 7 Simulation, Transferring Projects to the Physical CPU Unit, and Operation	This section describes simulation of Controller operation and how to use the results of simulation.
Section 8 CPU Unit Status	This section describes CPU Unit status.
Section 9 CPU Unit Functions	This section describes the functionality provided by the CPU Unit.
Section 10 Communications Setup	This section describes how to go online with the CPU Unit and how to connect to other devices.
Section 11 Example of Actual Application Procedures	This section describes the procedures that are used to actually operate an NJ-series Controller.
Section 12 Troubleshooting	This section describes the event codes, error confirmation methods, and corrections for errors that can occur.
Appendices	The appendices provide the CPU Unit specifications, task execution times, system-defined variable lists, data attribute lists, CJ-series Unit memory information, CJ-series Unit memory allocation methods, and data type conversion information.

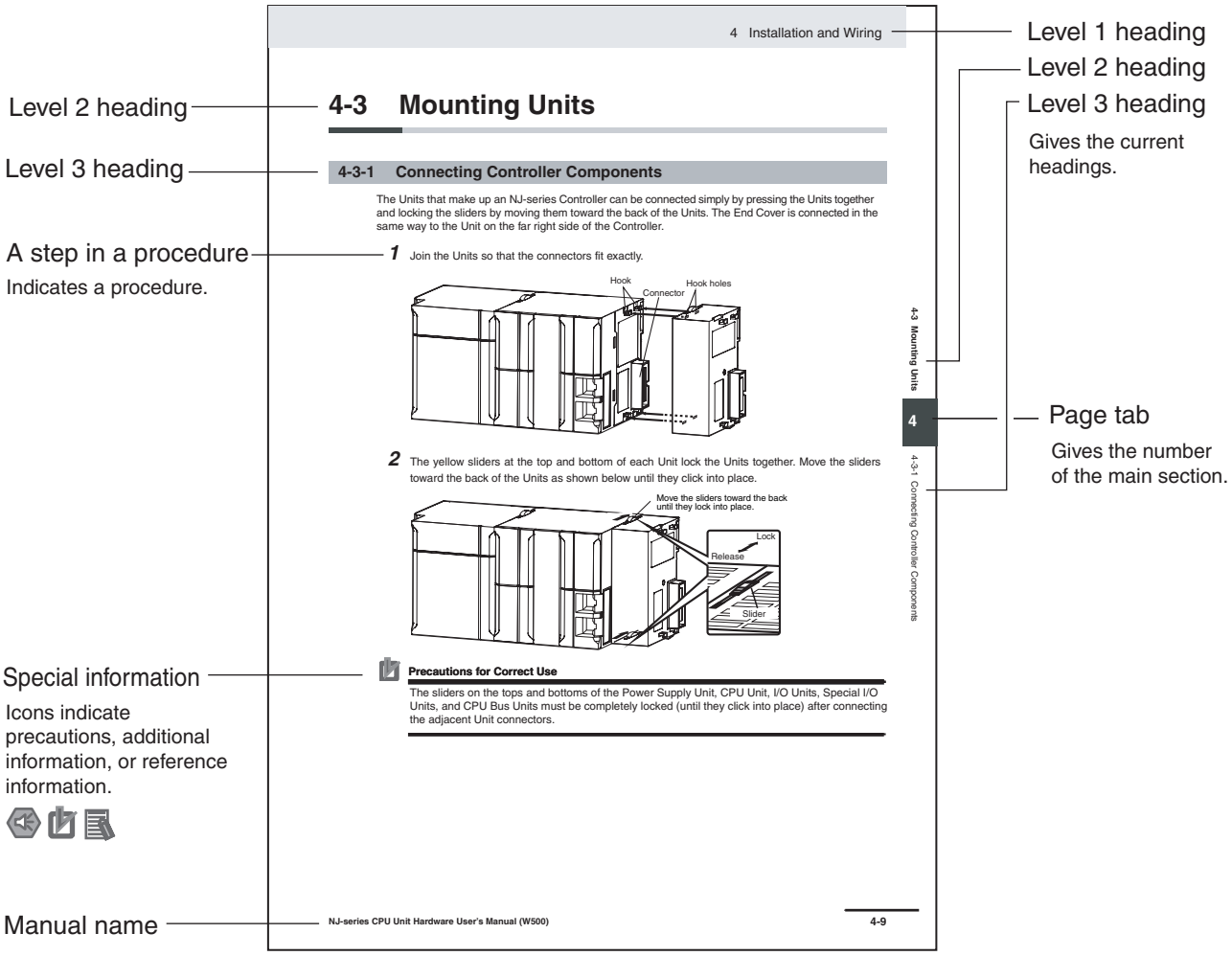
Sysmac Studio Version 1 Operation Manual (Cat. No. W504) (This Manual)

Section	Description
Section 1 Introduction	This section provides an overview and lists the specifications of the Sysmac Studio and describes its features and components.
Section 2 Installation and Uninstallation	This section describes how to install and uninstall the Sysmac Studio.
Section 3 System Design	This section describes the basic concepts for designing an NJ-series System with the Sysmac Studio and the basic operating procedures.
Section 4 Programming	This section describes how to create programs with the Sysmac Studio.
Section 5 Online Connections to a Controller	This section describes how to go online with a Controller.
Section 6 Debugging	This section describes how to debug the programs online on the Controller or debug it offline with the Simulator.
Section 7 Other Functions	This section describes Sysmac Studio functions other than system design functions.
Section 8 Reusing Programming	This section describes how to reuse the programs that you create with the Sysmac Studio.
Section 9 Support Software Provided with the Sysmac Studio	This section describes the Support Software that is provided with the Sysmac Studio.
Section 10 Troubleshooting	This section describes the error messages that are displayed when you check a program on the Sysmac Studio and how to correct those errors.
Appendices	The appendices describe the following: Driver Installation for Direct USB Cable Connection Specifying One of Multiple Ethernet Interface Cards Online Help Simulation Instructions

Manual Structure

Page Structure

The following page structure is used in this manual.



This illustration is provided only as a sample. It may not literally appear in this manual.

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.

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.

Note References are provided to more detailed or related information.

Precaution on Terminology

In this manual, “download” refers to transferring data from the Sysmac Studio to the physical Controller and “upload” refers to transferring data from the physical Controller to the Sysmac Studio.

For the Sysmac Studio, synchronization is used to both upload and download data. Here, “synchronize” means to automatically compare the data for the Sysmac Studio on the computer with the data in the physical Controller and transfer the data in the direction that is specified by the user.

Sections in this Manual

1 Introduction

2 Installation and Uninstallation

3 System Design

4 Programming

5 Online Connections to a Controller

6 Debugging

7 Other Functions

8 Reusing Programming

9 Support Software Provided with the Sysmac Studio

10 Troubleshooting

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Read and Understand this Manual

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY
OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON. OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

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Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the Sysmac Studio and an NJ-series Machine Automation Controller
The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.
The following notation is used.

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

Precautions for Safe Use
Indicates precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use
Indicates precautions on what to do and what not to do to ensure proper operation and performance.

Symbols

The circle and slash symbol indicates operations that you must not do.
The specific operation is shown in the circle and explained in text.
This example indicates prohibiting disassembly.

The triangle symbol indicates precautions (including warnings).
The specific operation is shown in the triangle and explained in text.
This example indicates a precaution for electric shock.

The triangle symbol indicates precautions (including warnings).
The specific operation is shown in the triangle and explained in text.
This example indicates a general precaution.

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

⚠ WARNING

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

Check the user program for proper execution before you use it for actual operation.

Execute online editing only after you confirm that no adverse effects will be caused to the operation of the master and slave axes if the synchronized control processing time is extended.

Before you perform online editing for a function or a function block, check the locations where the function or function block is used in the Cross Reference Tab Page and confirm the range that will be affected.

⚠ Caution

Although the Simulator simulates the operation of the Controller, there are difference from the Controller in operation and timing. After you debug the user program on the Simulator, always check operation on the physical Controller before you use the user program to operate the controlled system. Accidents may occur if the controlled system performs unexpected operation.

The Simulator instructions are not processed on the physical Controller and all outputs from the instructions will be FALSE. After you debug the user program on the Simulator, always check operation on the physical Controller before you use the user program to operate the controlled system. Accidents may occur if the controlled system performs unexpected operation.

Confirm that the controlled system will not be adversely affected before you perform any of the following operations.
Changing the operating mode of the CPU Unit (including changing the Startup Mode).
Changing the user program or settings.
Changing set values or present values.
Performing forced refreshing.

Sufficiently confirm safety before you change the values of variables online. Incorrect operation may cause the devices that are connected to Output Units to operate regardless of the operating mode of the Controller.

Confirm the axis number carefully before you perform an axis operation from the Sysmac Studio.

If you perform FFT analysis, the motor velocity may change drastically. Be particularly careful to ensure safety. Provide a means so that you can at any time turn OFF the Servo power supply in an emergency.
Do not use FFT analysis if a wide range of motor operation presents a risk of machine failure.
Keep the gain as low as possible when you make measurements.

After you transfer the user program, the CPU Unit is restarted. Communications with the EtherCAT slave is cut off for up to 45 seconds. During that period, the slave outputs behave according to the slave settings. Before you transfer the user program, confirm that the system will not be adversely affected.

Always confirm safety before you reset the Controller or any components.

Precautions for Safe Use

Operation

- Check the parameters for proper execution before you use them for actual operation.
- Before you restart operation, make sure that the required data, including device variables, the user program, and parameters, is transferred to a CPU Unit, Special I/O Unit, CPU Bus Unit, or externally connected device that was replaced.

EtherCAT Communications

- If verifying revisions is not selected in the Revision Check Method parameter in the master settings in EtherCAT configuration, parameters are also transferred to slaves with different revisions. If an incompatible revision of a slave is connected, incorrect parameters may be set and operation may not be correct. If you select the revision check, make sure that only compatible slaves are connected before transferring the parameters.
- Unexpected operation may result if you transfer inappropriate network configuration settings. Even if appropriate network configuration settings are set, confirm that the controlled system will not be adversely affected before you transfer the data.

MC Test Run

- Before you start an MC Test Run, make sure that the operation parameters are set correctly.
- Confirm the axis number carefully before you perform an MC Test Run.
- An MC Test Run operation involves motor operation. Refer to the operation manual before you execute an MC Test Run. Be particularly careful of the following points.
  - Confirm safety around all moving parts.
  - When you click the **Run** Button, the motor begins actual operation at the specified velocity. Only begin motor operation if you are absolutely sure there is no danger if you start the motor.
  - Always have an external emergency stop device available.
  - Sometimes you may be unable to stop the motor from your computer. Install an external emergency stop device so that you can stop the motor immediately if needed.
  - Only operate the motor when you can clearly confirm the motor operation so that you can react quickly in the case of any danger that may arise due to operation of the motor.
  - A communications error will occur if you attempt to begin operations without EtherCAT communications. Always establish EtherCAT communications first.
- Precautions during MC Test Run Operation
  - During test run execution, only the Sysmac Studio has any control of the operation. Any commands from motion control instructions are ignored.
  - If communications are interrupted between the Sysmac Studio and Controller during test run operations, you will not be able to stop the motor from the computer. Provide an external hardware means that you can use to stop the motor without fail.

Motion Control

- Gain adjustment is automatically performed by the Servo Driver. The motor operates during the adjustment, so be sufficiently careful of the following points.
  1. Provide a means to perform an emergency stop (i.e., to turn OFF the power supply). The response may greatly change during the adjustment.
  2. Confirm safety around all moving parts. Always confirm that there are no obstacles in the movement range and directions of the motor and that the motor can operate safely. Provide protective measures for unexpected motion.
  3. Before you start the adjustment, make sure that the device that is being adjusted is not out of place. Before you start normal operation, make sure to perform homing to reset the position. If home is not reset before the adjustment is performed, the motor may run away, creating a very hazardous condition. Confirm the safety of the system if you use a vertical axis. Make sure that the object that is being adjusted does not fall when the Servo is turned OFF.

4. If vibration or oscillation occurs when advanced adjustment is performed, manually reduce the gain until the system is stable.

- The motor operates and the workpiece moves during autotuning. Provide a means so that you can turn OFF the Servo immediately when you perform autotuning.
- Damping control is automatically performed by the Servo Driver. The motor operates during the adjustment, so be sufficiently careful of the following points.
  1. Provide a means to perform an emergency stop (i.e., to turn OFF the power supply). The response may greatly change during the adjustment.
  2. Confirm safety around all moving parts. Always confirm that there are no obstacles in the movement range and directions of the motor and that the motor can operate safely. Provide protective measures for unexpected motion.
  3. Before you start the adjustment, make sure that the device that is being adjusted is not out of place. Before you start normal operation, make sure to perform homing to reset the position. If home is not reset before the adjustment is performed, the motor may run away, creating a very hazardous condition. Confirm the safety of the system if you use a vertical axis. Make sure that the object that is being adjusted does not fall when the Servo is turned OFF.
- The absolute encoder home offset is stored in the Controller as absolute encoder information. If you replace the Controller and restore backup data that is different from the Controller data from before the Controller was replaced, do not restore the absolute encoder home offset. If data from another Controller that includes the absolute encoder home offset is accidentally restored, set home again.

Precautions for Correct Use

- No checks are made to verify the logical consistency between data items in the Special Unit Setup. Therefore, always check the logical consistency between all settings before transferring the Special Unit Setup to the Controller and starting operation, especially when you perform tasks such as enabling or disabling a setting from another setting. Depending on the settings, logical inconsistencies could result in unintended operation.
  For example, assume that setting item 1 specifies either standard settings or custom settings and that the custom settings start from setting item 2. Here, even if you set the custom settings from item 2 onward, the setting of setting item 1 will not be automatically changed to specify using the custom settings. In this case, if you do not also change the setting of setting item 1 to specify using the custom settings, the settings from items 2 onward will be ignored.

Regulations and Standards

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- EtherCAT® is a registered trademark of Beckhoff Automation GmbH for their patented technology.
- The SD logo is a trademark of SD-3C, LLC.
- NVIDIA, the NVIDIA logo, GeForce, and the GeForce logo are the trademarks or registered trademarks of NVIDIA Corporation in the USA and other countries.
- ATI RadeonTM is a trademark of Advanced Micro Devices, Inc. in the USA.

Other company names and product names in this document are the trademarks or registered trademarks of their respective companies.

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at http://www.fa.omron.co.jp/nj_info_e/.

Unit Versions

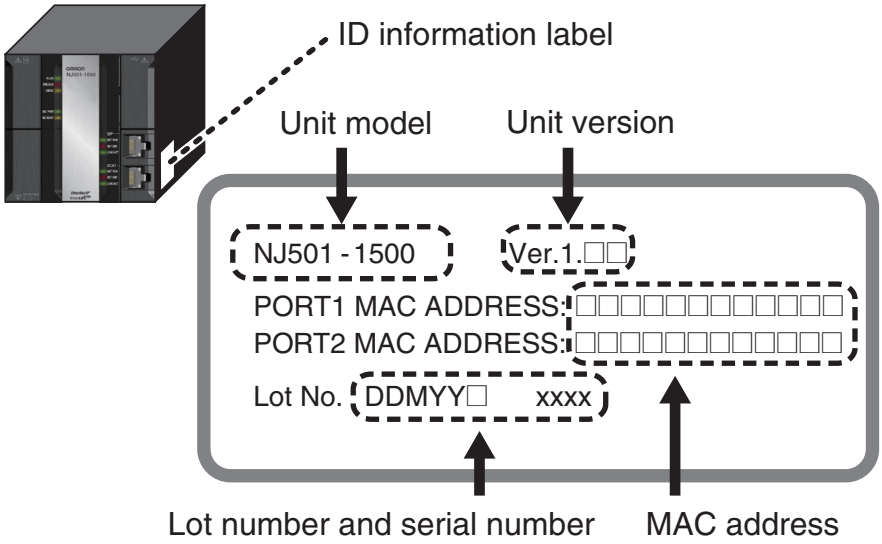
Unit Versions

A “unit version” has been introduced to manage CPU Units in the NJ Series according to differences in functionality accompanying Unit upgrades.

Notation of Unit Versions on Products

The unit version is given on the ID information label of the products for which unit versions are managed, as shown below.

Example for NJ-series NJ501-□□□□ CPU Unit:



The following information is provided on the ID information label.

Item	Description
Unit model	Gives the model of the Unit.
Unit version	Gives the unit version of the Unit.
Lot number and serial number	Gives the lot number and serial number of the Unit. DDMYY: Lot number, □: For use by OMRON, xxxx: Serial number “M” gives the month (1 to 9: January to September, X: October, Y: November, Z: December)
MAC address	Gives the MAC address of the built-in port on the Unit.

Confirming Unit Versions with Sysmac Studio

You can use the Unit Production Information on the Sysmac Studio to check the unit version of the CPU Unit, CJ-series Special I/O Units, CJ-series CPU Bus Units, and EtherCAT slaves. The unit versions of CJ-series Basic I/O Units cannot be checked from the Sysmac Studio.

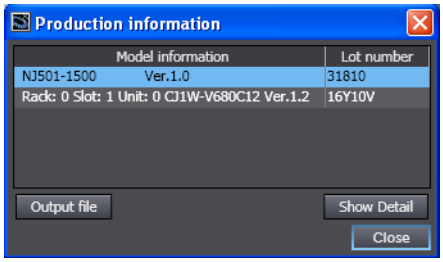
● CPU Unit and CJ-series Units

1 Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **CPU/Expansion Racks** under **Configurations and Setup** and select ***Edit*** from the menu.

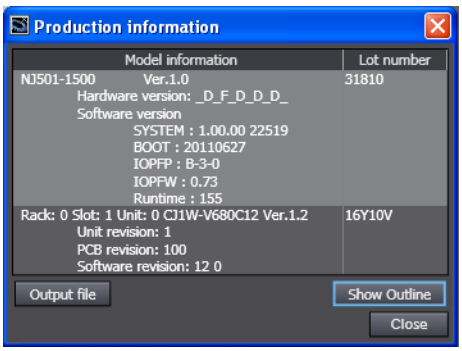
The Unit Editor is displayed for the Controller Configurations and Setup layer.

2 Right-click any open space in the Unit Editor and select ***Production Information***.

The Production Information Dialog Box is displayed.



Simple Display



Detailed Display

In this example, “Ver.1.0” is displayed next to the unit model.

The following items are displayed.

CPU Unit	CJ-series Units
Unit model	Unit model
Unit version	Unit version
Lot number	Lot number
	Rack number, slot number, and unit number

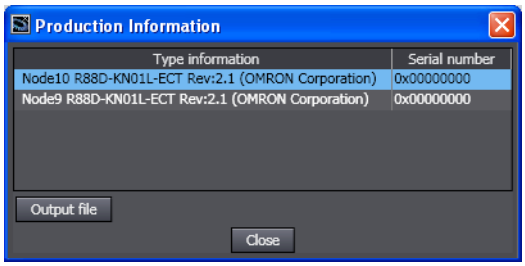
● EtherCAT Slaves

1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select ***Edit*** from the menu.

The EtherCAT Configuration Tab Page is displayed for the Controller Configurations and Setup layer.

2 Right-click the master in the EtherCAT Configurations Editing Pane and select **Display Production Information**.

The Production Information Dialog Box is displayed.



The following items are displayed.
Node address
Type information*
Serial number

* If the model number cannot be determined (such as when there is no ESI file), the vendor ID, product code, and revision number are displayed.

Unit Version Notation

In this manual, unit versions are specified as shown in the following table.

Product nameplate	Notation in this manual	Remarks
“Ver.1.0” or later to the right of the lot number	Unit version 1.0 or later	Unless unit versions are specified, the information in this manual applies to all unit versions.

Related Manuals

The following manuals are related to the NJ-series Controllers. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
Sysmac Studio Version 1 Operation Manual (this manual)	W504	SYSMAC-SE2□□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
CX-Integrator CS/CJ/CP/NSJ-series Network Configuration Tool Operation Manual	W464		Learning how to configure networks (data links, routing tables, Communications Unit settings, etc.).	Describes operating procedures for the CX-Integrator.
CX-Designer User's Manual	V099		Learning to create screen data for NS-series Programmable Terminals.	Describes operating procedures for the CX-Designer.
CX-Protocol Operation Manual	W344		Creating data transfer protocols for general-purpose devices connected to CJ-series Serial Communications Units.	Describes operating procedures for the CX-Protocol.
NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual	W506	NJ501-□□□□	Using the built-in EtherNet/IP port on an NJ-series CPU Unit.	Describes the operating procedures of the Network Configurator.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

Revision code	Date	Revised content
01	July 2011	Original production

1

Introduction

This section provides an overview and lists the specifications of the Sysmac Studio and describes its features and components.

1-1 The Sysmac Studio 1-2
1-2 Features 1-3
1-3 Specifications 1-4
1-4 Components 1-6
1-4-1 Sysmac Studio Components 1-6

1-1 The Sysmac Studio

The Sysmac Studio Automation Software provides an integrated development environment to set up, program, debug, and maintain SYSMAC NJ-series Controllers and other Machine Automation Controllers, as well as EtherCAT slaves.

Flexible Development Environment

The Sysmac Studio provides an environment for programming with variables. There is no need for concern about memory addresses. This eliminates the need to wait for memory address definitions for hardware before the start of software development. Hardware and software can be designed independently and developed in parallel. POUs (program organization units) that include programs, functions, and function blocks can be used to design programming that does not depend on any one specific system. This increases the reusability of programming.

Development Environment for Multiple Programmers

The Sysmac Studio provides an environment for programming with variables and POUs. Programming is designed with POUs (programs, functions, and function blocks). The programs are then assigned to tasks and the program execution order is defined. This reduces the interdependence of the programs and therefore allows more than one programmer to easily work at the same time. The assignments of variables to hardware and the definitions of the relations between information that is shared between different programs can be set at any time.

1-2 Features

More Support for IEC 61131-3 Programming Languages

The Sysmac Studio is based on the International Standard IEC 61131-3. It provides a state-of-the-art programming environment based on the ladder diagram and structured text programming languages and on POUs which include programs, functions, and function blocks.

Easy Operation

The Sysmac Studio places as few restrictions as possible on the design procedures to allow you to start design work from any part of the system. The design concept features easy-to-understand operating procedures with suitable guides that do not interfere with the workflow so that you can see the flow of design work. This provides user-friendly operation for flexible design work in which even mistakes in settings and procedures can be corrected immediately or left until the project is finalized as long as they will not lead to serious accidents. The Sysmac Studio is designed to achieve optimum functionality and ease of operation to combine Machine Automation Controllers, such as those in the NJ Series, with Sysmac-compliant EtherCAT slaves and other Sysmac devices.

Complete Debugging

The Sysmac Studio provides complete functions for debugging sequence control, such as changing present values and changing programming online. It also provides debugging functions with motion control simulations of motion control, such as displaying trace results in 2D or 3D and displaying traces on virtual devices. These functions enable debugging on images that are closer to the physical devices.

Maintenance

The Sysmac Studio lets you check the Controller status on a status list. Troubleshooting functions let you easily check error details and corrections for Controller errors. You can also assign user-defined errors in the same way as Controller errors are assigned.

1-3 Specifications

Product Model Numbers

If you are purchasing the Sysmac Studio for the first time, purchase both a DVD and one or more licenses. You can also purchase the DVD separately. The DVD is not included with the licenses.

Product	Number of licenses	Media	Model number
Sysmac Studio Standard Edition version 1.□□	None (DVD only)	DVD	SYSMAC-SE200D
	1 license	---	SYSMAC-SE201L
	3 licenses	---	SYSMAC-SE203L
	10 licenses	---	SYSMAC-SE210L
	30 licenses	---	SYSMAC-SE230L
	50 licenses	---	SYSMAC-SE250L

Support Software You Can Install from the Sysmac Studio Package and Enclosed Data

The following table lists the Support Software that you can install from the Sysmac Studio Package and the data that is included with the Sysmac Studio.

Installable Software	Version	Classification	Enclosed data
• Sysmac Studio	Ver. 1.□	Automation Software	• CPS • Manuals (PDF files)
• CX-Integrator	Ver. 2.□	Support Software	
• CX-Designer	Ver. 3.□	Support Software	
• CS-Protocol	Ver. 1.□	Support Software	
• Network Configurator	Ver. 3.□	Support Software	
• CX-Server	Ver. 5.□	Communication Middleware	
• Communications Middleware	Ver. 1.□	Communication Middleware	

License Conditions

- This product incorporates certain third party software.
  The license and copyright information associated with this software is available at http://www.fa.omron.co.jp/nj_info_e/.
- This software uses knowledge media technology that was developed by the Meme Media Laboratory (VBL) of Hokkaido University.

Applicable Controllers

The Sysmac Studio can be used for the following Controllers.

Model numbers
NJ501-1300
NJ501-1400
NJ501-1500

License Activation (Advanced Warning)
For future versions of the Sysmac Studio, activation will be required for installation and re-installation. Activation is necessary to create a relationship between the OMRON software project and the computer on which you will use it. This allows OMRON to help prevent illegal usage and copying of software. When license activation is introduced, you will need to perform a license activation procedure. If you do not perform license activation at that time, you will be able to use the software for only a limited period of time.

Applicable Computers

The Sysmac Studio runs on Microsoft Windows. It will run on the following versions of Microsoft Windows.

- Windows XP with SP3
- Windows Vista
- Windows 7 (32-bit or 64-bit edition)

The following application must also be installed. It is installed automatically if it is not already installed on the computer when the Sysmac Studio is installed.

- .NET Framework 3.5

System Requirements

The system requirements for the Sysmac Studio are given in the following table.

OS	CPU		RAM	Display
Windows XP SP3 Windows Vista Windows 7 (32-bit or 64-bit edition)	Minimum	IBM AT or compatible with Celeron 540 (1.8 GHz) processor	2 GB	XGA 1,024 × 768, 16 million colors
	Recommended	IBM AT or compatible with Core i5 M520 (2.4 GHz) processor or the equivalent	2 GB	WXGA 1,280 × 800, 16 million colors

In addition, the following are also required.

System requirement	Specification
Available hard disk space	1.6 GB min.
Optical drive	DVD-ROM
Communications port	Ethernet or USB (USB 2.0)

Recommended Video Cards

The following are recommended to use 3D motion traces.

System requirement	Specification
Video memory	512 MB min.
Video Card	One of the following video cards: • NVIDIA GeForce 200 Series or better • ATI Radeon HD5000 Series or better

1-4 Components

1-4-1 Sysmac Studio Components

The following components are included in the Sysmac Studio package. Make sure that all components are included.

● DVD-ROM (SYSMAC-SE200D)

Component	Description
Introduction	An introduction to the Sysmac Studio is provided.
Setup disk (DVD-ROM)	1
Model number label	1

● Licenses (SYSMAC-SE2□□□L)

Component	Description
License Agreement	The license agreement gives the usage conditions and warranty for the Sysmac Studio.
License Card	The following are given: Model number, version, license number, and number of licenses.
License Stickers	The following are given: Model number, version, license number, and number of licenses. Two stickers are provided.
User Registration Card	Two cards are provided, one for Japan and one for other countries.
Address Sheet	This is an address sheet that is used when the license is purchased outside of Japan.

Precautions for Correct Use

You must purchase a license for the Sysmac Studio that is separate from the DVD-ROM. The license number, which is required for installation, is given on the license certificate. Keep it in a safe place so that it is not lost.

● Support Software and PDF Manuals Provided with the Sysmac Studio

The following Support Software and PDF manuals are included with the Sysmac Studio.

Support Software	Application	Description	Manual name
CX-Integrator	Learning how to configure networks (data links, routing tables, Communications Unit settings, etc.).	Describes the operating procedures of the CX-Integrator.	CX-Integrator Operation Manual (Cat. No. W464)

Support Software	Application	Description	Manual name
CX-Designer	Learning to create screen data for NS-series Programmable Terminals.	Describes the operating procedures of the CX-Designer.	CX-Designer User's Manual (Cat. No. V099)
CX-Protocol	Creating data transfer protocols for general-purpose devices connected to CJ-series Serial Communications Units.	Describes the operating procedures of the CX-Protocol.	CX-Protocol Operation Manual (Cat. No. W344)
Network Configurator	Learning how to set tag data links for the built-in EtherNet/IP ports on NJ-series CPU Units.	Describes the operating procedures of the Network Configurator.	NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)

2

Installation and Uninstallation

This section describes how to install and uninstall the Sysmac Studio.

2-1 Installing the Sysmac Studio 2-2
2-1-1 Confirmations before Installation 2-2
2-1-2 Requirements for Installation 2-2
2-1-3 Installing the Sysmac Studio 2-3
2-2 Uninstalling the Sysmac Studio 2-13
2-2-1 Uninstalling the Sysmac Studio 2-13

2-1 Installing the Sysmac Studio

2-1-1 Confirmations before Installation

Check the following items before you install the Sysmac Studio.

- To install or use the Sysmac Studio, log onto Windows as the administrator or as a user with administrator rights. There are files that a user without administrator rights cannot write. An access error will occur if you log on without administrator rights.
- Exit all applications that are running on the computer before you install the Sysmac Studio.
- You cannot install the Sysmac Studio from a network drive, such as a DVD drive or hardware drive that is shared on a network. Always install the Sysmac Studio from a DVD drive on the computer onto which you need to install the Sysmac Studio.
- Corrupted files cannot be restored on a compressed drive. Do not install the Sysmac Studio on a compressed drive.
- Do not cancel the setup while it is in progress. Files that were copied may remain in the installation directory.
- Do not turn OFF the power to the computer or reset the computer while the installation is in progress. Computer data may be corrupted.
- You may need to restart Windows after you install the Sysmac Studio. Restart as required according to Installation Wizard messages.

2-1-2 Requirements for Installation

Supported OS

You can install the Sysmac Studio on computers with any of the following operating systems.

- Windows XP with SP3 (excluding 64-bit edition)
- Windows Vista (excluding 64-bit edition)
- Windows 7 (32-bit or 64-bit edition)

CX-One Installation

If the CX-One is installed on the computer, the operation when you install the Sysmac Studio depends on the version of the CX-One.

● Versions Earlier Than CX-One Version 4

Installation is cancelled and the Sysmac Studio cannot be installed. Uninstall the CX-One before you install the Sysmac Studio.

● CX-One Version 4 or Higher

You can install the Sysmac Studio.*1

The Support Software*2 is installed in the installation folder of the CX-One. If the same Support Software is already installed, it is overwritten.

*1 If the Sysmac Studio is installed on a computer with the CX-One and then the CX-One is uninstalled, the Support Software may no longer operate correctly.

*2 Here, “Support Software” indicates the CX-Integrator, CX-Designer, CX-Protocol, Network Configurator, and CX-Server.

Installed Application Software

The following application software is installed.

Support Software: CX Common Tools

Name	Version
Sysmac Studio	Ver. 1.□
CX-Integrator	Ver. 2.□
CX-Designer	Ver. 3.□
CX-Protocol	Ver. 1.□
Network Configurator	Ver. 3.□
CX-Configurator FDT	Ver. 1.□

Communications Middleware

Name	Version
CX-Server	Ver. 5.□
Communications Middleware	Ver. 1.□

Other Application Software

Name	Version
.NET Framework	Ver. 1.1 SP1
.NET Framework	Ver. 3.5 SP1
DirectX	Ver. 9.□

2-1-3 Installing the Sysmac Studio

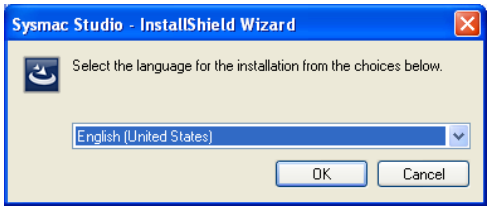
This section provides the procedure to install the Sysmac Studio for the first time.*

* If the CX-One is installed on the computer, you may not be able to install the Sysmac Studio depending on the version of the CX-One. Refer to *2-1-2 Requirements for Installation* for details.

Preparations for Installation

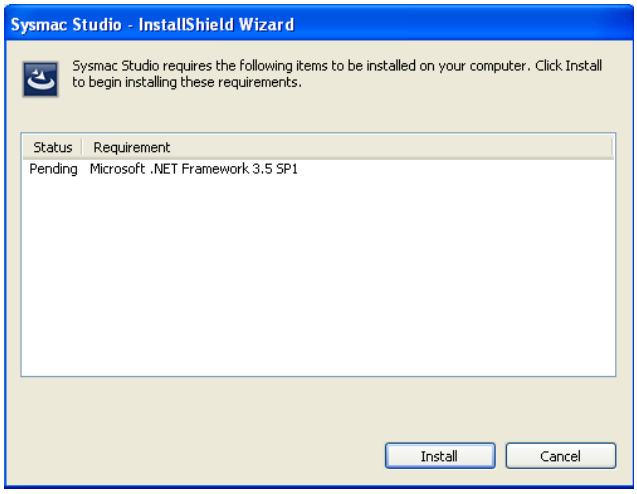
1 Set the Sysmac Studio installation disk into the DVD-ROM drive.
The setup program is started automatically and the Select Setup Language Dialog Box is displayed.

2 Select the language to use, and then click the **OK** Button.



The Sysmac Studio Setup Wizard is started.

Note If .NET Framework 3.5SP1 is not installed on the computer, the following dialog box is displayed.

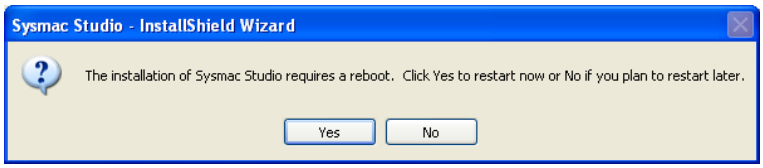


Click the **Install** Button to start installation of .NET Framework 3.5SP1. Click the **Cancel** Button to cancel installation of the Sysmac Studio.

3 Click the **Yes** Button in the confirmation dialog box for restarting the computer.

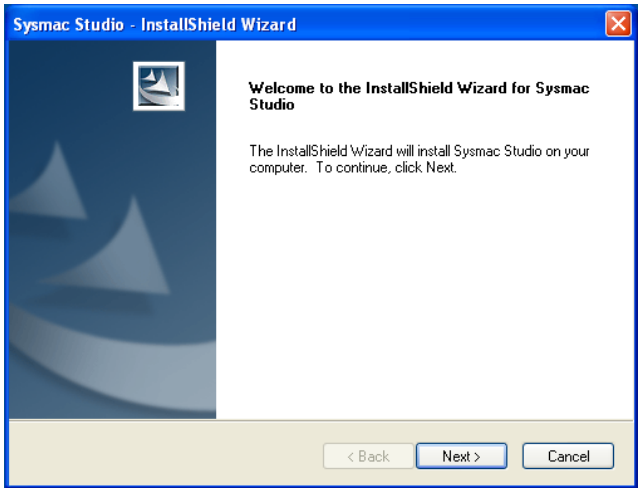
The computer is restarted.

Note If you click the **No** Button, installation of .NET Framework 3.5 SP1 will not end. Always click the **Yes** Button to restart the computer.



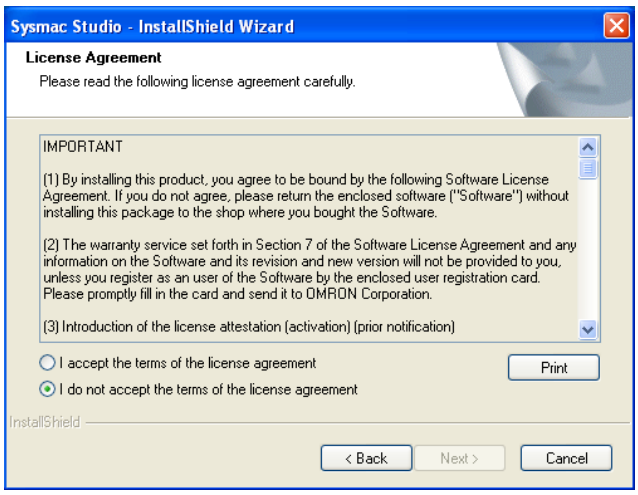
After the computer is restarted, the Setup Wizard will automatically continue with the rest of the procedure.

4 Click the **Next** Button.



The License Agreement Dialog Box is displayed.

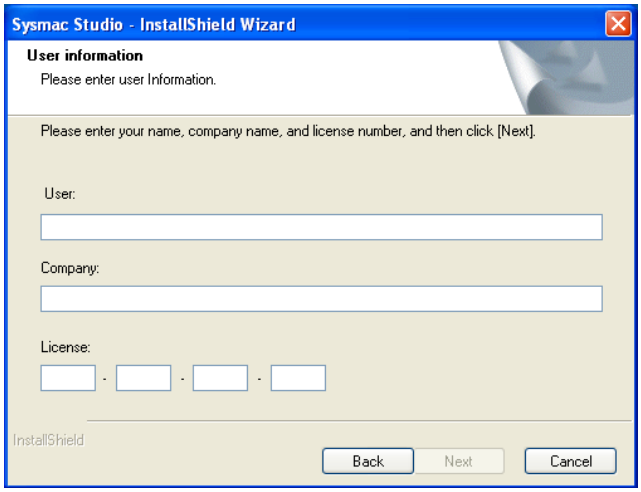
5 Read the License Agreement carefully. If you agree to all of the conditions, select the *I accept the terms of the license agreement* Option, and then click the **Next** Button.



The User Information Dialog Box is displayed.

6 The names that are registered on the computer are automatically entered for the user name and company name. Enter the license number (see note), and then click the **Next** Button.

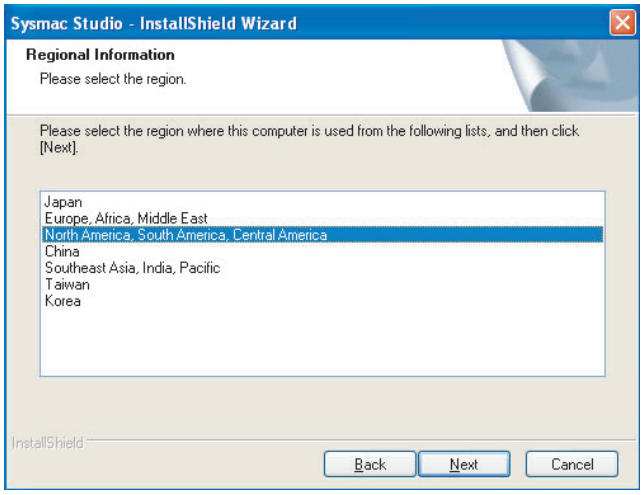
Note You must purchase a license separately.



The Select Location Dialog Box is displayed.

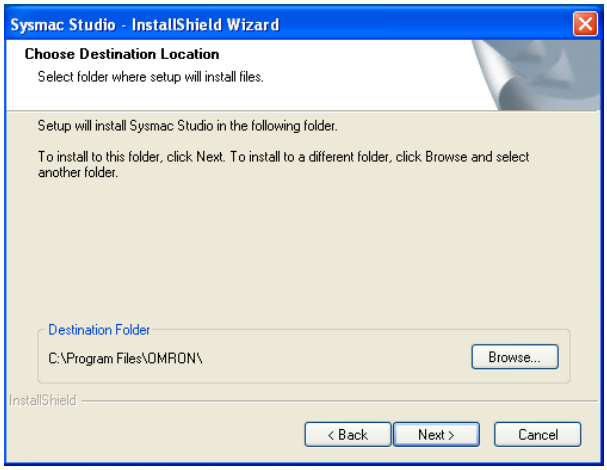
Note If the CX-One is installed, the Choose Destination Location Dialog Box is not displayed and the location that was selected for the CX-One is used. Go to step 8.

7 Select the region where you purchased the Sysmac Studio, and then click the **Next** Button.



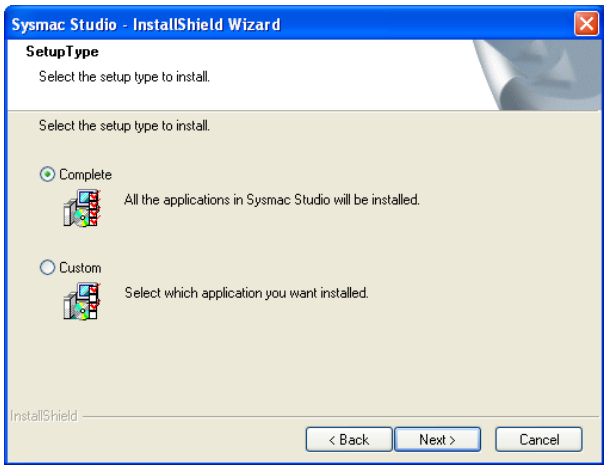
The Choose Destination Location Dialog Box is displayed.

8 Check the installation folder, and then click the **Next** Button. The default installation folder is C:\Program Files\OMRON\.



The Setup Type Dialog Box is displayed.

9 Select the *Complete* or *Custom* Option, and then click the **Next** Button.

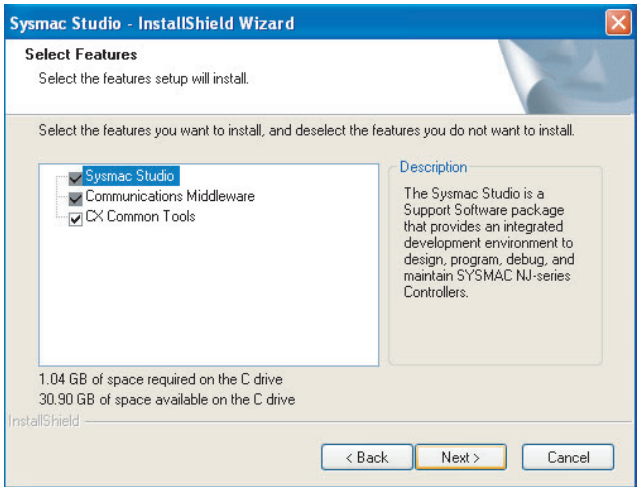


If you select the *Complete* Option, go to step 11.
If you select the *Custom* Option, go to step 10.

Note If CX-One version 4 is installed, the dialog box is not displayed. Go to step 10.

10 Select the *CX Common Tools* Check Box, and then click the **Next** Button.

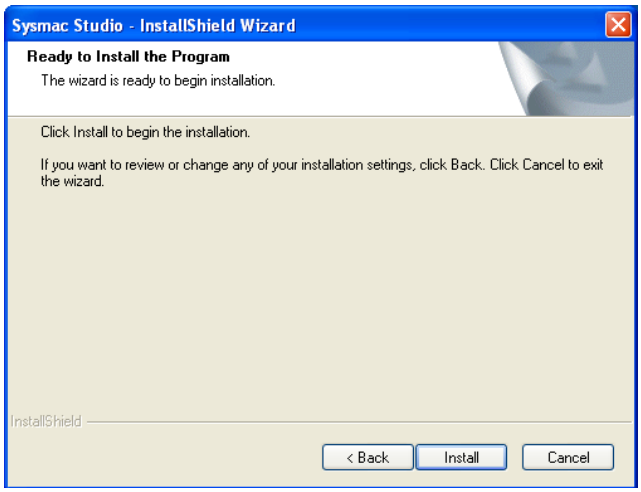
The Sysmac Studio and communications middleware are installed by default. The selections of these cannot be cleared.



The Ready to Install the Program Dialog Box is displayed.

11 Click the **Install** Button.

To change the installation settings, click the **Back** Button.

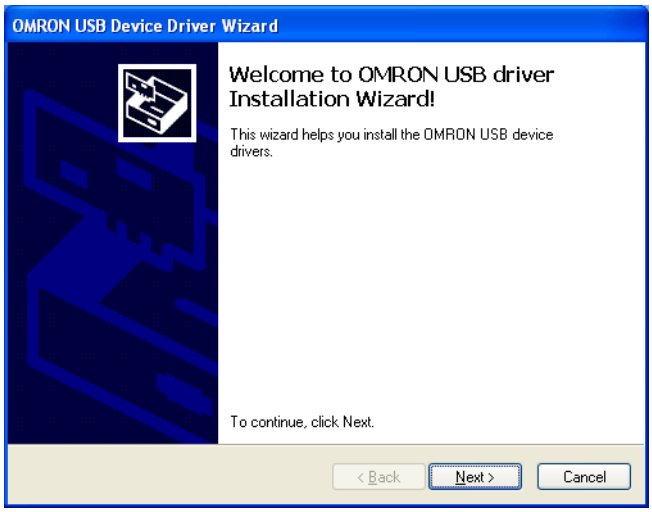


Installation of the Sysmac Studio starts.

Installing the OMRON USB Device Driver

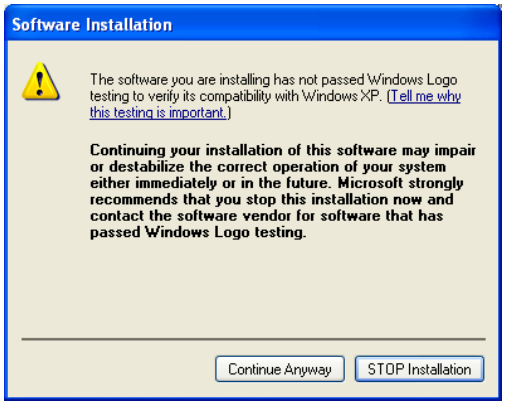
The OMRON USB driver Installation Wizard is displayed during the installation.

12 Click the **Next** Button.



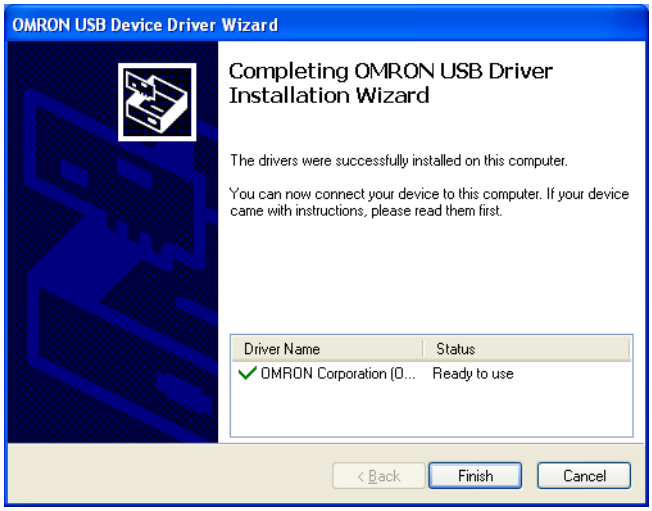
The following dialog box is displayed.

13 Click the **Continue Anyway** Button.



After the USB device driver is installed, the following dialog box is displayed.

14 Click the **Finish** Button.

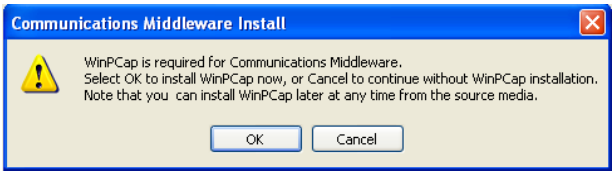


The USB device driver is installed and installation of the Sysmac Studio continues.

Installing WinPCap

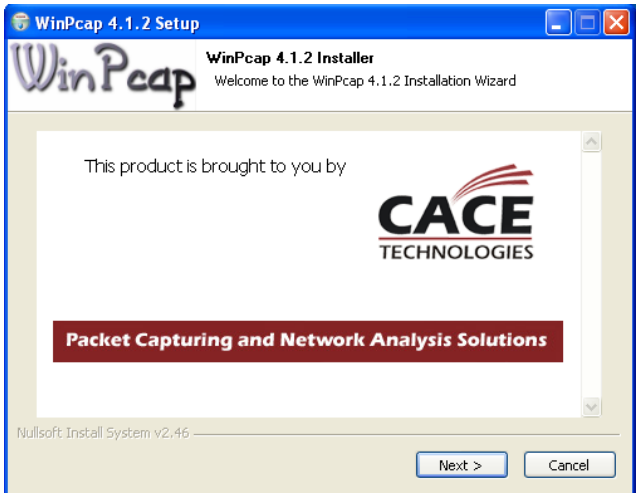
During the installation, a dialog box will prompt you to install the WinPCap component of the communications middleware.

15 Click the **OK** Button.



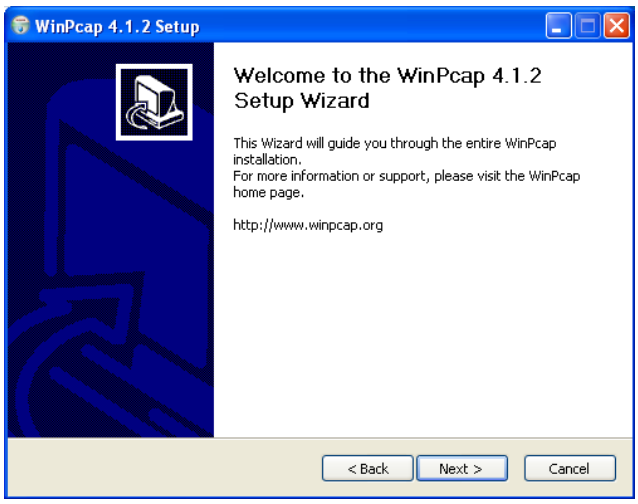
The WinPCap Setup Wizard is displayed.

16 Click the **Next** Button.



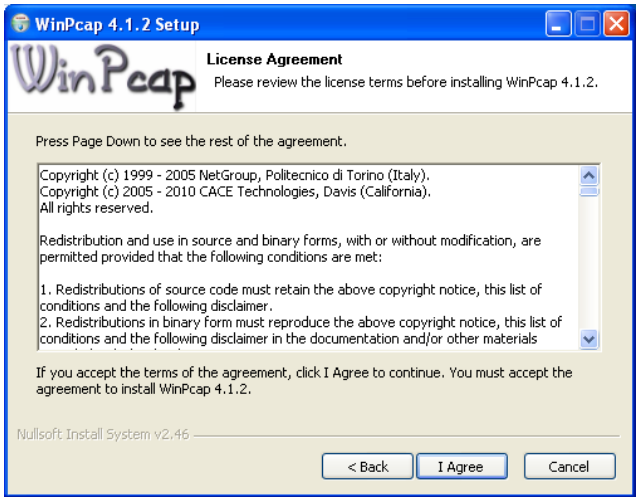
The WinPCap Installation Wizard is displayed.

17 Click the **Next** Button.



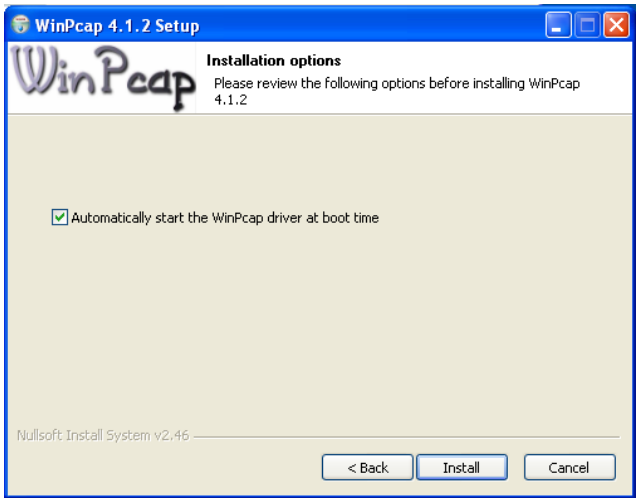
The License Agreement Dialog Box is displayed.

18 Read the License Agreement carefully. If you agree to all of the conditions, click the **I Agree** Button.



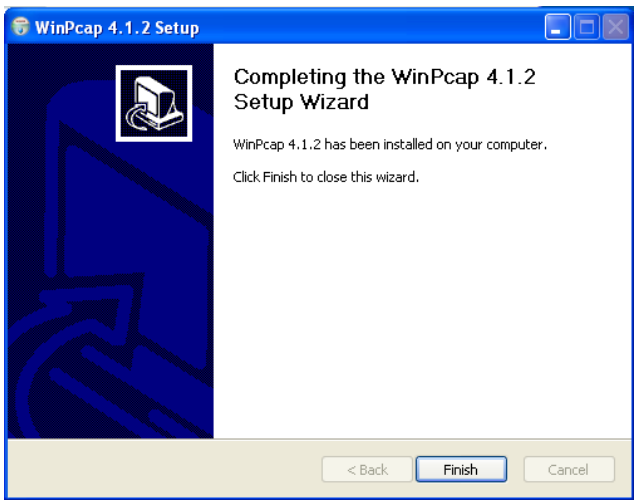
The *Installation options* Dialog Box is displayed.

19 Select the *Automatically start the WinPCap driver at boot time* Option, and then click the **Install** Button.



Installation of WinPCap starts.

20 Click the **Finish** Button.

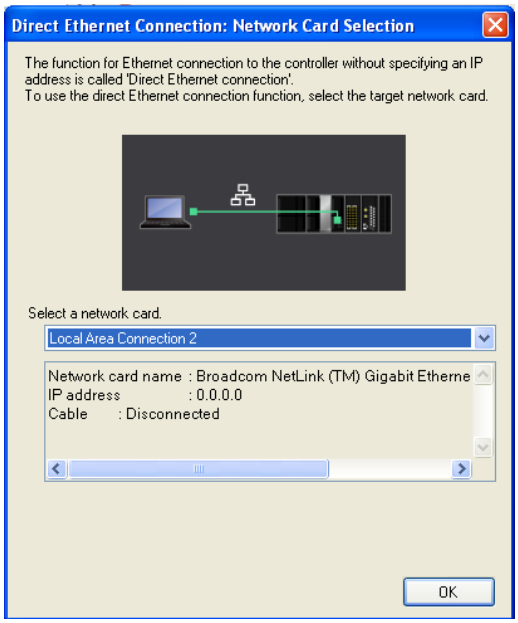


WinPCap is installed and installation of the Sysmac Studio continues.

Ethernet Card Selection

During installation wizard execution, the *Direct Ethernet Connection: Network Card Selection* Dialog Box is displayed.

21 Select the network card for connecting the Controller with an Ethernet cable from the computer that runs the Sysmac Studio, and then click the **OK** Button.

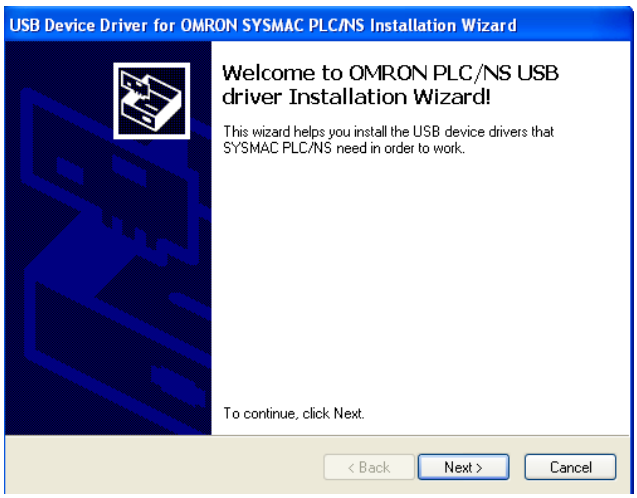


The network card for a direct Ethernet connection is selected and installation continues.

Installing the USB Driver for OMRON SYSMAC PLCs and NS-series PTs

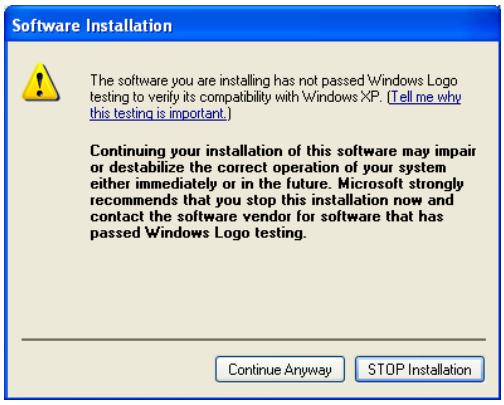
The USB Device Driver for OMRON SYSMAC PLC/NS Installation Wizard is displayed during the installation.

22 Click the **Next** Button.



The following message is displayed.

23 Click the **Continue Anyway** Button.

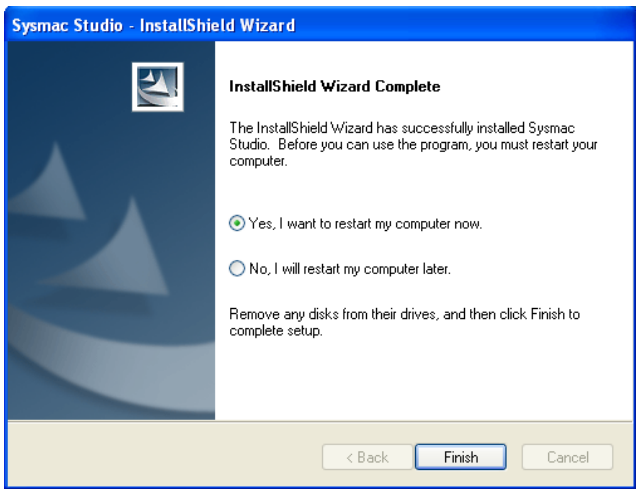


The USB device driver is installed. The following dialog box is displayed.

24 Click the **Finish** Button.

The USB device driver is installed and installation of the Sysmac Studio continues.

25 Select the *Yes, I want to restart my computer now* Option, and then click the **Finish** Button.



The computer is restarted. This completes the installation of the Sysmac Studio.

2-2 Uninstalling the Sysmac Studio

2-2-1 Uninstalling the Sysmac Studio

Use the following steps to uninstall the Sysmac Studio.

(1) Uninstall the Sysmac Studio.

(2) Uninstall the Communications Middleware.

(3) Uninstall the CX-Server Driver Manager* and the CX-Server.*

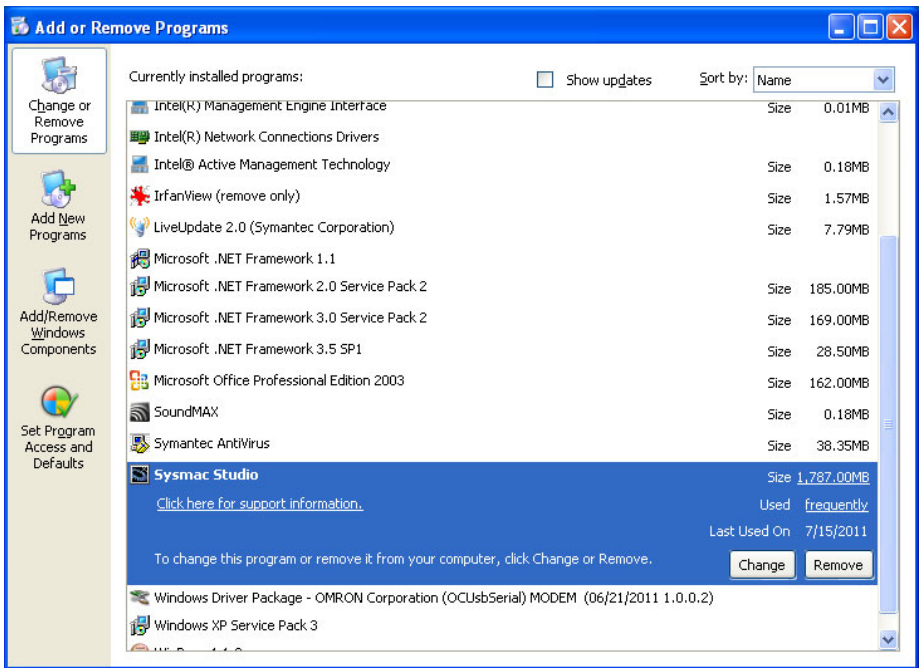
* These are displayed if the Support Software is installed or if the Sysmac Studio is installed on a computer with the CX-One. To uninstall the CX-One, refer to the *CX-One Setup Manual* for the procedure.

Uninstalling the Sysmac Studio

1 Open the Control Panel from the Windows Start Menu and then select ***Add or Remove Programs***.

The Add or Remove Programs Dialog Box is displayed.

2 Select the Sysmac Studio, and then click the **Remove** Button.



The following dialog box is displayed to confirm deletion of the Sysmac Studio, and uninstallation of the Sysmac Studio continues.

3 Click the **Yes** Button.

The following dialog box is displayed to confirm uninstallation of CX Common Tools.

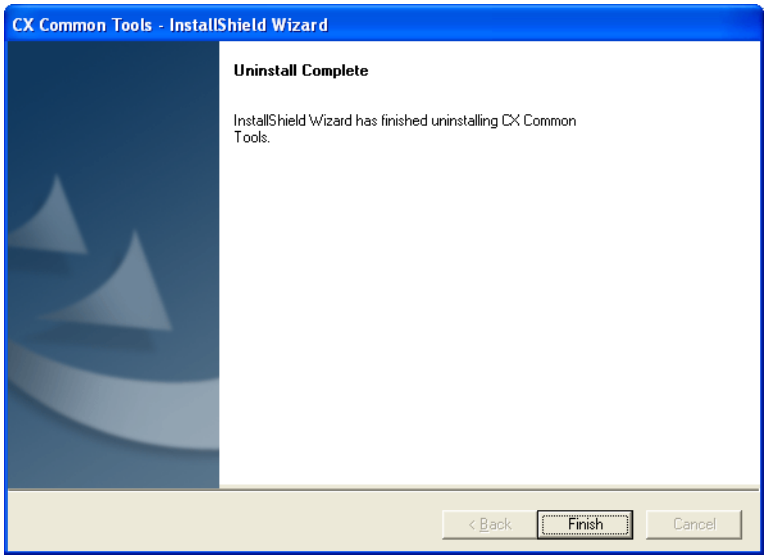
4 Click the **Yes** Button to continue removal of the CX Common Tools.

The CX Common Tools are removed.

*Always click the **Yes** Button and remove the CX Common Tools.

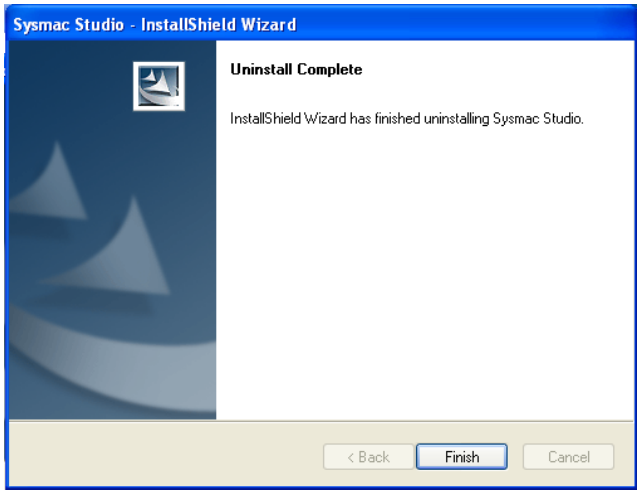
The following dialog box is displayed after the CX Common Tools are removed.

5 Click the **Finish** Button.



Uninstallation of the Sysmac Studio continues.
The following dialog box is displayed after uninstallation of the Sysmac Studio is completed.

6 Click the **Finish** Button.



This completes the uninstallation of the Sysmac Studio.

Uninstalling the Communications Middleware

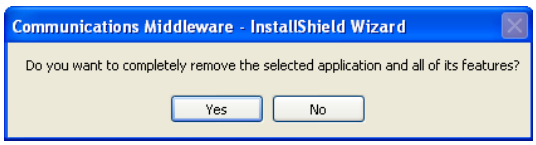
1 Open the Control Panel from the Windows Start Menu and then select ***Add or Remove Programs***.

The Add or Remove Programs Dialog Box is displayed.

2 Select the Communications Middleware, and then click the **Remove** Button.

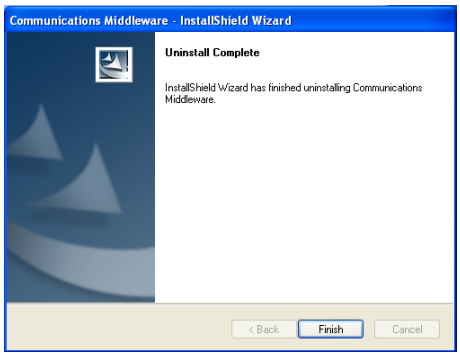
The following dialog box is displayed to confirm the uninstallation of Communication Middleware.

3 Click the **Yes** Button.



Uninstallation of the Communications Middleware is started.

4 The Maintenance Completed Dialog Box is displayed when uninstallation is completed.



Uninstalling the CX-Server Driver Manager and the CX-Server

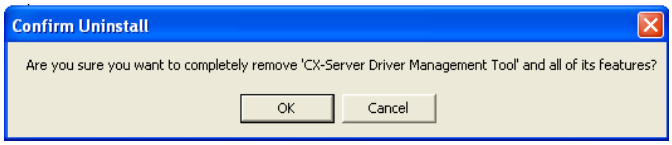
1 Open the Control Panel from the Windows Start Menu and then select ***Add or Remove Programs***.

The Add or Remove Programs Dialog Box is displayed.

2 Select the CX-Server Driver Manager Tool, and then click the **Change/Remove** Button.

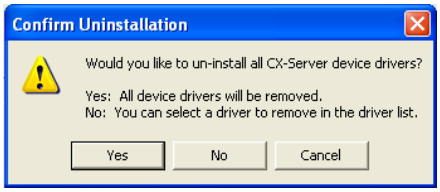
The following dialog box is displayed.

3 The following dialog box is displayed to confirm the uninstallation of CX-Server Driver Management Tool. Click the **Yes** Button.



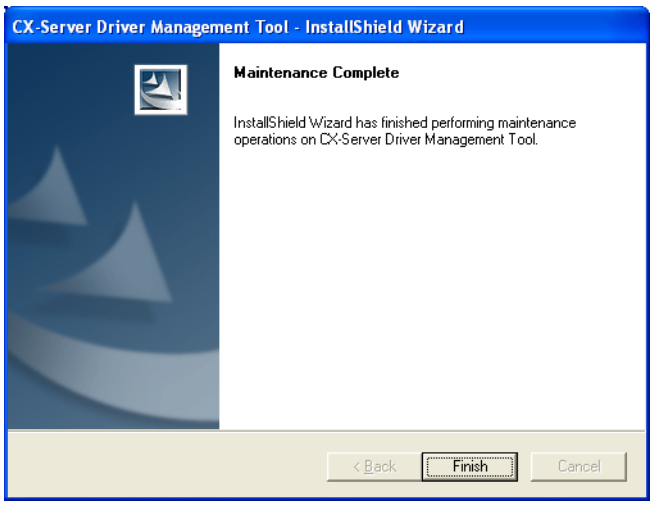
A dialog box is displayed to select the driver to remove.

4 Click the **Yes** Button to remove all device drivers.



Uninstallation of the CX-Server Driver Manager is started.

5 The Maintenance Completed Dialog Box is displayed when the uninstallation of the CX-Server Driver Management Tool is completed.



Click the **Finish** button.

6 Continue by selecting the CX-Server and repeat the above procedure for uninstallation of CX-Server.

3

System Design

This section describes the basic concepts for designing an NJ-series System with the Sysmac Studio and the basic operating procedures.

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3-1 Basic Flow of System Design 1

This section gives the basic flow and settings that are required to use the Sysmac Studio to design a user program that takes advantage of the characteristics of IEC 61131-3 programming. This basic flow is suitable for user program design in a development scenario in which hardware and software specifications are determined in phases. The procedures are described below.

Creating a Project

A project file is created.

1. Starting the Sysmac Studio: Start the Sysmac Studio. *3-3-1*
2. Creating a Project: Create a project. *3-3-2*

Designing the User Program

Variables and POUs are registered.

1. Registering Global Variables: Register user-defined variables that are used in more than one program in the *Global Variables*. *4-1-1*
2. Registering POUs: Register the programs, functions, and function blocks as *POUs*. *4-1-2*
3. Registering Local Variables: Register the user-defined variables that are used in only one POU in the *Local Variables* for that POU. *4-1-1*
4. Registering Axis Variables: Register the Axis Variables that are used in the user program in the *Axis Settings*. . *4-1-1*
5. Registering Axes Group Variables: Register the Axes Group Variables that are used in programs that control interpolates axes in the *Axes Group Settings*. *4-1-1*
6. Registering Cam Data Variables: Register the cam data variables that are used in the user program in the *Cam Data Settings*. *4-1-1*
7. Creating the POU Algorithms: Create the POU algorithms. . . . . *4-1-1* to *4-1-6*

Controller Configurations and Setup

The Controller Configurations and Setup are created.

Controller Configurations:

1. Creating the EtherCAT Configuration: Register the EtherCAT slaves in the *EtherCAT* Configuration. *4-2-1*
2. Creating the CPU/Expansion Rack Configuration: Register the Units in the *CPU/Expansion Racks* Configuration. *4-2-3*
3. Registering Device Variables: Register device variables to user-defined variables in the *I/O Map* to use or to edit and use device variables in the user program. The device variables interface the user program with I/O information from the devices (slaves and Units). *4-1-1*

Controller Setup:

1. Editing Slave Parameters: Edit the *Operation Settings* of the slaves. *4-2-2*
2. Editing Unit Parameters: Edit the *Operation Settings* of the Units *4-2-3*
3. Editing Controller Setup: Edit the *Operation Settings* of the Controller in the *Controller Setup*. *4-2-4*
4. Editing Axes: Edit the *Operation Settings* of the axes that you registered in the *Axis Settings*. *4-2-5*
5. Editing Axes Groups: Edit the *Operation Settings* of the interpolated axes that you registered in the *Axes Group Settings*. *4-2-5*

Designing Tasks

The tasks, which are used to execute programs, are created.

1. Registering Tasks: Register the tasks in *Tasks*. *4-2-7*
2. Designing Tasks: Design the operation of the tasks. *4-2-7*
3. Editing Tasks: Assign programs to the tasks. *4-2-7*
4. Editing Tasks: Design the I/O that are controlled by the tasks and the variables that are shared between tasks. *4-2-7*

Offline Program Debugging

The Simulator is used to debug the program.

1. Debugging though Simulation: Start the Simulator and debug the user program. *6-3*

Preparations for Online Debugging

The settings that are required for online debugging are made.

1. Assigning Variables and Axis IDs: Assign the variables and axis IDs in the *Axis Settings*. *6-4-1*
2. Assigning Variables and Real I/O: Assign the user-defined variables and I/O devices in the I/O Map. *6-4-1*

Online Program Debugging

Debugging is performed on the physical system.

1. Transferring Data to the Controller: Transfer the user program, system configuration, and variable information to the Controller. *6-4-2*
2. Testing Axis Operation: Use the MC Test Run to check wiring. *6-4-2*
3. Checking I/O: Use the *I/O Map* to check the I/O status between internal I/O devices and external I/O devices, and the wiring to external I/O devices. *6-4-2*
4. Checking Assignments: Use a Watch Tab Page to check the assignments between user-defined variables and I/O devices. *6-2-1*, *6-4-2*

Testing Operation

Final debugging of the user program is performed using trial operation.

Debugging Programming with Data Traces: Execute data traces to check the operation of the user program. . . . *6-2-9*

3-2 Basic Flow of System Design 2

This section gives the basic flow and settings that are required to use the Sysmac Studio to design a user program in a traditional top-down fashion. This basic flow is suitable for user program design in a development scenario in which hardware and software specifications are determined in advance. The procedures are described below.

Creating a Project

A project file is created.

1. Starting the Sysmac Studio: Start the Sysmac Studio. *3-3-1*
2. Creating a Project: Create a project. *3-3-2*

Controller Configurations and Setup

The Controller Configurations and Setup are created.

Controller Configurations:

1. Creating the EtherCAT Configuration: Register the EtherCAT slaves in the *EtherCAT* Configuration. *4-2-1*
2. Creating the CPU/Expansion Rack Configuration: Register the Units in the *CPU/Expansion Racks* Configuration. *4-2-3*

Controller Setup:

1. Editing Slave Parameters: Edit the *Operation Settings* of the slaves. *4-2-1*
2. Editing Unit Parameters: Edit the *Operation Settings* of the Units *4-2-2*
3. Editing Controller Setup: Edit the *Operation Settings* of the Controller in the *Controller Setup*. *4-2-3*
4. Registering Axis Variables: Register the Axis Variables that are used in the user program in the *Axis Settings*. . . *4-1-1*
5. Registering Axes Group Variables: Register the Axes Group Variables that are used in programs that control interpolates axes in the *Axes Group Settings*. *4-1-1*
6. Editing Axes: Edit the Operation Settings of the axes that you registered in the *Axis Settings*. *4-2-5*
7. Editing Axes Groups: Edit the Operation Settings of the interpolated axes that you registered in the *Axes Group Settings*. *4-2-5*

Designing the User Program

The variables are registered and the POUs are created.

1. Registering Global Variables: Register user-defined variables that are used in more than one program in the *Global Variables*. *4-1-1*
2. Registering POUs: Register the programs, functions, and function blocks as *POUs*. *4-1-2*
3. Registering Local Variables: Register the user-defined variables that are used in only one POU in the Local Variables for that POU. *4-1-1*
4. Registering Device Variables: Register device variables to user-defined variables in the *I/O Map* to use or to edit and use device variables in the user program. The device variables interface the user program with I/O information from the devices (slaves and Units). *4-1-1*
5. Registering Cam Data Variables: Register the cam data variables that are used in the user program in the *Cam Data Settings*. *4-1-1*
6. Creating the POU Algorithms: Create the POU algorithms. . . . . *4-1-1* to *4-1-6*

Designing Tasks

The tasks, which are used to execute programs, are created.

1. Registering Tasks: Register the tasks in *Tasks*. *4-2-7*
2. Editing Tasks: Assign programs to the tasks. *4-2-7*
3. Editing Tasks: Design the I/O that are controlled by the tasks and the variables that are shared between tasks. *4-2-7*

Offline Program Debugging

The Simulator is used to debug the program.

1. Debugging though Simulation: Start the Simulator and debug the user program. *6-3-1*

Preparations for Online Debugging

The settings that are required for online debugging are made.

1. Assigning Variables and Axis IDs: Assign the variables and axis IDs in the *Axis Settings*. *6-4-1*
2. Assigning Variables and Real I/O: Assign the user-defined variables and I/O devices in the *I/O Map*. *6-4-1*

Online Program Debugging

Debugging is performed on the physical system.

1. Transferring Data to the Controller: Transfer the user program, system configuration, and variable information to the Controller. *6-4-2*
2. Testing Axis Operation: Use the MC Test Run to check wiring. *6-4-2*
3. Checking I/O: Use the *I/O Map* to check the I/O status between internal I/O devices and external I/O devices, and the wiring to external I/O devices. *6-4-2*
4. Checking Assignments: Use a Watch Tab Page to check the assignments between user-defined variables and I/O devices. *6-2-1*, *6-4-2*

Testing Operation

Final debugging of the user program is performed using trial operation.

1. Debugging Programming with Data Traces: Execute data traces to check the operation of the user program. . *6-2-9*

3-3 Creating a Project

This section describes how to start and exit the Sysmac Studio, create and save projects, and perform other basic operations.

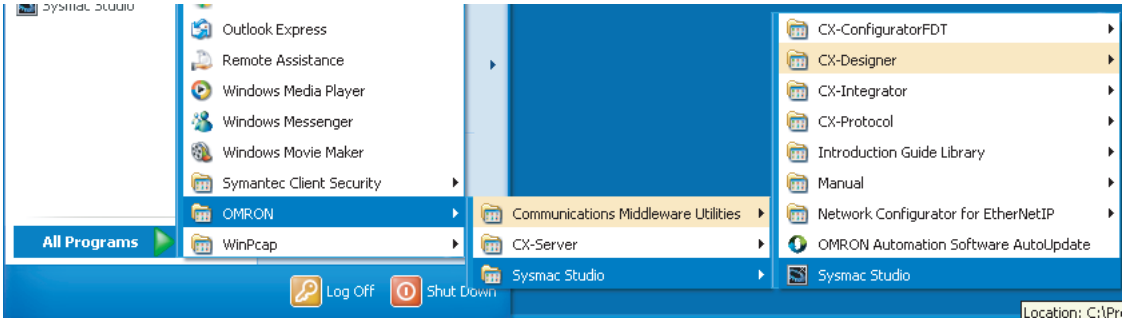
3-3-1 Starting and Exiting the Sysmac Studio

Starting the Sysmac Studio

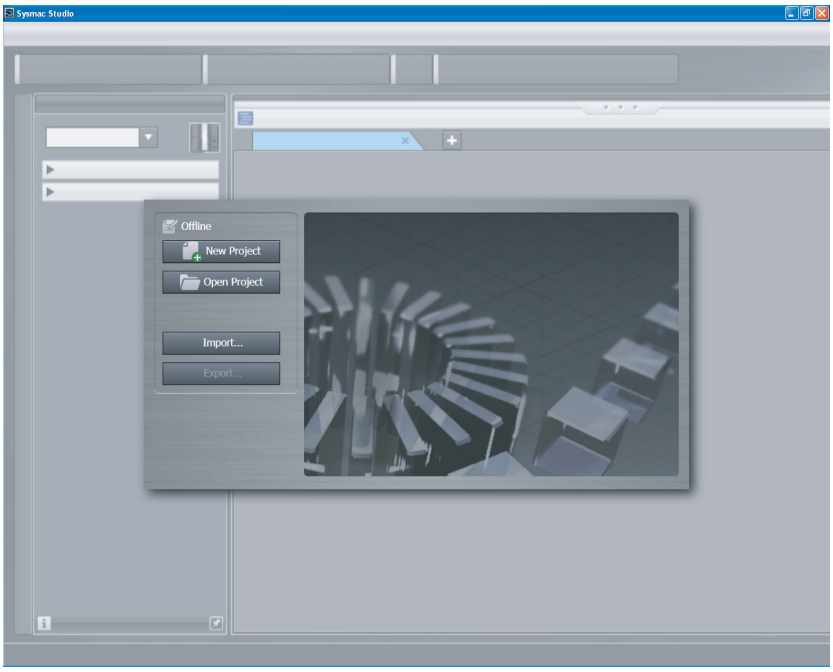
Use one of the following methods to start the Sysmac Studio.

- Double-click the Sysmac Studio shortcut icon on your desktop.

- Select ***All Programs - OMRON - Sysmac Studio - Sysmac Studio*** from the Windows Start Menu.



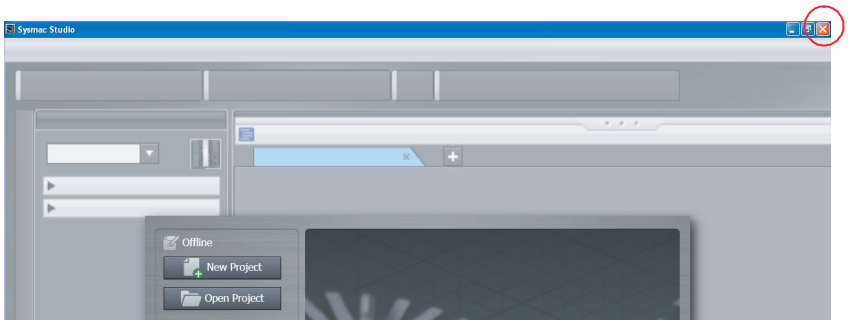
The Sysmac Studio starts and the following window is displayed.



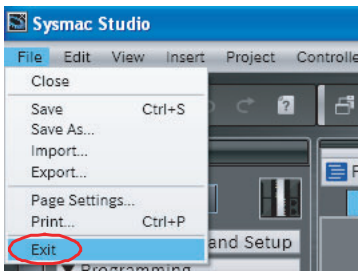
Exiting the Sysmac Studio

Use one of the following methods to exit the Sysmac Studio.

- Click the **Close** Button in the title bar.



- Select ***Exit*** from the File Menu.

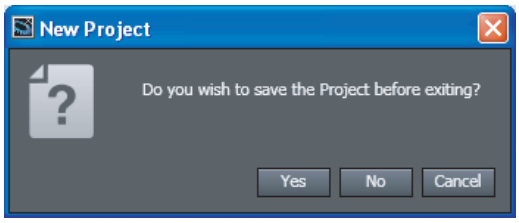


The Sysmac Studio will close.

* This menu is not displayed if the Project Window is displayed. Click the **Close** Button in the title bar.

Additional Information

If there is unsaved data when you exit the Sysmac Studio, a dialog box will appear that asks if you want to save the data.



Save the data if required. The Sysmac Studio will close after this operation.

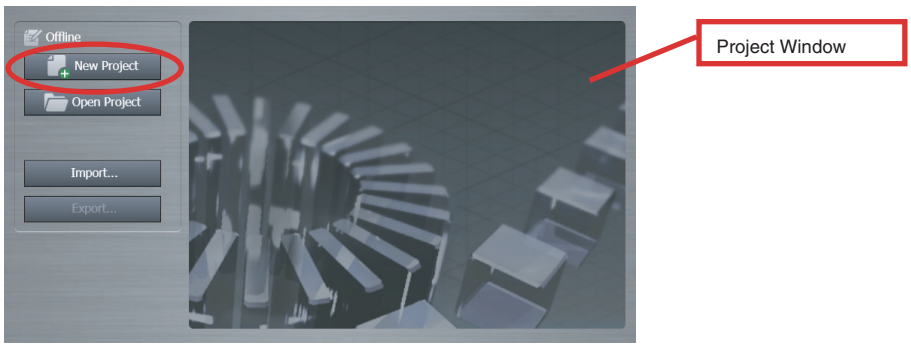
3-3-2 Creating a Project File

This section describes how to create a project file.

Creating a Project File from the Project Window

Use the following procedure to create a project file from the Project Window.

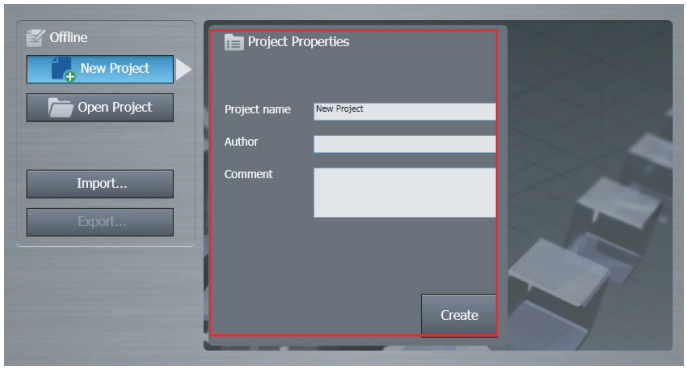
1 Click the **New Project** Button in the Project Window.



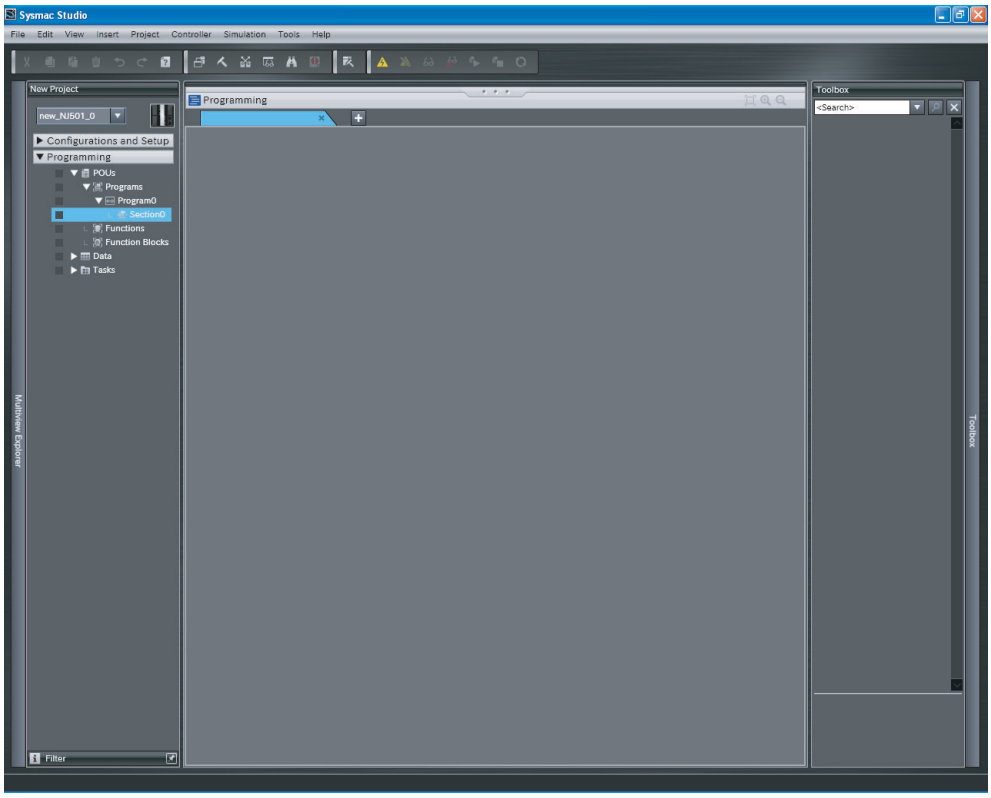
The Project Properties Dialog Box is displayed. The following table gives the functions of the buttons.

Button	Function
New Project	Creates a project file.
Open Project	Opens an existing project file.

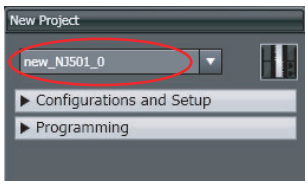
2 Enter the project name, author, and comment in the Project Properties Dialog Box and click the **Create** Button. (Only the project name is required.)



A project file is created and the following window is displayed.



The project file is created with an NJ501 Controller (displayed as “new_NJ501_0”) inserted in the configuration.

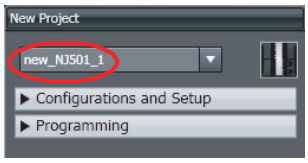


In the default status, the following model numbers are set.

Model	Model numbers in default status
NJ501	NJ501-1300/1400/1500

To add a Controller, right-click the Controller icon and select ***Add - Controller (NJ501).***

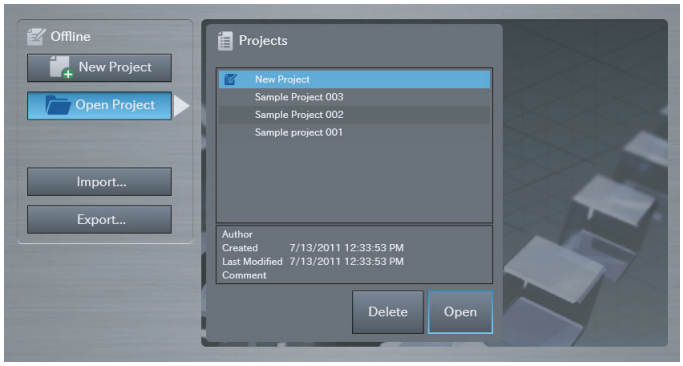
An NJ501 Controller is added with a serial number (displayed as “new_NJ501_1”).



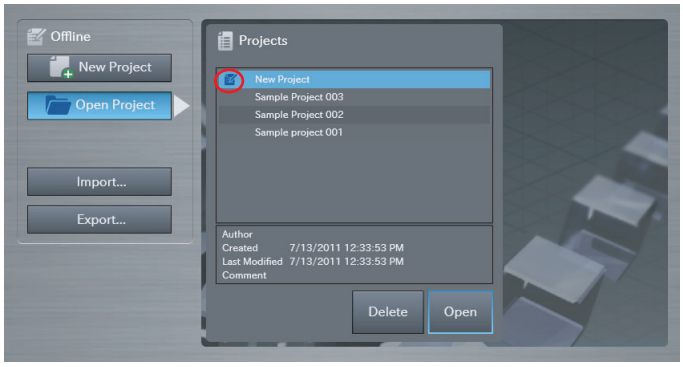
Editing Project File Properties

Use the following procedure to edit the properties of a project file.

1 Select the project file to edit in the Project Window.

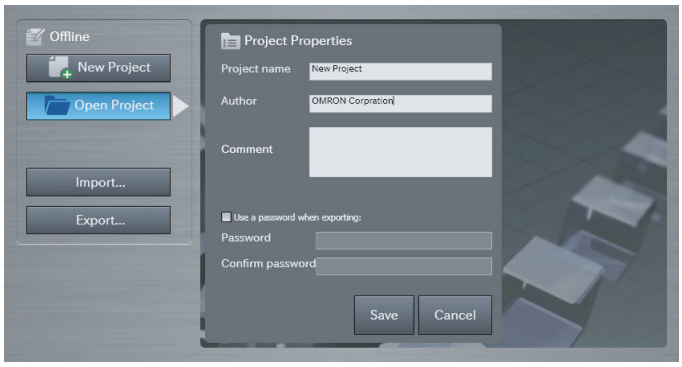


2 Click the **Edit Properties** Button ( ) that appears to the left of the selected project file.



The Edit Properties Dialog Box is displayed.

3 Edit the properties, and then click the **Save** Button.

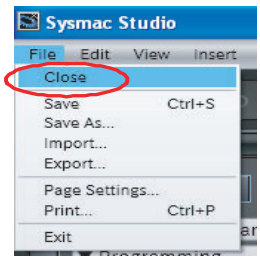


The properties are saved.

3-3-3 Closing a Project File and Returning to the Project Window

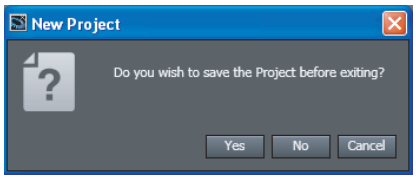
When you close a project file, you will return to the Project Window. Use the following procedure.

1 Select ***Close*** from the File Menu.

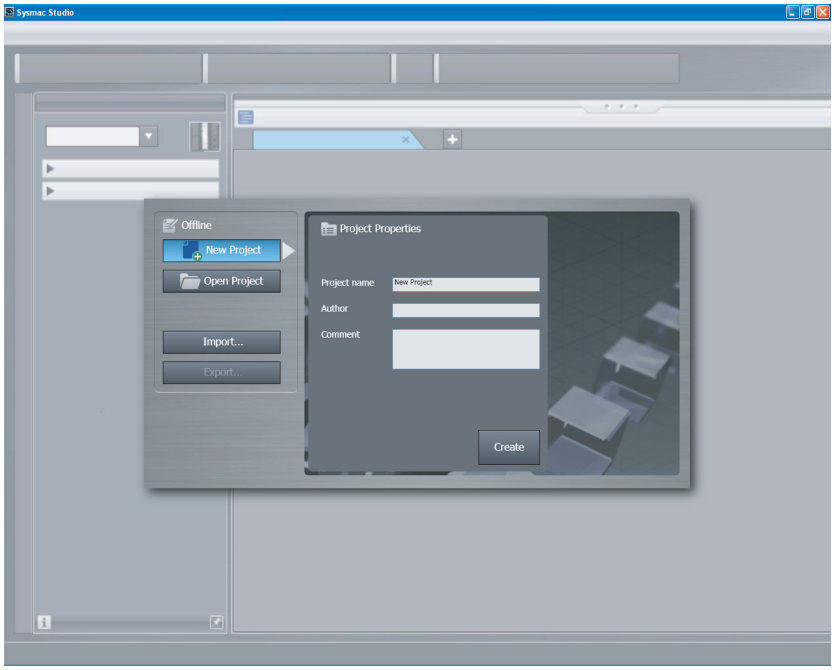


A dialog box is displayed to ask if you need to save the project.

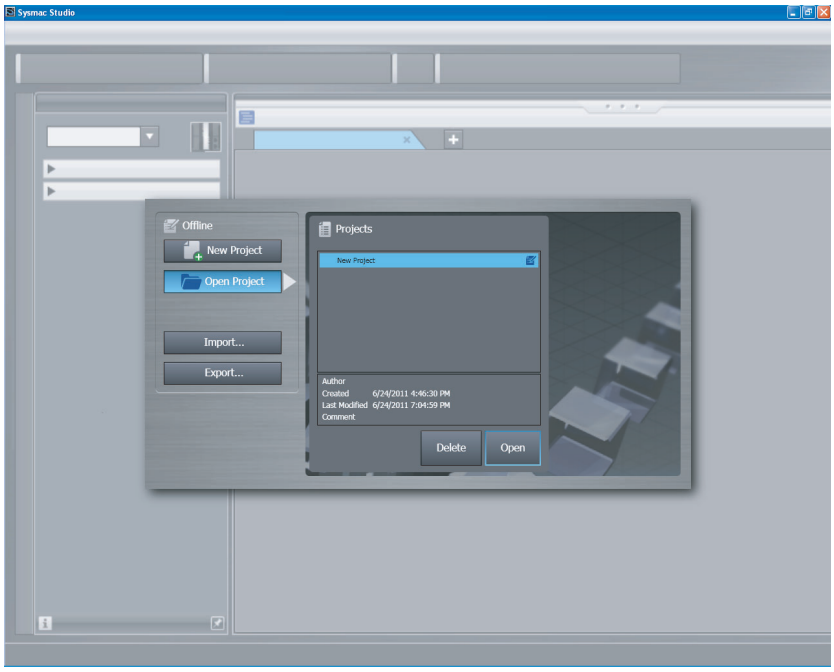
2 Click the **Yes** Button in the following dialog box.



The project name is registered in the project properties and the Project Window is displayed.



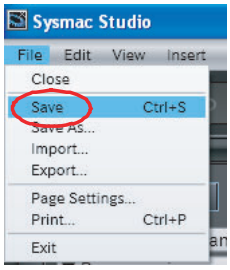
If you click the **No** Button, the Project Window is displayed without saving the project. You can check the name of the registered project if you click the **Open Project** Button in the Project Window.



3-3-4 Saving the Project File

This section describes how to save the project file.

1 Select ***Save*** from the File Menu. (Or press the **Ctrl + S** Keys.)



The current project file is saved. To use a project file on a different computer, export the project file as described in *3-3-7 Exporting a Project File*.

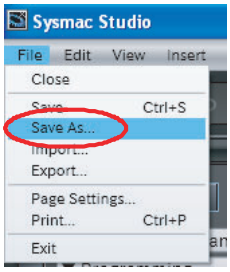
Additional Information

Information on synchronization is updated in the project file when synchronization is performed. After you perform synchronization, save the project file before you close it. If you do not save the project file, a message that says that the program execution IDs are different and that all data will be transferred is displayed the next time you perform synchronization.

3-3-5 Saving a Project File Under a Different Name

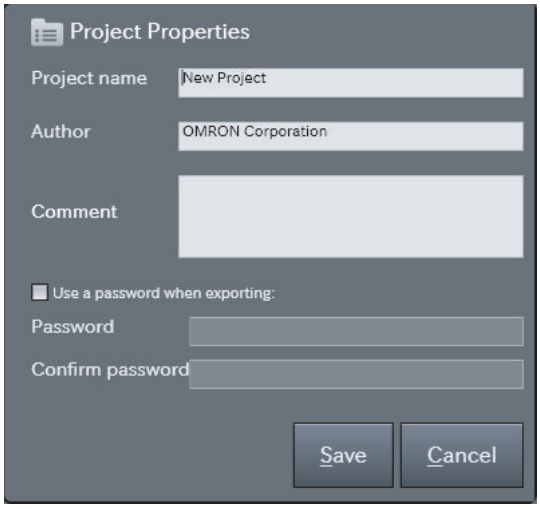
This section describes how to save a project file under a different name.

1 Select ***Save As*** from the File Menu.



The Project Properties Dialog Box is displayed.

2 Change the project file name, and then click the **Save** Button.



The project file is saved.

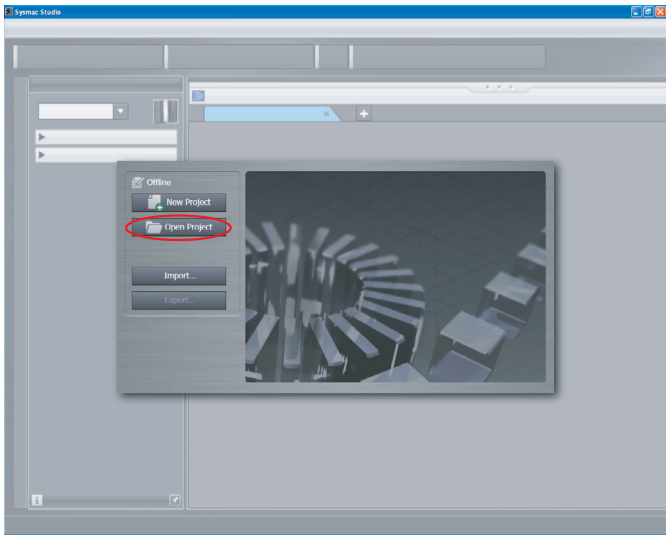
Additional Information

Information on synchronization is updated in the project file when synchronization is performed. After you perform synchronization, save the project file before you close it. If you do not save the project file, a message that says that the program execution IDs are different and that all data will be transferred is displayed the next time you perform synchronization.

3-3-6 Opening a Project File

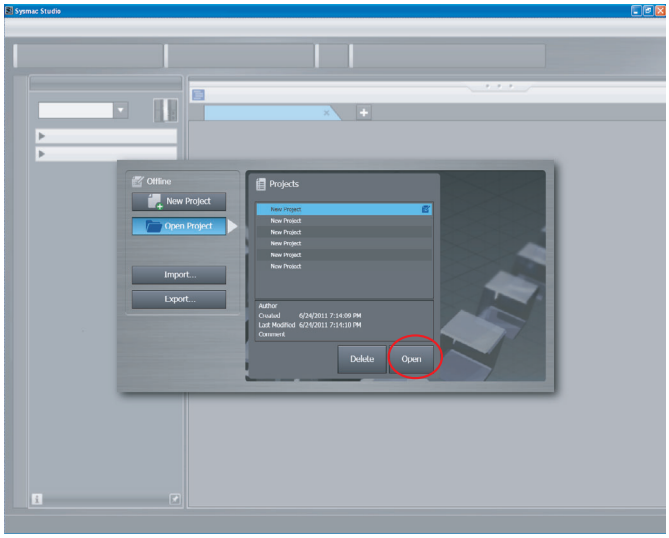
Use the following procedure to open an existing project file.

1 Click the **Open Project** Button in the Project Window.



The Project Dialog Box is displayed.

2 Select a project from the list of project names and click the **Open** Button.



The project is opened.

The following information is displayed in the Project Dialog Box. Use this information to help determine which file to select.

Item	Description
Project name	The project names that were entered when the projects were created are displayed. The default name is *NewProject*.
Author	The creator that was entered when the project was created is displayed.
Created	The date and time that the project was created is displayed.
Last date modified	The last date that the project was modified is displayed.
Comment	The comment that was entered when the project was created is displayed.

3-3-7 Exporting a Project File

You can use the following methods to export a project file.

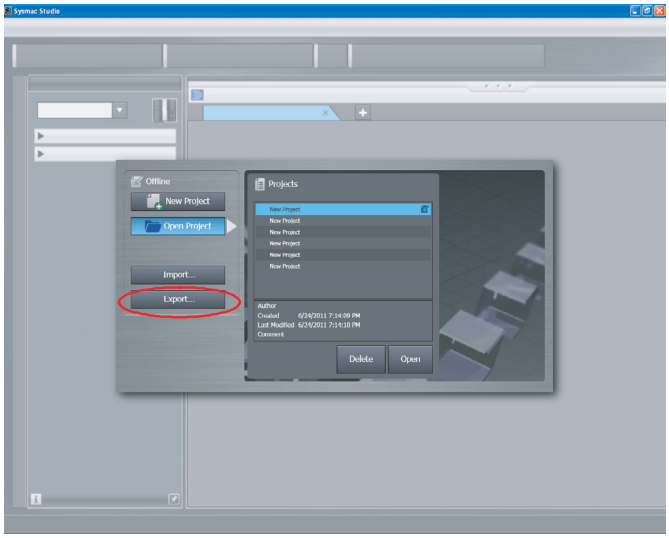
Method 1: Exporting from the Project Window

Method 2: Exporting from the Menu Bar of the Application Window

Method 1: Exporting from the Project Window

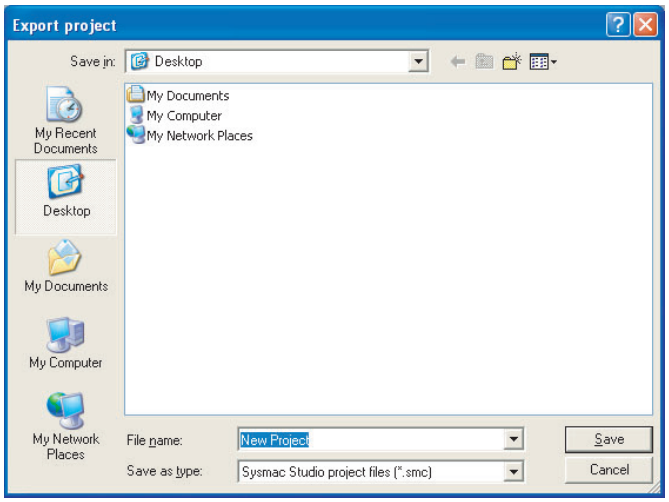
1 Select ***Close*** from the File Menu to return to the Project Window.

2 Select the project to export in the Project Window and click the **Export** Button.



The Export Project Dialog Box is displayed.

3 Specify a directory, enter a file name, and then click the **Save** Button.



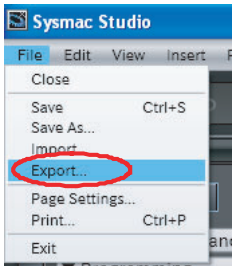
The project is exported to a file with a .smc file name extension.

Additional Information

The exported project file has the same contents as a project that was saved on the Sysmac Studio.

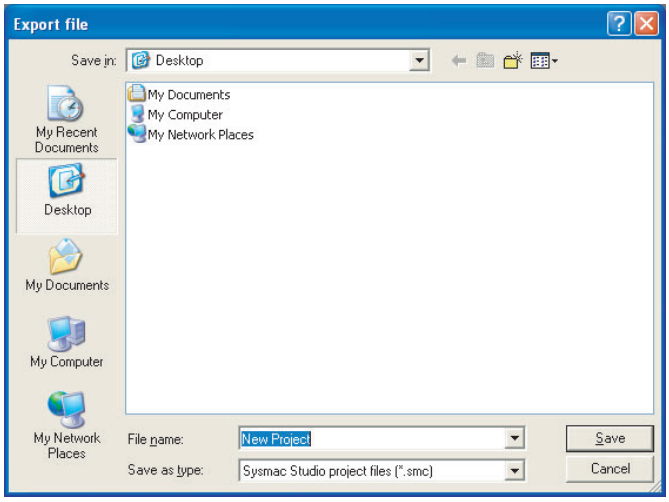
Method 2: Exporting from the Menu Bar of the Application Window

1 Select ***Export*** from the File Menu in the Application Window.



The Export Project Dialog Box is displayed.

2 Specify a directory, enter a file name, and then click the **Save** Button.

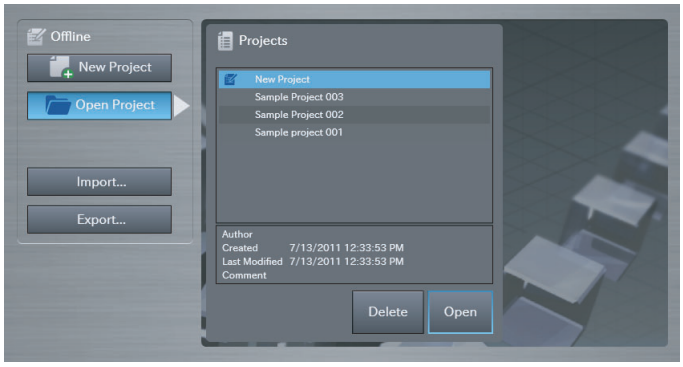


The project is exported to a file with a .smc file name extension.

Exporting a Project File with a Password

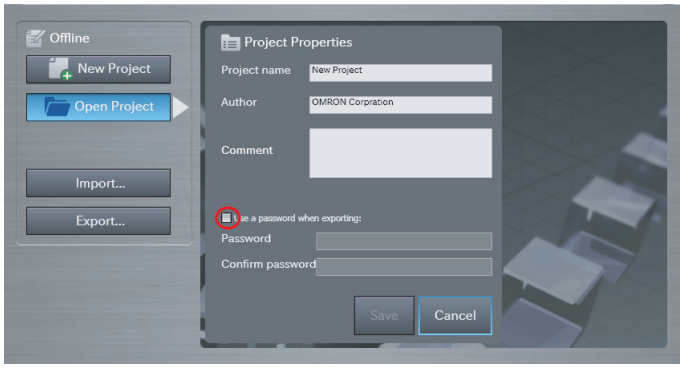
When you export a project file, you can place a password on the file to project your assets. Use the following procedure.

1 Select a project in the Project Window and click the **Edit properties** Button.

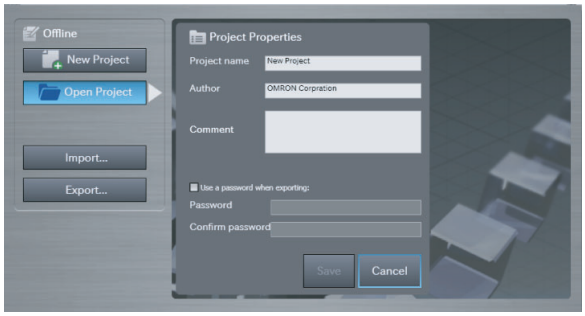


The Project Properties Dialog Box is displayed.

2 Select the *Use a password when exporting* Check Box, enter the password, and click the **Save** Button. The file is saved.

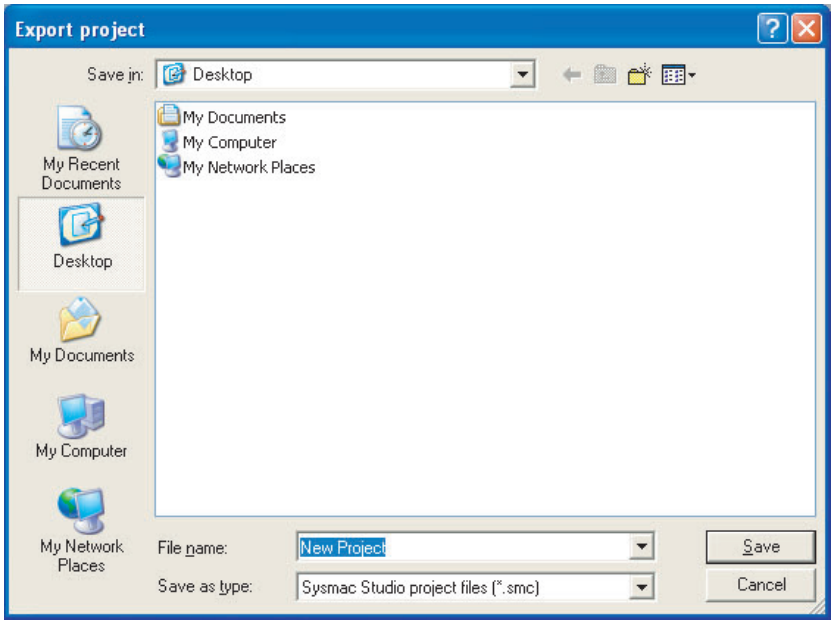


3 Select the project to export in the Project Window and click the **Export** Button.



The Export File Dialog Box is displayed.

4 Specify a directory, enter a file name, and then click the **Save** Button.



The project is exported to a file with an .smc file name extension.

3-3-8 Importing a Project File

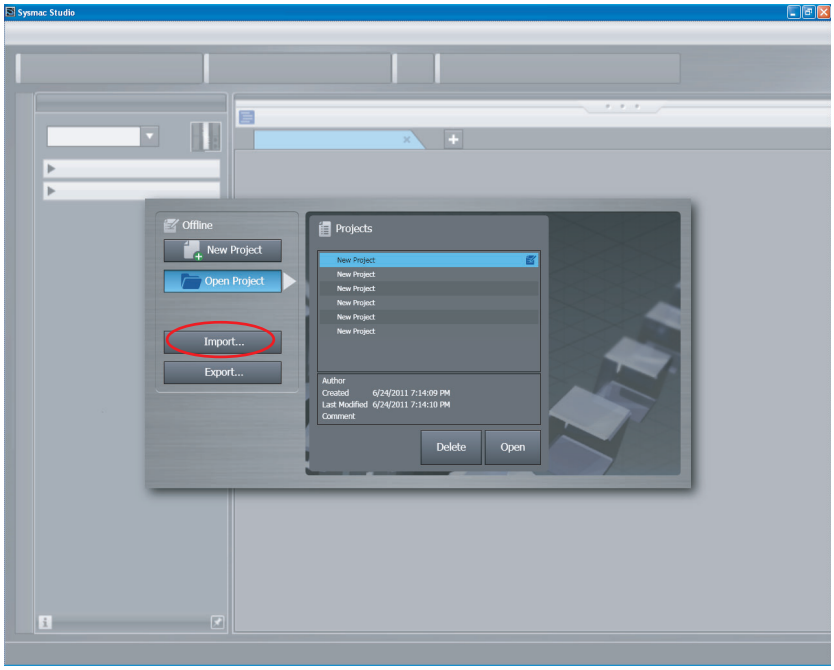
You can use the following methods to import a project file.

Method 1: Importing from the Project Window

Method 2: Importing from the Menu Bar of the Application Window

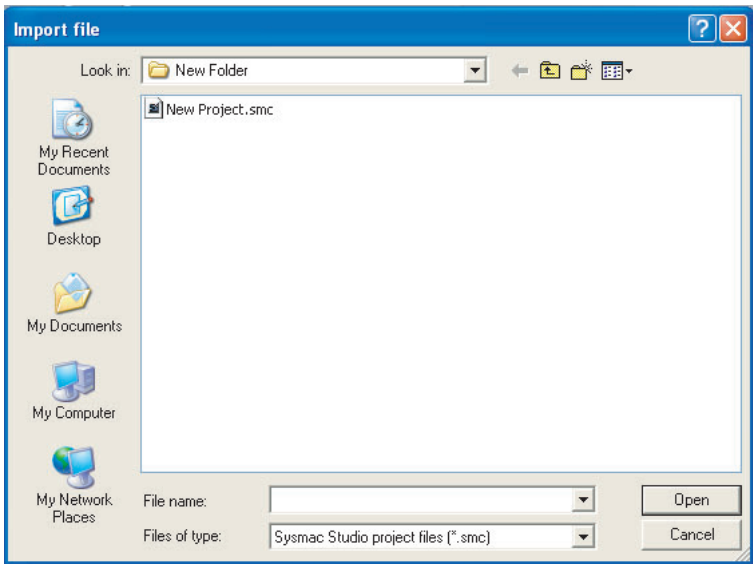
Method 1: Importing from the Project Window

1 Click the **Import** Button.



The Import file Dialog Box is displayed.

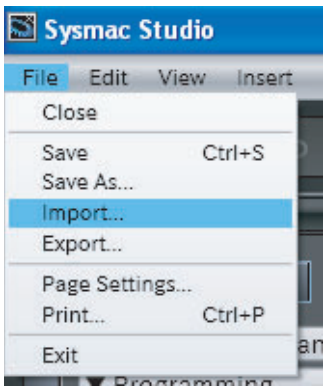
2 Select a project file with a .smc file name extension, and then click the **Open** Button.



The project file is imported.

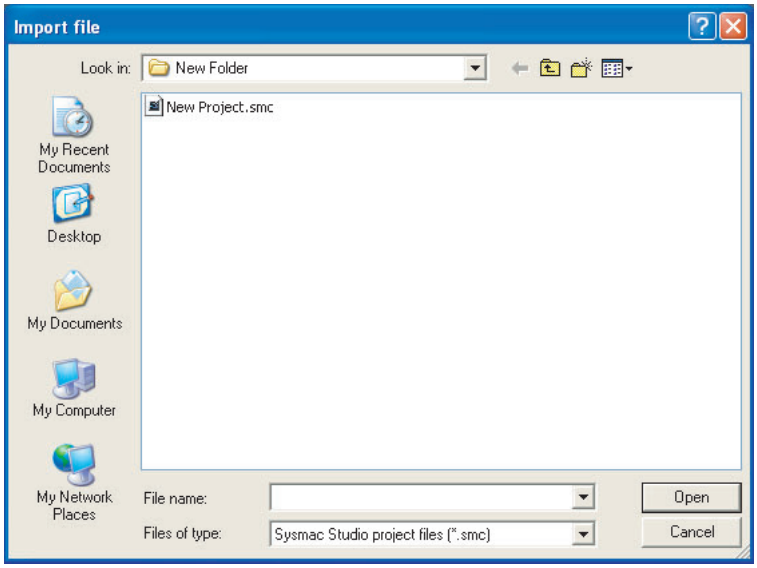
Method 2: Importing from the Menu Bar of the Application Window

1 Select ***Import*** from the File Menu in the Application Window.



The Import file Dialog Box is displayed.

2 Select a project file with a .smc file name extension, and then click the **Open** Button.

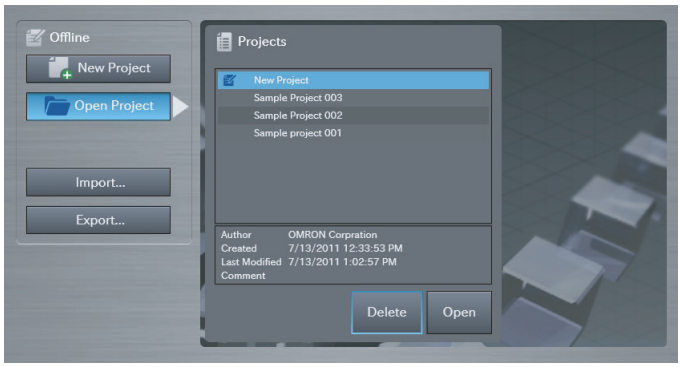


The project file is imported.

Importing a Project File with a Password

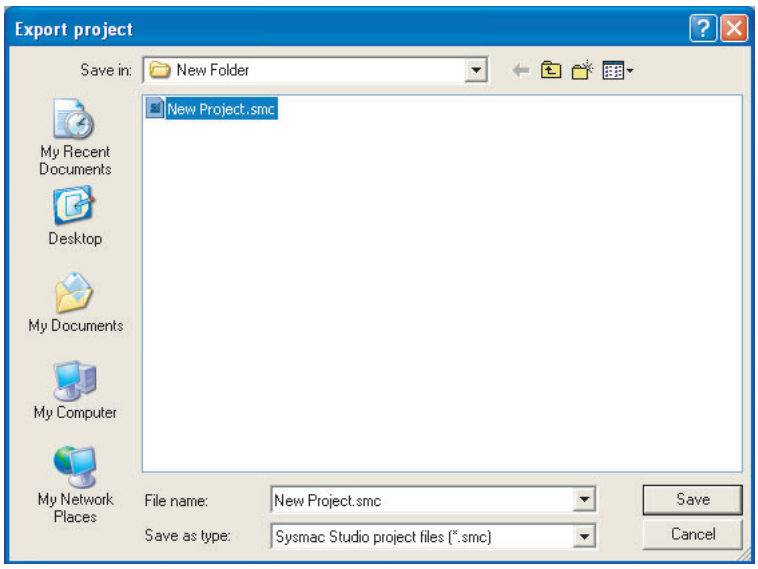
Use the following procedure to import a project file for which a password was set when the project was exported.

1 Click the **Import** Button.

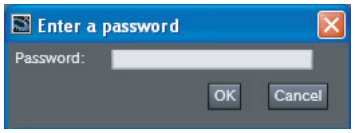


The Import file Dialog Box is displayed.

2 Select a project file with an .smc file name extension, and then click the **Open** Button.



The Enter a password Dialog Box is displayed.



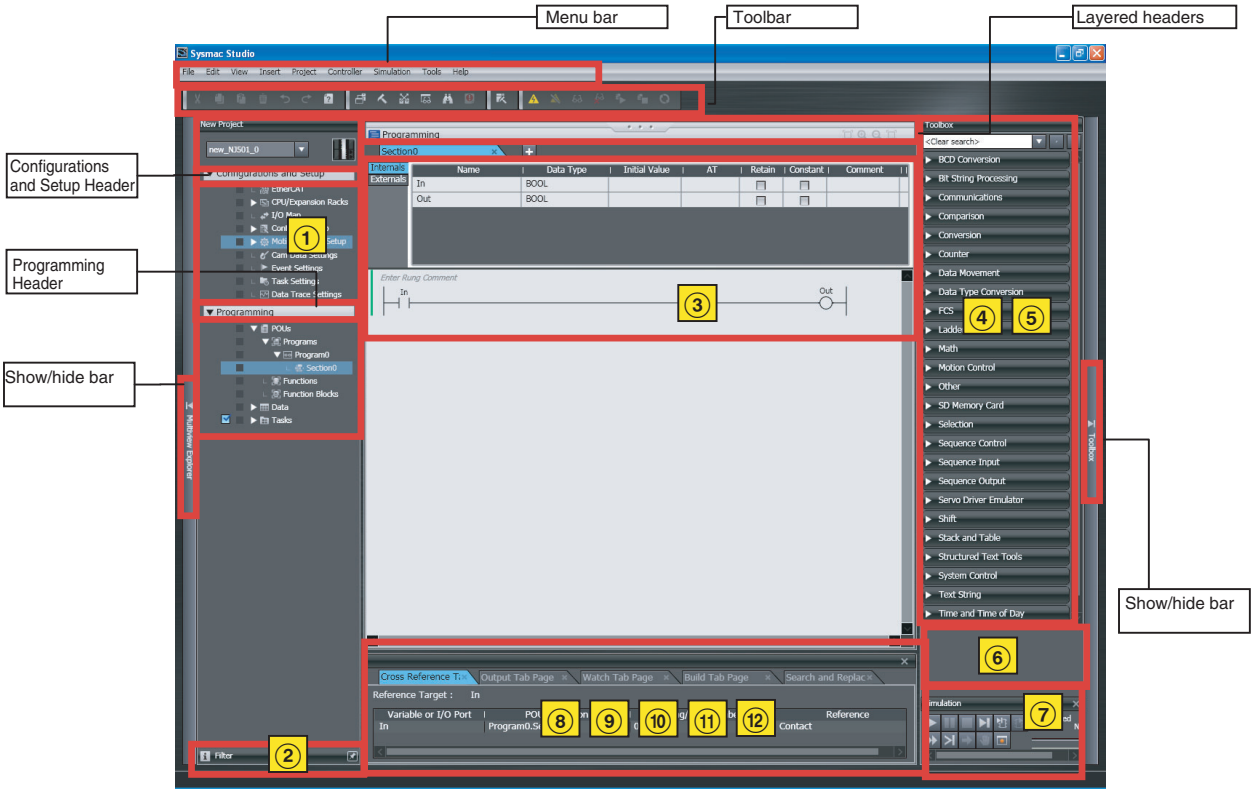
3 Enter the password, and click the **OK** Button.

The project file is imported.

3-4 Parts of the Window

This section gives the names and functions of the parts of the Sysmac Studio Window.

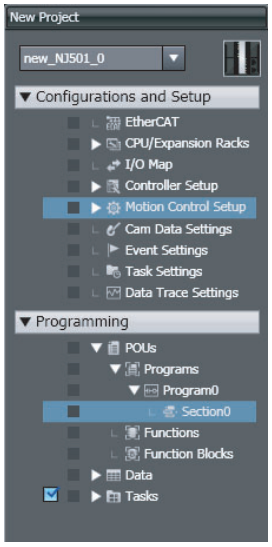
3-4-1 Application Window



Number	Name
①	Multiview Explorer
②	Filter Pane
③	Edit Pane
④	Toolbox
⑤	Search and Replace Pane
⑥	Status Monitor Pane
⑦	Simulation Pane
⑧	Cross Reference Tab Page
⑨	Output Tab Page
⑩	Watch Tab Page
⑪	Build Tab Page
⑫	Search and Replace Results Tab Page

The functions of these parts are described starting on the next page.

3-4-2 Multiview Explorer (1)



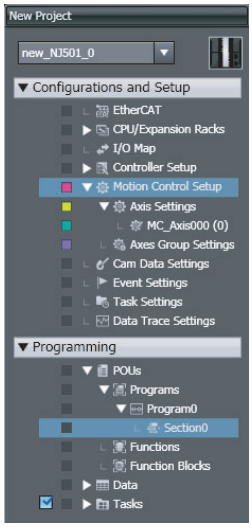
- This pane is your access point for all Sysmac Studio data. It is separated into *Configurations and Setup* and *Programming* Layers. Each of these layers is displayed in a tree structure.
- Click the icons (▶ or ▼) in front of each item in the tree to expand or collapse the tree.
- A pop-up menu is displayed if you right-click any data items that can be set.
- You can hide or display the Multiview Explorer by clicking the hide/show bar on the left side of the window. Even if the pane is hidden, you can display it temporarily by placing the mouse on the hide/show bar. The pane is hidden again five seconds after you move the mouse away from the hide/show bar.

- Layers and Items in the Multiview Explorer

Configurations and Setup
EtherCAT
CPU/Expansion Racks CPU Rack Expansion Rack 1
I/O Map
Controller Setup Operation Settings Built-in EtherNet/IP Port Settings
Motion Control Setup Axis Settings Axes Group Settings
Cam Data Settings
Event Settings
Task Settings
Data Trace Settings

Programming
POUs Programs Functions Function Blocks
Data Data Types Global Variables
Tasks

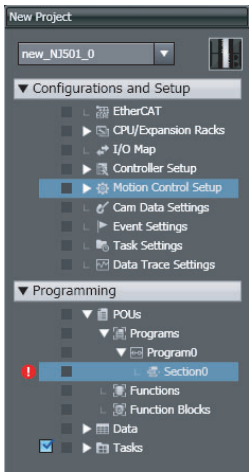
- Color Codes



You can display marks in five colors on the categories and members of the Multiview Explorer.

You can define how you want to use these marks, e.g., to indicate data development status or developer assignments. You can also use them as filter conditions in the Filter Pane that is described later in this section.

- Error Icons



The error icon indicates when there is an error in the edited data.

Click this icon to display the item with the error in the Edit Pane.

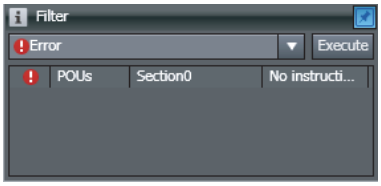
Precautions for Correct Use

You cannot download the data to the NJ-series CPU Unit if an error icon is displayed.

Filter Pane (2)

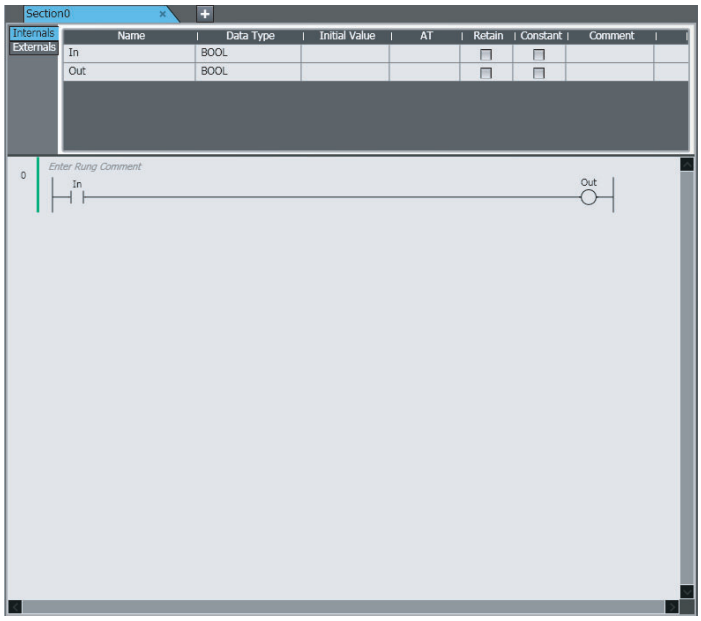
The Filter Pane allows you to search for color codes and for items with an error icon. The results are displayed in a list. Click the Filter Pane Bar to display the Filter Pane. The Filter Pane is hidden automatically if the mouse is not placed in it for more than five seconds at a time.

Automatically hiding the Filter Pane can be canceled by clicking the pin ( ) icon.



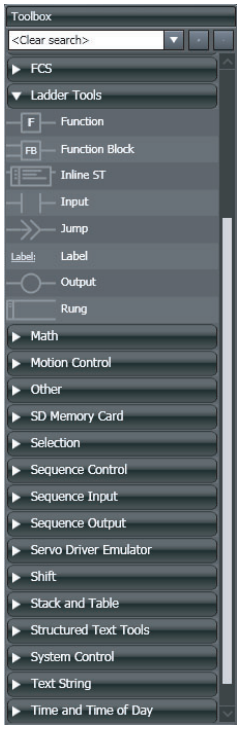
You can search for only items with a specific color code or items with error icons to display a list with only items that meet the search condition. This allows you to edit multiple items from a single list. Click any item in the search result to display the item in the Edit Pane.

3-4-3 Edit Pane (3)



The Edit Pane is used to display and edit the data for any of the items. It is separated into *Configurations and Setup* and *Programming* Layers. Double-click an item in the Multiview Explorer to switch the layers and display details of the selected item in the Edit Pane. You can also click a layer header to quickly switch to the layer. You can use this to effectively design your system while switching the Layer in the Edit Pane, e.g., to program while looking at the data in **Configurations and Setup** Layer.

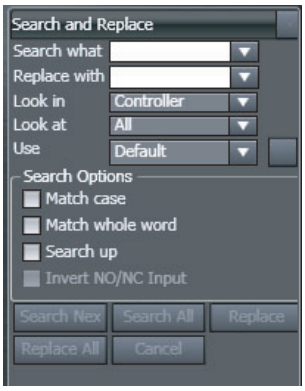
3-4-4 Toolbox (4)



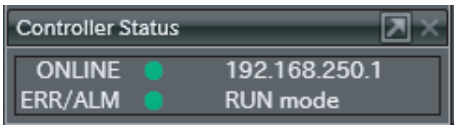
The Toolbox shows the objects that you can use to edit the data that is displayed in the Edit Pane. You can hide or display the Toolbox by clicking the hide/show bar on the right side of the window. Even if the toolbox is hidden, you can display it temporarily by placing the mouse on the hide/show bar. The toolbox is hidden again five seconds after you move the mouse away from the hide/show bar.

Search and Replace Pane (5)

In the Search and Replace Pane, you can search for and replace strings in the data in the Programming Layer.



Status Monitor Pane (6)



The Status Monitor Pane shows the current operating status of the Controller. The Status Monitor Pane is displayed only while the Sysmac Studio is online with the Controller.

Additional Information

The Status Monitor Pane is not displayed when the Sysmac Studio is offline.

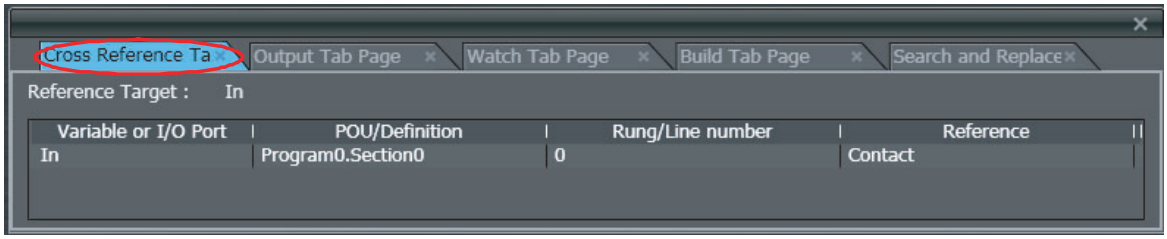
Simulation Pane (7)

The Simulation Pane is used to set up, start, and stop the Simulator for the Controller.

Additional Information

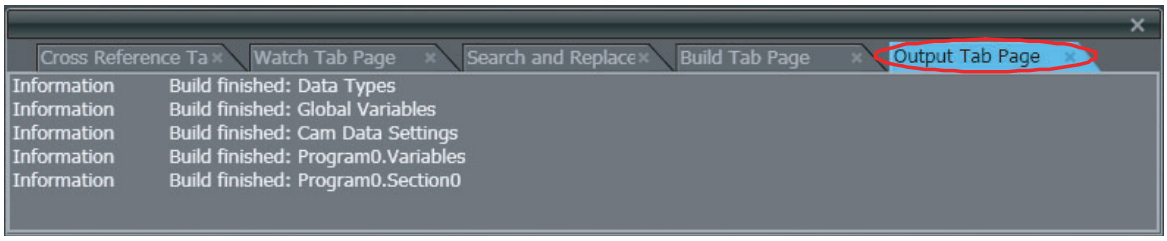
The Simulation Pane is not displayed when the Sysmac Studio is online with the Controller.

Cross Reference Tab Page (8)



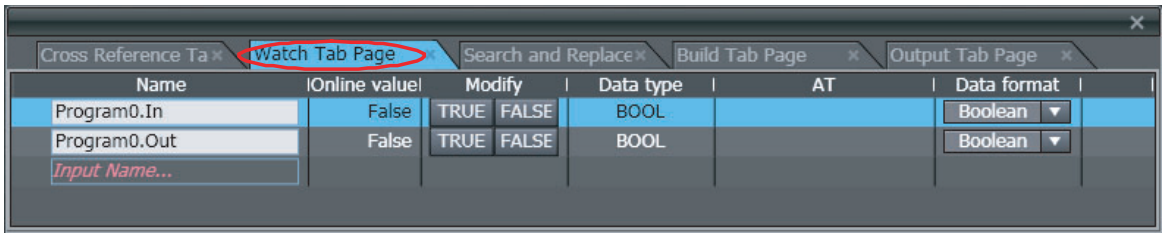
A Cross Reference Tab Page displays a list of where variables, data types, I/O ports, functions, and function blocks are used in the Sysmac Studio. You can select a variable or other item in the Ladder Editor or a variable table to display a list of the locations where the item is used. You can click any of the items in the list to jump to the location where the item is used.

Output Tab Page (9)



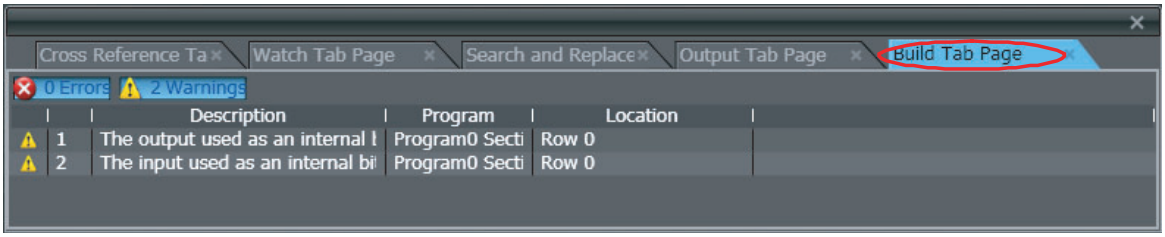
The Output Tab Page shows the results of building.

Watch Tab Page (10)



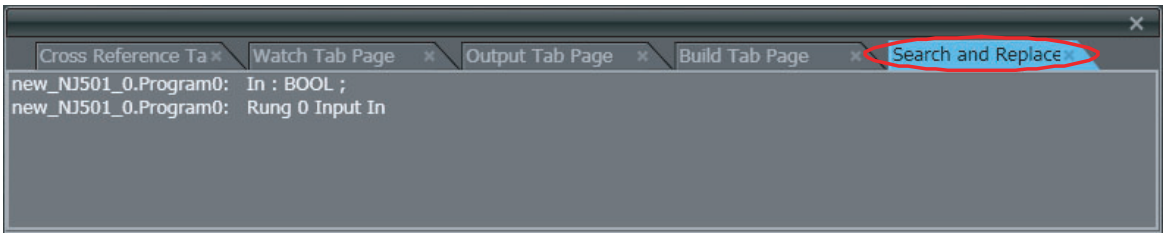
The Watch Tab Page shows the monitor results of the Simulator or online Controller. You can monitor the current values of variables by inputting the variables directly or by dragging them from a variable table or program rung.

Build Tab Page (11)



The Build Tab Page shows the results of program checks and building. Double-click any of the results to display the location of the program check error, program check warning, or building error in the Edit Pane so that you can edit it.

Search and Replace Results Tab Page (5)



The Search and Replace Results Tab Page shows the results when ***Search All*** or ***Replace All*** is executed. Double-click any of the search/replace results to display the location in the Edit Pane so that you can edit it.

3-5 Menu Command Structure

Menu	Submenu/command	
File	Close	---
	Save	
	Save As	
	Import	
	Export	
	Page Settings	
	Print	
	Exit	
Edit	Undo	---
	Redo	
	Cut	
	Copy	
	Paste	
	Delete	
	Select All	
	Search and Replace	
	Jump	
View	Output Tab Page	---
	Watch Tab Page	
	Cross Reference Tab Page	
	Build Tab Page	
	Search and Replace Results Tab Page	
	Simulation Pane	
	Zoom	Zoom In
		Zoom Out
		Zoom to Fit
		Zoom Reset
Insert	Circuit Parts	Line
		N.O. Input
		N.C. Input
		OR with N.O. Input
		OR with N.C. Input
		Output
		NOT Output
		Function
		Function Block
	Controller	NJ501
	Program	Ladder
		ST
		Section
	Function	Ladder
		ST

Menu	Submenu/command	
Insert	Function Block	Ladder
		ST
	Debug Program	Ladder
		ST
		Section
	Axis Settings	---
	Axes Group Settings	
	Cam Data Settings	
	Data Trace	
Project	Check All Programs	
	Check Selected Programs	
	Build Controller	
	Rebuild Controller	
	Abort Build	
	Memory Usage	
	Online Edit	Start
		Transfer
		Cancel
Controller	Communications Setup	---
	Online	
	Offline	
	Synchronization	---
	Mode	RUN Mode
		PROGRAM Mode
	Monitor	---
	Stop Monitoring	
	Set/Reset	Set
		Reset
	Forced Refreshing	TRUE
		FALSE
		Cancel
		Cancel All
	MC Test Run	Start
		Stop
	MC Monitor Table	---
	SD Memory Card	
	Controller Clock	
	Release Access Right	
	Update CPU Unit Name	
	Security	Setting of Operation Authority
		ID for User Program Execution
		Change Write Protect Switch
	Clear All Memory	---
	Reset Controller	

Menu	Submenu/command	
Simulation	Run	---
	Pause	
	Stop	
	Step Execution	
	Step In	
	Step Out	
	Continuous Step Execution	
	Execute One Scan	
	Jump to Current Position	
	Breakpoint Window	
	Set/Clear Breakpoint	
	Clear All Breakpoints	
	Calibration	
	Run in Execution Time Estimation Mode	
Tools	Troubleshooting	---
	Backup Variables and Memory	Backup
		Restore
	Export Global Variables	Network Configurator
		CX-Designer
Help	Help Contents	---
	Instruction Reference	
	System Defined Variable Reference	
	Keyboard Mapping Reference	
	Online Registration	
	About Sysmac Studio	

3-6 Basic Editing Operations

The following table lists the basic operations that you can perform in the Multiview Explorer and Edit Pane. The operations that you can use depend on the item that you are editing.

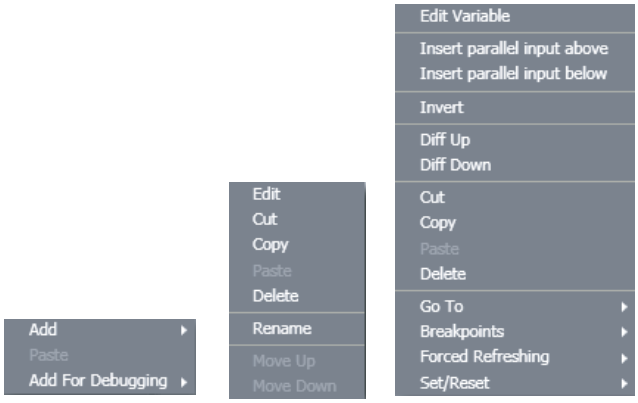
Operation	Button	Menu command	Pop-up menu command	Mouse operation	Shortcut keys
Inserting	---	---	Insert	---	R or Shift + R
Cutting		Edit - Cut	Cut	Drag	Ctrl + X
Copying		Edit - Copy	Copy	Press Ctrl and drag.	Ctrl + C
Pasting		Edit - Paste	Paste	Drop	Ctrl + V
Deleting		Edit - Delete	Delete	---	Delete
Deleting to the left	---	---	---	---	BackSpace
Changing a name	---	---	Rename	---	---
Selecting rows	---	---	Select All	Enclose items.	Ctrl + ↑
Undoing		Edit - Undo	Undo	---	Ctrl + Z
Redoing		Edit - Redo	Redo	---	Ctrl + Y
Entering Edit Mode	---	---	Edit	Double-click	F2
Leaving Edit Mode	---	---	---	Click	Enter
Moving the cursor	---	---	---	---	↑, ↓, ←, or →
Moving the cursor to next or previous item	---	---	---	---	Tab or Shift + Tab
Moving the cursor to the beginning of the row	---	---	---	---	Home
Moving the cursor to the end of the row	---	---	---	---	End
Moving to the next page	---	---	---	---	PageDown
Moving to previous page	---	---	---	---	PageUp
Finding and replacing	---	---	---	---	Ctrl + F
Jumping to an address	---	---	---	---	Ctrl + G
Jumping to a row comment	---	---	---	---	L

Note 1 The editing operation depends on the item/row.

2 Refer to *A-5 Keyboard Mapping* for other shortcut keys.

Pop-up Menus

Pop-up menus are provided to facilitate data editing in the panes. Right-click the data item and select the command (e.g., Add, Rename, Copy, or Paste) from the pop-up menu.



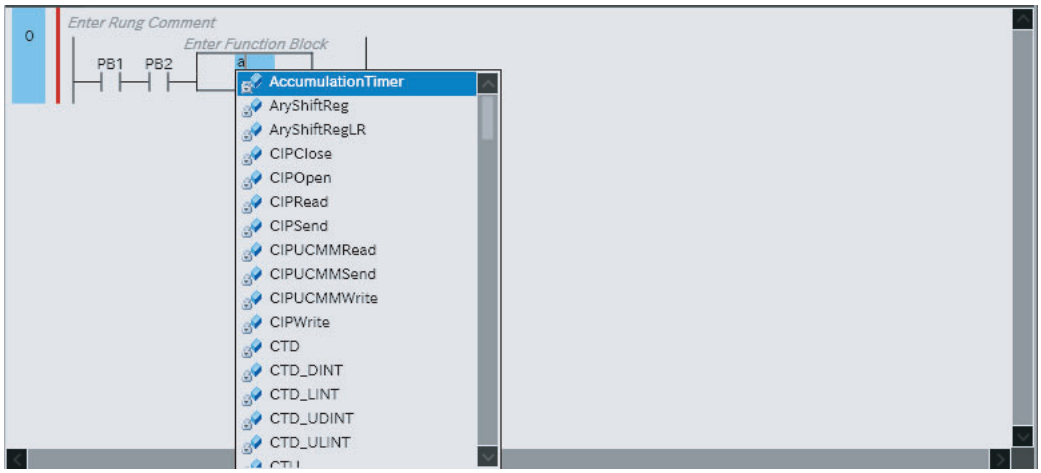
Entry Assistance

When you enter characters from the keyboard at the following times, the list of candidates that is displayed for selection is automatically narrowed.

● Entering Variable Names and Data Types

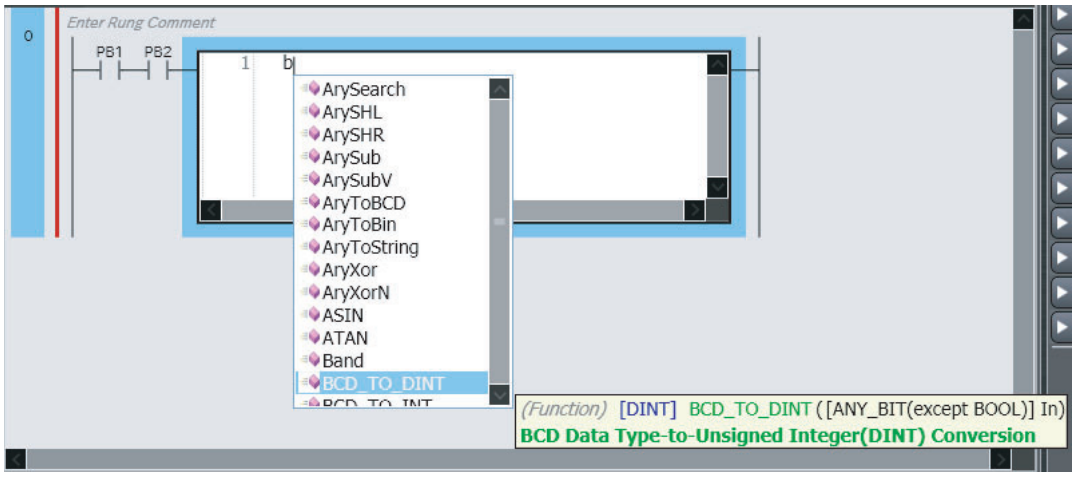
- Entering Variables Names in the Ladder Editor or ST Editor
- Entering Data Types in the ST Editor or ST Editor for Programs, Functions, or Function Blocks
- Entering Data Types in Variable Tables

Example: When you enter a variable name in the Ladder Edit, the variable names that you can enter are displayed in a list when you click the mouse button.

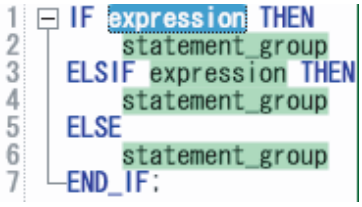


Entering Text in the ST Editor

- When you enter text in the ST Editor or in an Inline ST Box, the cursor moves to the first item in the list that starts with the character that you entered.



- When you press the **Tab** Key after entering the first keyword of a construct ("IF" in this example), the rest of the construct is automatically entered.



- When you drag an ST statement (here, an IF statement) from the Structured Text Tools in the Toolbox of the ST Editor, the keywords for the construct for the ST statement are automatically entered.

3-7 Sysmac Studio Settings and Operations

This section lists the operations of the Sysmac Studio.

3-7-1 Setting Parameters

Item		Description	Reference
EtherCAT Configuration and Setup		You create a configuration in the Sysmac Studio of the EtherCAT slaves connected to the built-in EtherCAT port of the Controller, and setup the EtherCAT masters and slaves in that configuration.	*4-2-1 EtherCAT Configuration and Settings*
	Registering slaves	You can set up devices by dragging slaves from the device list displayed in the Toolbox Pane to the locations where you want to connect them.	*4-2-1 EtherCAT Configuration and Settings*
	Setting master parameters	You set the common parameters of the EtherCAT network (e.g., the fail-soft operation and wait time for slave startup settings).	*4-2-1 EtherCAT Configuration and Settings*
	Setting slave parameters	You set the standard slave parameters and assign PDOs (process data objects).	*4-2-1 EtherCAT Configuration and Settings*
	Comparing and merging network configuration information	The EtherCAT network configuration information in the NJ-series CPU Unit and in the Sysmac Studio are compared and the differences are displayed.	*4-2-1 EtherCAT Configuration and Settings*
	Transferring the network configuration information	The EtherCAT network configuration information is transferred to the NJ-series CPU Unit. Or, the EtherCAT network configuration information in the NJ-series CPU Unit is transferred to the Sysmac Studio and displayed in the EtherCAT Editor.	*6-4-2 Performing Online Debugging*
	Importing ESI files	ESI (EtherCAT slave information) files are imported.	*4-2-1 EtherCAT Configuration and Settings*
CPU/Expansion Rack Configuration and Setup		You create the configuration in the Sysmac Studio of the Units mounted in the NJ-series CPU Rack and Expansion Racks and the Special Units. You can build a Rack by dragging Units from the device list displayed in the Toolbox Pane to the locations where you want to mount them.	*4-2-3 CPU/Expansion Rack Configuration and Setup*

Item		Description	Reference
	Registering Units	A Rack is built by dragging Units from the device list displayed in the Toolbox Pane to the locations where you want to mount them.	*4-2-3 CPU/Expansion Rack Configuration and Setup*
	Creating Racks	An Expansion Rack (Power Supply Unit, I/O Interface Unit, and End Cover) is added.	*4-2-3 CPU/Expansion Rack Configuration and Setup*
	Switching Unit displays	The model number, unit number, and slot number are displayed.	*4-2-3 CPU/Expansion Rack Configuration and Setup*
	Setting Special Units	The input time constants are set for Input Units and parameters are set for Special Units.	*4-2-3 CPU/Expansion Rack Configuration and Setup*
	Displaying Rack widths, current consumption, and power consumption	The Rack widths, current consumption, and power consumption are displayed based on the Unit configuration information.	*4-2-3 CPU/Expansion Rack Configuration and Setup*
	Comparing the CPU/Expansion Rack configuration information with the physical configuration	When online, you can compare the configuration information in the project with the physical configuration. You can also select the missing Units and add them.	*4-2-3 CPU/Expansion Rack Configuration and Setup*
	Transferring the CPU/Expansion Rack configuration information	The Unit configuration information is transferred to the CPU Unit. The synchronize function is used.	*4-2-3 CPU/Expansion Rack Configuration and Setup*, *6-4-2 Performing Online Debugging*
	Printing the Unit configuration information	The Unit configuration information is printed.	*7-5 Printing*
Controller Setup		The Controller Setup is used to change settings related to the operation of the Controller. The Controller Setup contains PLC Function Module operation settings and built-in EtherNet/IP Function Module port settings.	*4-2-4 Controller Setup*
	Operation Settings	The Startup Mode, SD Memory Card diagnosis, Write Protection at Startup, and other settings are made.	*4-2-4 Controller Setup*
	Transferring Operation Settings	Use the synchronize operation to transfer the operation settings to the Controller.	*4-2-4 Controller Setup*
	Built-in EtherNet/IP Port Settings	These settings are made to perform communications using the built-in EtherNet/IP port of the Controller.	*4-2-4 Controller Setup*
	Transferring Built-in EtherNet/IP Port Settings	Use the synchronize operation to transfer the Built-in EtherNet/IP Port Settings to the Controller.	*4-2-4 Controller Setup*
Motion Control Setup		The Motion Control Setup is used to create the axes to use in motion control instructions, assign those axes to Servo Drives and encoders, and set axis parameters.	*4-2-5 Motion Control Setup*
	Axis Setting	Axes are added to the project.	*4-2-5 Motion Control Setup*
	Axis Setting Table	The Axis Setting Table is a table of all registered axis parameters. You can edit any axis parameters here just as you can on the Axis Settings Tab Page.	*4-2-5 Motion Control Setup*
Axes Group Setup		You can set up axes to perform interpolated motions as an axes group.	*4-2-5 Motion Control Setup*
	Axes Group Basic Settings	Set the axes group number, whether to use the axes group, the composition, and the composition axes.	
	Operation Settings	Set the interpolated velocity, the maximum interpolated acceleration and deceleration, and the interpolated operation settings.	

Item		Description	Reference
Cam Data Settings		The curve that defines the relationship between the phases and displacements of the cam data is called the cam profile curve. You can create cam profile curves with the Cam Editor.	*4-2-6 Cam Data Settings*
	Creating cam data	Cam data is added to the project.	*4-2-6 Cam Data Settings*
	Editing cam data	The profile data is set.	*4-2-6 Cam Data Settings*
	Transferring cam data	You can select to transfer all or part of the cam data.	*4-2-6 Cam Data Settings*
	Importing cam data settings	You can import cam data settings from a CSV file.	*4-2-6 Cam Data Settings*
	Exporting cam data settings	You can export cam data to a CSV file.	*4-2-6 Cam Data Settings*
	Exporting cam tables	You can export cam data in the data format of the master and slave axes that is used by the Controller.	*4-2-6 Cam Data Settings*
	Transferring cam data from the Controller to files	You can save a cam table that was transferred to the Controller to a file in the data format of the master and slave axes.	*4-2-6 Cam Data Settings*
	Transferring cam data from files to the Controller	You can transfer the data from a cam data file in the data format of the master and slave axes to update the contents of the cam data that is already in the Controller.	*4-2-6 Cam Data Settings*
Task Settings		Programs are executed in tasks in an NJ-series CPU Unit. The Task Setup defines the execution period, the execution timing, the programs executed by the task, the I/O refreshing performed by the task, and which variables to share between tasks.	*4-2-7 Task Settings*
	Registering tasks	The tasks, which are used to execute programs, are registered.	*4-2-7 Task Settings*
	Setting task I/O	The task I/O settings define what Units the task should perform I/O refreshing for.	*4-2-7 Task Settings*
	Assigning programs	Program assignments define what programs a task will execute.	*4-2-7 Task Settings*
	Setting exclusive control of variables in tasks	You can specify if a task can write to its own values (known as a refreshing task) or if it can only access them (an accessing task) for global variables. This ensures concurrency for global variable values from all tasks that reference them.	*4-2-7 Task Settings*
I/O Map Settings		The I/O ports that correspond to the registered EtherCAT slaves and to the registered Units on the CPU Rack and Expansion Racks are displayed. The I/O Map is edited to assign variables to I/O ports. The variables are used in the user program.	*4-1-1 Variable Registration*
	Displaying I/O ports	I/O ports are displayed based on the configuration information of the devices (slaves and Units).	
	Assigning variables	Variables are assigned to I/O ports.	
	Creating device variables	Device variables are created in the I/O Map. You can either automatically create a device variable or manually enter the device variable to create.	
	Checking I/O assignments	The assignments of external I/O devices and variables are checked.	*6-4-1 Preparations for Online Debugging*

3-7-2 Programming

Item		Description	Page
Instruction list (Toolbox)		A hierarchy of the instructions that you can use is displayed in the Toolbox. You can drag the required instruction to a program in the Ladder Editor to insert the instruction.	*3-4-3 Edit Pane (3)*
Programming ladder diagrams		Ladder diagram programming involves connecting circuit parts with connecting lines to build algorithms. Circuit Parts and connecting lines are entered in the Ladder Editor.	*4-1-5 Programming Ladder Diagrams*
	Starting the Ladder Editor	The Ladder Editor for the program is started.	*4-1-5 Programming Ladder Diagrams*
	Adding and deleting sections	You can divide your ladder diagrams into smaller units for easier management. These units of division are called sections.	*4-1-5 Programming Ladder Diagrams*
	Inserting circuit parts	You insert circuit parts in the Ladder Editor to create an algorithm.	*4-1-5 Programming Ladder Diagrams*
	Inserting and deleting function blocks	You can insert a function block instruction or user-defined function block into the Ladder Editor.	*4-1-5 Programming Ladder Diagrams*
	Inserting and deleting functions	You can insert a function instruction or user-defined function into the Ladder Editor.	*4-1-5 Programming Ladder Diagrams*
	Inserting and deleting inline ST	You can insert a circuit part in a ladder diagram to enable programming in ST. This allows you to include ST in a ladder diagram.	*4-1-5 Programming Ladder Diagrams*
	Editing circuit parts	You can copy and past circuit Parts.	*4-1-5 Programming Ladder Diagrams*
	Inserting and deleting jump labels and jumps	You can insert a jump label in the rung to jump to and then specify that jump label when you insert a jump.	*4-1-5 Programming Ladder Diagrams*
	Inserting and deleting bookmarks	You can add bookmarks to the beginning of rungs and move between them.	*4-1-5 Programming Ladder Diagrams*
	Rung comments	You can add comments to rungs.	*4-1-5 Programming Ladder Diagrams*
	Displaying rung errors	When you enter a circuit part, the format is always checked and any mistakes are displayed as errors. If there are any errors, a red line is displayed between the rung number and the left bus bar.	*4-1-5 Programming Ladder Diagrams*
	Entry assistance	When you enter instructions or parameters, each character that you enter from the keyboard narrows the list of candidates that is displayed for selection.	*3-6 Basic Editing Operations*

Item		Description	Page
Programming structured text		You combine different ST statements to build algorithms.	*4-1-6 Programming Structured Text*
	Starting the ST Editor	The ST Editor for programs or for functions/function blocks is started.	*4-1-6 Programming Structured Text*
	Editing ST	You combine different ST statements to build algorithms.	*4-1-6 Programming Structured Text*
	Entering calls to functions and function blocks	You can enter the first character of the instance name of the function or the function block in the ST Editor to call and enter a function or function block.	*4-1-6 Programming Structured Text*
	Entering constants	You can enter constants in the ST Editor.	*4-1-6 Programming Structured Text*
	Entering comments	Enter “(*” at the beginning and “*)” at the end of any text to be treated as a comment in the ST Editor. If you only want to comment out a single line, enter a double forward slash (//) at the beginning of the line.	*4-1-6 Programming Structured Text*
	Copying, pasting, and deleting ST elements	You can copy, paste, and delete text strings.	*4-1-6 Programming Structured Text*
	Indenting	You can indent nested statements to make them easier to read.	*4-1-6 Programming Structured Text*
	Moving to a specified line	You can specify a line number to jump directly to that line.	*4-1-6 Programming Structured Text*
	Bookmarks	You can add bookmarks to any lines and move between them.	*4-1-6 Programming Structured Text*
	Entry assistance	When you enter instructions or parameters, each character that you enter from the keyboard narrows the list of candidates that is displayed for selection.	*3-6 Basic Editing Operations*
Searching and replacing		You can search for and replace strings in the data of a project.	*4-1-7 Searching and Replacing*
Jumping		You can jump to the specified rung number or line number in the program.	*4-1-5 Programming Ladder Diagrams*
Building	Building	The programs in the project are converted into a format that is executable in the Controller.	*4-1-9 Building and Rebuilding*
	Rebuilding	A rebuild is used to build project programs that have already been built.	*4-1-9 Building and Rebuilding*
	Aborting a build operation	You can abort a build operation.	*4-1-9 Building and Rebuilding*

3-7-3 File Operations

Item		Description	Page
File operations	Creating a project file	A project file is created.	*3-3-2 Creating a Project File*
	Opening a project file	A project file is opened.	*3-3-6 Opening a Project File*
	Saving the project file	The project file is saved.	*3-3-4 Saving the Project File*
	Saving a project file under a different name	A project file is saved under a different name.	*3-3-5 Saving a Project File Under a Different Name*
	Exporting a project file	You can export a project to an .smc project file.	*3-3-7 Exporting a Project File*
	Importing a project file	You can import a project file that was saved in .smc format.	*3-3-8 Importing a Project File*

Item		Description	Page
Cutting, copying, and pasting		You can cut, copy, or paste items that are selected in the Multiview Explorer or any of the editors.	*3-4-2 Multiview Explorer (1)*
Synchronize		The project file in the computer is compared with the data in the online NJ-series CPU Unit and any differences are displayed. You can specify the transfer direction for any type of data and transfer all of the data.	*6-4-2 Performing Online Debugging*
Printing		You can print various data. You can select the items to print.	*7-5 Printing*
Clear All Memory		The Clear All Memory Menu command is used to initialize the user program, Controller Configurations and Setup, and variables in the CPU Unit to the defaults from the Sysmac Studio.	*7-6 Clearing Memory*
SD Memory Cards		The following procedures are used to execute file operations for the SD Memory Card mounted in the Controller and to copy files between the SD Memory Card and computer.	*7-1 SD Memory Card Operations*
	Formatting the SD Memory Card	The SD Memory Card is formatted.	*7-1 SD Memory Card Operations*
	Displaying properties	The properties of the selected file or folder in the SD Memory Card are displayed.	*7-1 SD Memory Card Operations*
	Copying files and folders in the SD Memory Card	The selected file or folder in the SD Memory Card is copied to the SD Memory Card.	*7-1 SD Memory Card Operations*
	Copying files and folders between the SD Memory Card and the computer	The selected file or folder in the SD Memory Card is copied to the computer. Or, the selected file or folder in the computer is copied to the SD Memory Card.	*7-1 SD Memory Card Operations*

3-7-4 Debugging

Item	Description	Page
Monitoring	Variables are monitored during ladder program execution. You can monitor the TRUE/FALSE status of inputs and outputs and the present values of variables in the Controller. You can monitor operation on the Ladder Editor, ST Editor, Watch Tab Page, or I/O Map.	*6-2-1 Monitoring*
Changing present values and TRUE/FALSE	You can change the values of variables that are used in the user program and settings to any desired value, and you can change program inputs and outputs to TRUE or FALSE. This allows you to check the operation of the user program and settings.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Changing the present values of variables	You can change the present values of user-defined variables, system-defined variables, and device variables as required. You can do this in the Watch Tab Page or I/O Map.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Forced refreshing	You select a BOOL variable and make the assigned I/O port or AT specification bit in memory for CJ-series Units change to TRUE or FALSE to force refreshing with external devices. The specified value is retained even if the value of the variable is overwritten from the user program. You can use forced refreshing to force BOOL variables to TRUE or FALSE in the Ladder Editor, Watch Tab Page, or I/O Map.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Online editing	Online editing allows you to edit programs on systems that are currently in operation. Online editing can be used to edit only POUs and global variables. User-defined data types cannot be edited with online editing.	*6-2-4 Online Editing*

Item		Description	Page
Cross Reference Tab Page		Cross references allow you to see the programs and locations where program elements (variables, data types, I/O ports, functions, or function blocks) are used. You can view all locations where an element is used from this list.	*6-2-3 Cross References*
Data tracing		Data tracing allows you to sample the specified variables and store the values of the variables in trace memory without any programming. You can choose between two continuous trace methods: a triggered trace, where you set a trigger condition and data is saved before and after that condition is met, or a continuous trace, in which continuous sampling is performed without any trigger and the results are stored in a file on your computer. However, you can still display data retrieved on the Sysmac Studio and save those results to a file even if you use a triggered trace. These same functions can be used with the Simulator as well.	*6-2-9 Data Tracing*
	Setting sampling intervals	The interval to perform sampling on the target data is set. Sampling is performed for the specified task period, at the specified time, or when a trace sampling instruction is executed.	*6-2-9 Data Tracing*
	Setting triggers	To perform a triggered trace, you set a condition to trigger sampling. A suitable trigger condition is set to record data before and after an event.	*6-2-9 Data Tracing*
	Setting a continuous trace	The method to save the data traced during a continuous trace is set.	*6-2-9 Data Tracing*
	Setting variables to sample	The variables to store in trace memory are registered. The sampling intervals can also be set.	*6-2-9 Data Tracing*
	Starting and stopping tracing	The data trace settings are transferred to the Controller and the tracing starts. If you selected *Trigger (Single)* as the trace type, tracing waits for the trigger to begin sampling. If you selected *Continuous*, sampling begins immediately and all traced data is transferred to the computer as it is gathered and saved to a file.	*6-2-9 Data Tracing*
	Displaying trace results	You view the results of the traced data in either a chart or in 3D Motion Trace Display Mode. After sampling begins, sample data is immediately transferred and drawn on the graph. The trace target variable table shows the maximum, minimum, and average values for each variable.	*6-2-9 Data Tracing*
	Exporting trace results	Trace results are saved within your project automatically when you save the project on the Sysmac Studio. If you want to save this data as a separate file, you can export the data to a CSV file.	*6-2-9 Data Tracing*
	Printing trace results	You can print out data trace settings along with digital and analog charts.	*6-2-9 Data Tracing*

3-7-5 Simulation

Item		Description	Page
Programs for debugging		You can create programs for debugging that are used only to execute simulations and specify virtual inputs for simulation.	*6-3-1 Debugging with Program Simulation*
Executing a simulation	Selecting what to simulate	You can select the programs to simulate from all of the programs in the Sysmac Studio. Programs can be dragged to select them.	*6-3-1 Debugging with Program Simulation*
	Setting breakpoints	You can set breakpoints to stop the simulation in the Program Editor.	*6-3-1 Debugging with Program Simulation*
	Executing and stopping simulations	You can control simulation execution to monitor the user program or to check operation through data tracing. Step execution and pausing are also possible.	*6-3-1 Debugging with Program Simulation*
	Changing the simulation speed	You can change the execution speed.	*6-3-1 Debugging with Program Simulation*
	Task period simulation	You can display the task periods.	*6-3-1 Debugging with Program Simulation*
Setting the virtual equipment	Creating 3D device models	You can create a 3D device model at the control target to monitor with the 3D motion trace function.	*6-2-9 Data Tracing*
	Displaying 3D motion traces	You set the axis variables for each element of the 3D device model, and then set the 3D device into motion according to those axis motions.	*6-2-9 Data Tracing*
	Displaying 2D paths	You can display the 2D paths of the markers for the projections in the 3D display.	*6-2-9 Data Tracing*

3-7-6 Monitoring Information

Item	Description	Page
Displaying unit production information	You can display the production information of the Controller and Special Units, including the models of the Units and unit versions.	*7-8-1 Displaying Unit Production Information*
Monitoring task execution times	You can monitor the execution time of each task when the user program is executed on a Controller or in the Simulator. When you are connected to the Simulator, you can also monitor the real processing time of tasks. This allows you to perform a Controller performance test.	*6-2-7 Task Execution Time Monitor*

Item		Description	Page
Troubleshooting		You can use troubleshooting to check the errors that occurred in the Controller, display corrections for the errors, and clear the errors.	*7-11 Troubleshooting*
	Controller errors	Any current Controller errors are displayed. (Observations and information are not displayed.)	*7-11-1 Troubleshooting Dialog Box*
	User-defined errors	Information is displayed on current errors.	*7-11-4 User-defined Errors*
	Controller event log	You can display a log of Controller events (including Controller errors and Controller information). (You cannot display logs from EtherCAT slaves.)	*7-11-3 Controller Event Log*
	User-defined event log	The log of user-defined events that were stored for the Create User-defined Error (SetAlarm) instruction and the Create User-defined Information (SetInfo) instruction is displayed.	*7-11-5 User-defined Event Log*
	Event Settings Table	The Event Setting Table is used to register the contents displayed on the Sysmac Studio and on HMIs for user-defined events that occur for execution of the Create User-defined Error (SetAlarm) instruction and the Create User-defined Information (SetInfo) instruction.	*7-11-6 Event Setting Table*
User memory usage monitor		The space that is used by the project file you are editing in the Sysmac Studio is displayed in relation to the size of the Controller's memory. The file cannot be transferred to the Controller if the files size exceeds the available space.	*7-4 User Memory Usage Monitor*
Setting clock information		You can read and set the Controller's clock. The computer's clock information is also displayed.	*7-2 Clock Information Settings*

3-7-7 Communications

Item	Description	Page
Going online with a Controller	An online connection is established with the Controller.	*5-2 Going Online with a Controller*
Checking for forced refreshing	When you go offline, any forced refreshing is cleared.	*5-2-7 Checking for Forced Refreshing*

3-7-8 Maintenance

Item	Description	Page
Changing the operating mode of the Controller	There are two operating modes for NJ-series Controllers, depending on if control programs are executed or not. These are RUN mode and PROGRAM mode.	*6-4-2 Performing Online Debugging*
Resetting the Controller	The operations and status when the power supply to the Controller is cycled are emulated. This can be performed only in PROGRAM mode. You cannot reset the Controller in RUN mode.	*6-4-2 Performing Online Debugging*
Backing up variables and memory	When you replace an NJ-series Controller, you can back up the retained memory in the Controller to a file and restore the backed up data from the file to the new Controller.	*7-9 Backing Up Variables and Memory*

3-7-9 Security Measures

Item		Function	Page
Prevention of incorrect connections	Confirming Controller names and serial IDs	If the name or the serial ID is different between the project and the Controller when an online connection is established, a confirmation dialog box is displayed.	*5-2-6 Confirming Serial IDs*
Prevention of incorrect operation	Operation authority verification	Two levels of operation authority, Administrator and Maintainer, are set for access to the NJ-series CPU Unit to restrict the operations that can be performed.	*7-3-1 Operation Authority Verification*
	Controller write protection	You can prevent rewriting of data in the Controller from the Sysmac Studio.	*7-3-3 Controller Write Protection*
Prevention of the theft of assets	Authentication of user program execution IDs	You can ensure that a user program cannot be operated on another CPU Unit even if copied.	*7-3-2 Authentication of User Program Execution IDs*
	User program transfer with no restoration information	The program source code is not transferred. If this option is selected, programs are not displayed even if uploaded from another computer. However, variables and settings are transferred even if this option is selected.	*6-4-2 Performing Online Debugging*
	Password protection for project files (.smc)	When you export a project file, you can place a password on the file to protect your assets.	*3-3-7 Exporting a Project File*

3-7-10 Online Help

Item	Description	Page
Sysmac Studio help system	You can access Sysmac Studio operating procedures.	*A-4 Online Help*
Instructions reference	Information is provided on how to use the instructions that are supported by the NJ-series CPU Units.	
System-defined Variable Reference	You can display a list of descriptions of the system-defined variables that you can use on the Sysmac Studio.	
Keyboard mapping reference	You can display a list of convenient shortcut keys that you can use on the Sysmac Studio.	

4

Programming

This section describes how to create programs with the Sysmac Studio.

4-1 Designing the User Program 4-2
4-1-1 Variable Registration 4-2
4-1-2 Registering POUs 4-25
4-1-3 Creating Data Types 4-30
4-1-4 Programming 4-37
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4-1-6 Programming Structured Text 4-74
4-1-7 Searching and Replacing 4-79
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4-2 Controller Configurations and Setup 4-88
4-2-1 EtherCAT Configuration and Settings 4-88
4-2-2 Setting EtherCAT Servo Drives 4-99
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4-2-4 Controller Setup 4-117
4-2-5 Motion Control Setup 4-125
4-2-6 Cam Data Settings 4-129
4-2-7 Task Settings 4-139

4-1 Designing the User Program

4-1-1 Variable Registration

- Variable Registration
  You can create variables to hold the data that is used in the control algorithms in the NJ-series CPU Unit. You can define the following types of variables.

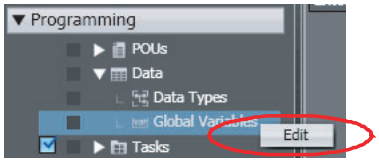
Variable type	Description
Global variables	You can read and write global variables from any POU (program, function, or function block). You declare global variables in the global variable table. You use global variables to interface different POUs. You can read and write a global variable from any POU that is executed on the CPU Unit where the global variable was declared. However, a POU that runs on another CPU Unit cannot access these variables. Device variables that are automatically generated from the Unit configuration and slave configuration are automatically registered as global variables. The Axis Variables and Axes Group Variables that are generated from the axes and axes groups are also automatically registered as global variables.
Device variables	A device variable is used to access data in a device (i.e., slave or Unit). The data is accessed through logical interface ports that are called I/O ports. You assign device variables to the I/O ports that are automatically created when you create the EtherCAT slave configuration information or the Unit configuration information in the I/O Map of the Sysmac Studio.
Local variables	A local variable can be used only within one POU. A local variable is declared in the local variable table for the POU. You cannot access the values of local variables from outside of the POU. Even if you declare a local variable with the same name in a different POU, those variables do not share the same memory space.
Axis Variables	Axis Variables are system-defined variables. They are structures that provide information on axes (such as physical quantities, status, and error information). They are used to access EtherCAT slaves that are assigned to an axis.
Axes Group Variables	Axes Group Variables are system-defined variables. They are structures for axes groups. An axes group contains multiple axes that are interpolated. Axes Group Variables are used for interpolated motions in programs.
Cam data variables	You use these variables to access cam data. You create them in the Cam Data Settings in the Sysmac Studio. A cam data variable is a structure array variable that consists of phases and displacements.
Function block instance variables	A function block instance variables are names that are assigned to a function block instances so that you can manage the function block instances individually. A function block that has a given name and can retain internal variables is called a function block instance. Instances of function blocks are automatically registered as local variables. Specify the instance variable name when you call a function block from another POU.
Derivative variables (structures, unions, and enumerations)	Derivative variables have user-defined data types. They group together variables of different data types into a single variable. You can give any name to the data type. You must specify the variable name that uses the user-defined data type and at least one member in that variable.
System-defined variables	System-defined variables are provided in advance in an NJ-series Controller. The variables and all attributes are defined by the system. They have specific functions. System-defined variables are supplied for each function module. You cannot change the variable names or any other attributes.

Creating Global Variables

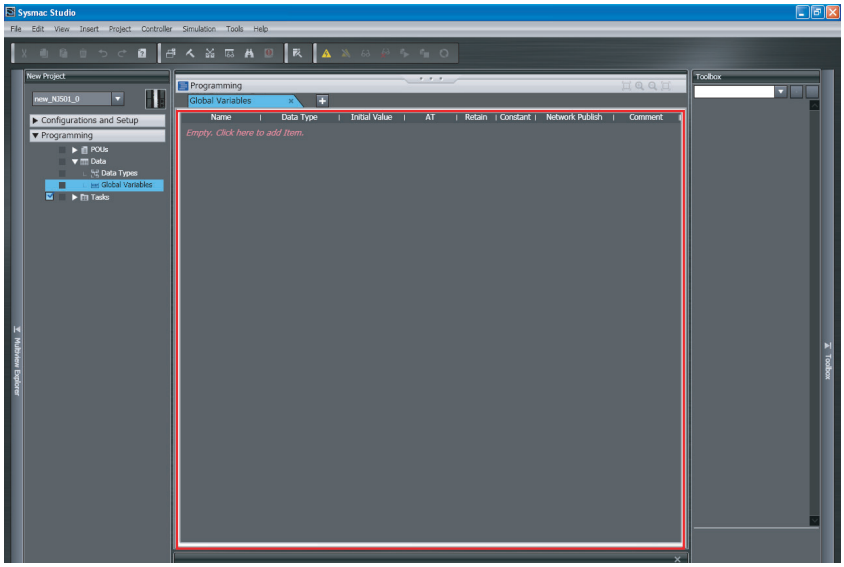
- Creating Global Variables
  You can create variables that you can access from different POUs (programs, functions, or function blocks). The device variables that are used to access slave and Unit data, such as EtherCAT slave and CJ-series Unit device variables, are also registered as global variables.

● Opening the Global Variable Tab Page

Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer. Or, right-click **Global Variables** under **Programming - Data** and select ***Edit*** from the menu.

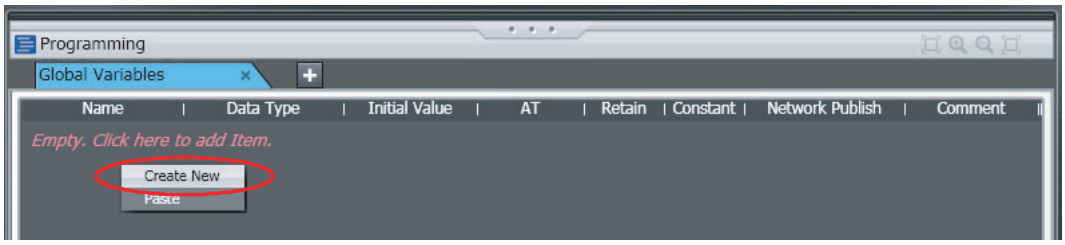


The global variable registration table is displayed in the Programming Layer.

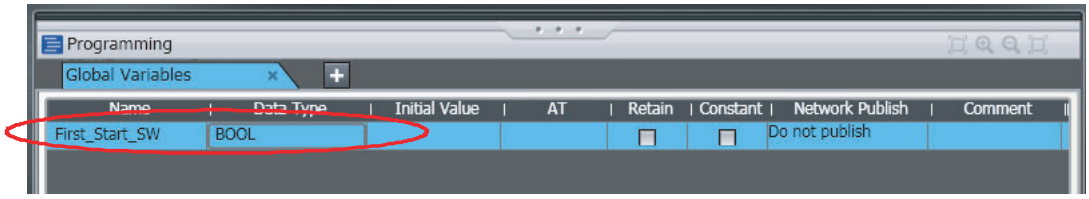


● Creating Global Variables

1 Press the **Insert** Key in the global variable table, or right-click in the global variable table and select ***Create New*** from the menu.



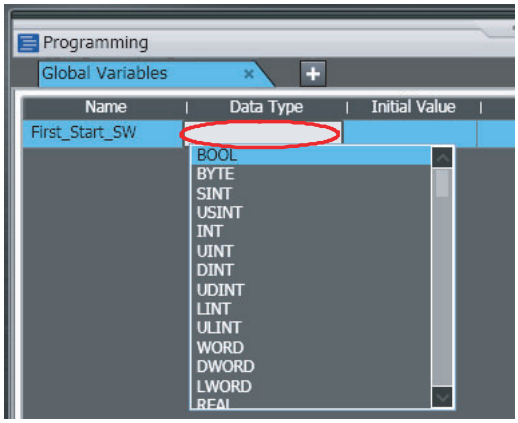
2 Enter values for each item, and then press the **Enter** Key.



The variable is registered. Always set the variable name and the data type. Refer to *Entering Variable Attributes* on page 4-21 for information on entering values for attributes.

Editing Global Variables

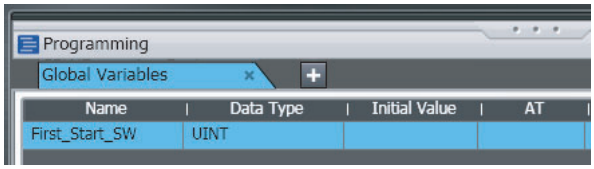
1 Click the cell to edit for the variable.



If you click the data type cell, a pull-down list is displayed.

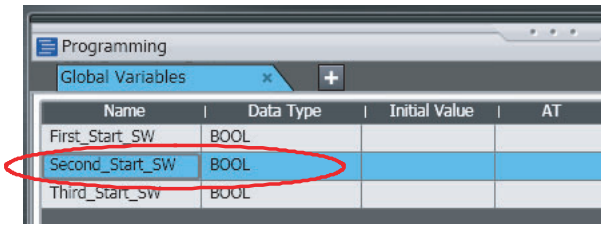
2 Change the setting, and then press the **Enter** Key.

The change is applied to the variable.

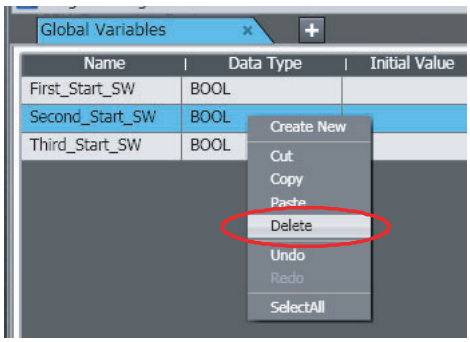


Deleting Variables

1 Click any cell on the line of the variable to delete to select the entire line.



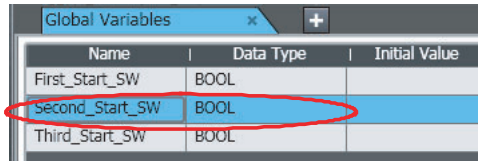
2 Press the **Delete** Key. Or, right-click a row and select ***Delete*** from the menu.



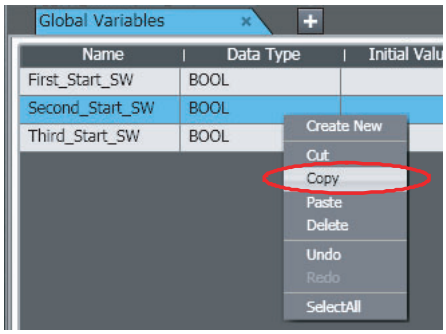
The variable is deleted.

Copying and Pasting Variables

1 Click any cell on the line of the variable to copy.

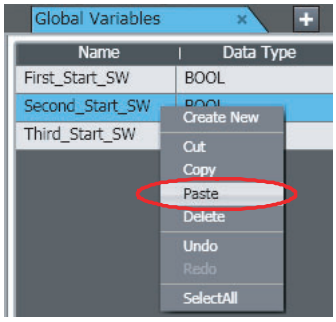


2 Press the **Ctrl + C** Keys. Or, right-click the row and select ***Copy*** from the menu.

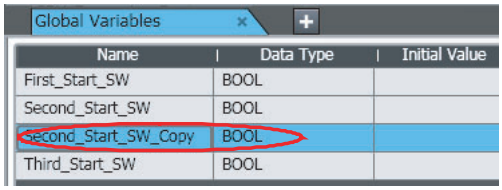


The specified variable is copied.

3 Press the **Ctrl + V** Keys. Or, right-click and select ***Paste*** from the menu.

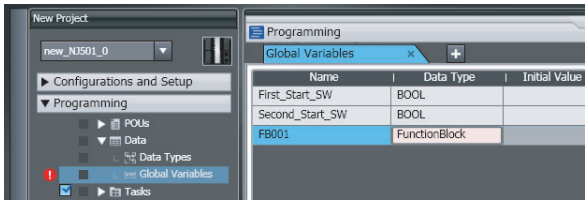


A copy of the variable is registered with "_Copy" added to the name of the variable that was copied.



Precautions for Correct Use

If you enter any invalid characters or out of range values, the cell is highlighted in red. An error will occur when the program is checked. For information on restrictions on variable names, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).



Additional Information

- If no variables are registered, "There are no variables in the table. Click here to add." is displayed. Click to add a new variable.

A global variable is registered automatically when you perform any of the following operations.

- When you enter a new variable in the *Variable* Column of the I/O Map with *Global Variable* specified in the *Scope* Column.
- When you create a new interface variable between tasks.
- When you create a new axis or axes group in the Multiview Explorer.

Creating Device Variables

- Device Variables
  A device variable is used to access data in a device (i.e., slave or Unit). This data is accessed through a port that acts as an interface to an external device. This logical port is called an I/O port.

Creating Variables

Device variables are created in the I/O Map. You can either automatically create a device variable or manually enter the device variable to create it.

Manually Entering a Device Variable

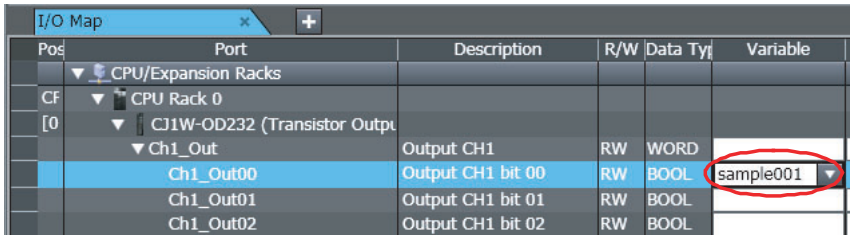
You can enter a device variable name manually. You create device variables with this method in the following cases.

- To assign your own name for a slave I/O Terminal or a Basic I/O Unit.

Use the following procedure.

1 Create the slave configuration information or Unit configuration information.

2 Select an I/O port in the I/O Map and enter a variable in the *Variable* Column.



Device variables are automatically assigned to the I/O ports for each slave or Unit. These device variables are also automatically registered in the variable table specified in the *Scope* Column.

Automatically Creating Device Variables

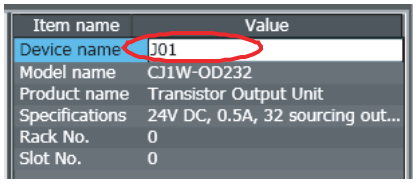
The device variables are named automatically from a combination of the device names and the I/O port names. You create device variables with this method in the following cases.

- To eliminate the work that is involved in obtaining the device variable names.
- To automatically create device variables to use to access operating data and setup data for Special Units.

Use the following procedure.

1 Create the slave configuration information or Unit configuration information.

2 Set a device name in the Unit Editor.

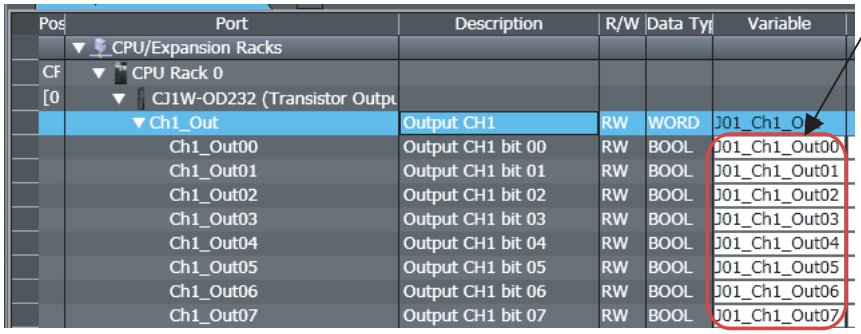


The default device names are as follows:

- For slaves, the default device names start with an E followed by a sequential number starting from 01.
- For Units, the default device names start with a J followed by a sequential number starting from 01.

3 Select a slave, Unit, or one or more I/O ports in the I/O Map, right-click, and then select ***Create Device Variable*** from the menu

Device variables that were automatically created



Device variables are automatically assigned to the I/O ports for each slave or Unit. These device variables are also automatically registered in the variable table specified in the *Scope* Column.

Additional Information

We recommend that you set the device names.

- Example of Creating Device Variables
  The following examples are for bit (terminal) 00 on 16-bit Input Units and slaves. The variable is created from the user-defined slave or Unit name and the selected I/O port name.

Registered slave or Unit	Device variable notation		Description	Variable name
	Slave or Unit name	I/O port name		
GX-ID1611	E001	Bit00	---	E001_Bit00
GX-AD0471	E002	CH0 input 16-bit	---	E002_CH0_input_16-bit
CJ1W-ID212	J01	Ch1_In00	Bit 00 on input word 1	J01_Ch1_In00
CJ1WAD041-V1	J02	Ch1_PkHdCmd	Holds peak value for input 1.	J02_Ch1_PkHdCmd

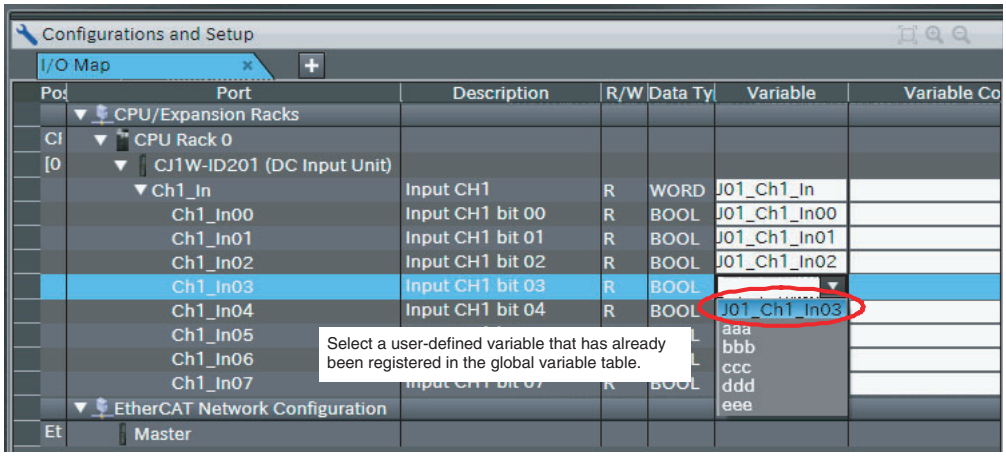
Selecting from the Registered Variables

You can select variables that are already registered on the menu on the I/O Map. You create device variables with this method in the following cases.

- To program before you create the slave configuration information or Unit configuration information.
- To reuse programs from another project.

Use the following procedure.

1. Register the variables in advance in the global variable table, or in the local variable table of one of the POUs.
2. Program using those variables.
3. Create the slave configuration information or Unit configuration information.
4. Select a variable from a pull-down list in the I/O Map View to assign it to an I/O port.



Additional Information

To remove the variable assigned to an I/O port, clear the *Variable* Column or right-click the variable and select ***Reset Assignment*** from the menu. The device variable assignment is removed. However, removing the assignment does not delete the variable from the variable table where it is registered.

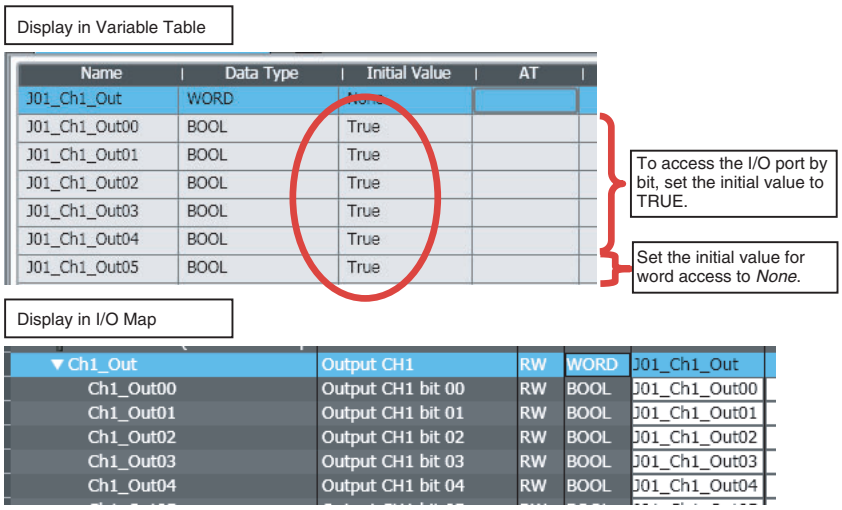
● Device Variable Attributes

Device variables are registered in the variable table specified in the *Variable* Column under the following conditions.

Attribute	Setting	Changes to settings
Name	Automatically generated variables: [*device_name*] + [*I/O_port_name*] The default devices names are as follows: • For CJ-series Units, the device names start with a J followed by a sequential number starting from 01. • For EtherCAT slaves, an E followed by a sequential number starting from 001. Refer to *Creating Device Variables* on page 4-6 for information on I/O port names. If entered manually, the variable name is simply the string you enter.	Possible.
Data Type	The data type must have the same size as the data type of the I/O port.	Possible.
Initial Value	None*	Possible.
AT	• Device variables for EtherCAT slaves: ECAT://node#[*node_number*]/[*I/O_port_name*] • Device variables for CJ-series Units: IOBus://rack#[*rack_number*]/slot#[*slot_number*]/[*I/O_port_name*]	Not possible.
Retain	• Device variables for EtherCAT slaves: Not retained. • Device variables for CJ-series Units assigned to the Operation Data (CIO Area): Not retained. Device variables for CJ-series Units assigned to the Setup Data (DM Area): Retained.	Not possible.

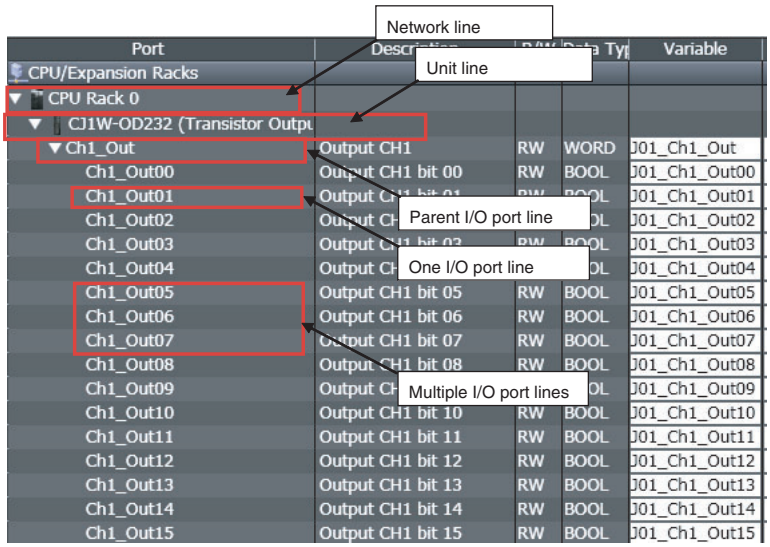
Attribute	Setting	Changes to settings
Constant	*Yes* for variables assigned to Setup Data (DM Area) for an I/O port that is set to *R* (read-only). Other variables: None	Possible.
Network Publish	Do not publish.	Possible.
Comment	Enter a user-defined comment.	Possible.

* Some Basic I/O Units have more than one access method for the same I/O port, such as bit string data and BOOL data. If you use initial values for this type of I/O port, set the initial values for one of the access types to *None*.



Additional Information

- You can select any of the following items in the I/O Map to create a group of device variables at one time.



- The operation results are given in the following table.

The variables are created based on the user-defined Unit name and the selected I/O port name.

User action	Result
Selected one I/O port line	A variable for the selected I/O port is created. If the selected I/O port line contains other lower level I/O ports, variables for those lower level I/O ports are also created.
Selected multiple I/O port lines	Variables for the selected I/O ports are created. If the selected I/O port line contains other lower level I/O ports, variables for those lower level I/O ports are also created.
Selected a parent I/O port line	Variables for all I/O ports under the selected I/O port are created.
Selected a Unit line	Variables are created for all I/O ports of the selected Unit.
Selected network line	Variables are created for all I/O ports of the selected network.

Additional Information

To register a variable in any other variable table besides the global variable table, change the variable table type in the *Variable* Column before selecting ***Create Device Variables***. If you do not specify anything in the *Variable* Column, the variables are automatically registered in the global variable table. If a variable of the same name already exists when you create a device variable, a unique ID number is appended to the end of the variable.

Creating Local Variables

- Creating Local Variables
  You can register variables that are used only within one POU (program, function, or function block). The following variable groups exist for local variables.

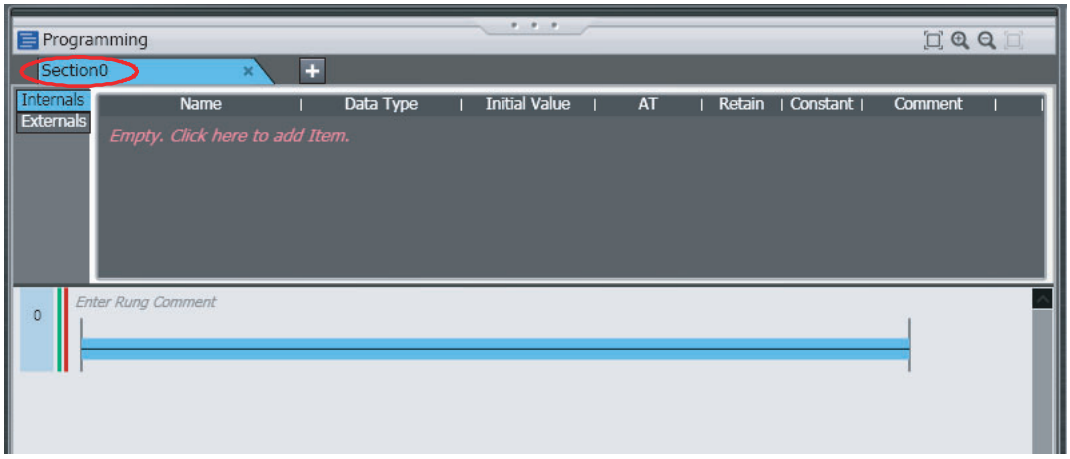
Variable group for local variables	Description	POU type		
		Program	Function	Function block
Internal variables	Used to create local variables for use in programs and internal variables for use in functions or function blocks.	Supported.	Supported.	Supported.
Input/output variables	Used to create input variables, output variables, and in-out variables for use in functions or function blocks.	---	Supported.	Supported.
External variables	Used to register variables from the global variable table. You can create external variables to access external data from within a POU (program, function, or function block).	Supported.	Supported.	Supported.
Return values	Used to register return values of functions.	---	Supported.	---

● Opening the Local Variable Tab Page

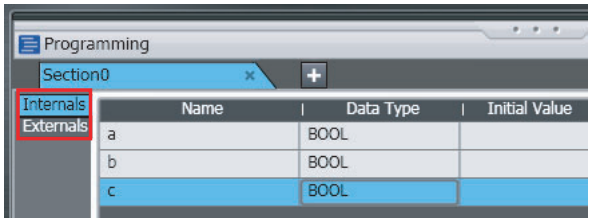
The following is an example that uses a registered ladder diagram program. Refer to *4-1-2 Registering POUs* for information on creating programs, functions, and function blocks (POUs).

1 Double-click **Section0** under **Programming - POUs - Programs - Program0** in the Multiview Explorer.

The local variable table for the section is displayed in the Edit Pane.



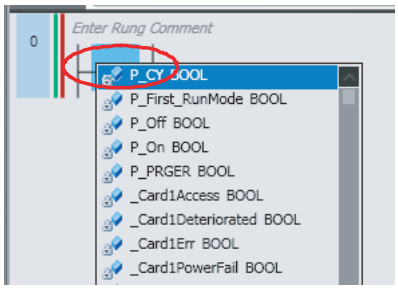
2 Select the variable group from the side tabs in the Multiview Explorer and create the local variables.



Creating Local Variables

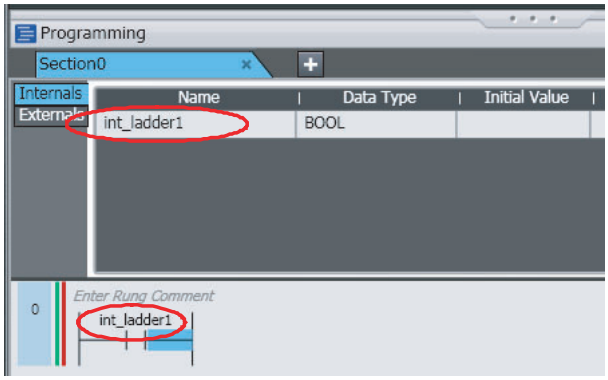
Local variables are created in the same way as global variables. You can create them directly in the Ladder Editor.

1 Click a new input or new output instruction in the Ladder Editor.



2 Enter a new variable name.

The variable name that you entered is registered in the Internals Side Tab Page.



Editing, Deleting, Copying, and Pasting Local Variables

You can edit, delete, copy, and paste local variables with the same procedures as for global variables.

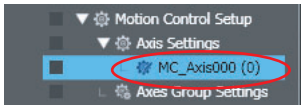
Creating Axis Variables

- Axis Variables
  An Axis Variable is a structure variable that is used to specify an axis in a program. An Axis Variable contains members used for axis control (axis settings) and members used to monitor the status of the axis in the programs or Sysmac Studio (axis monitor).

● Creating Axis Variables

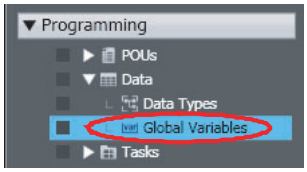
When you create an axis in the Axis Settings, the Axis Variable is automatically added as a global variable.

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

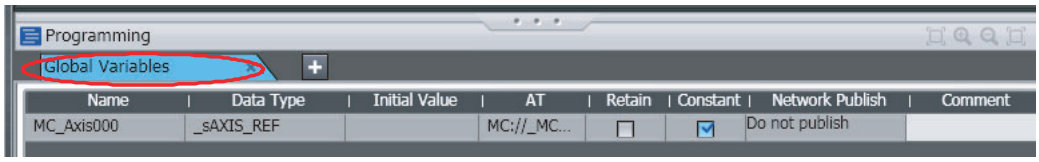


MC_Axis000 is added to the tree.

2 Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer.

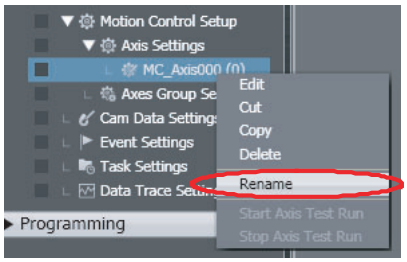


The *MC_Axis000* Axes Variable is automatically added to the global variable table.



● Changing Axis Variable Names

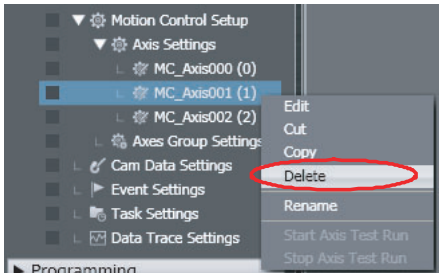
1 Right-click the Axis Variable to rename in the Multiview Explorer and select ***Rename*** from the menu.



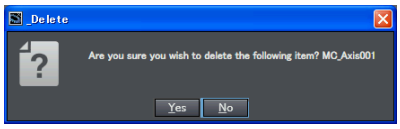
2 Enter a new name for the Axis Variable.

● Deleting Axis Variables

1 Right-click the Axis Variable to delete in the Multiview Explorer and select ***Delete*** from the menu.



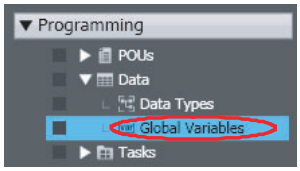
A deletion confirmation dialog box is displayed.



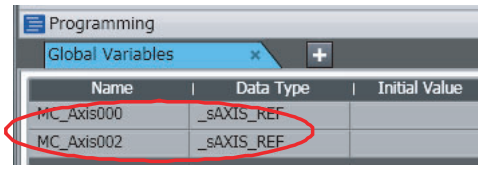
2 Click the **Yes** Button.

The selected Axis Variable is deleted.

3 Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer.

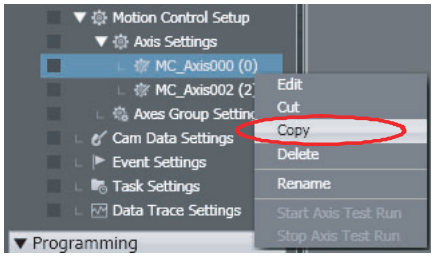


You can confirm that the Axis Variable was automatically deleted.



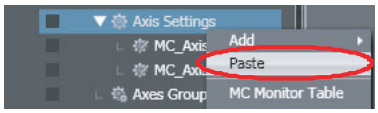
● Copying Axis Variables

1 Right-click the Axis Variable to copy in the Multiview Explorer and select ***Copy*** from the menu.

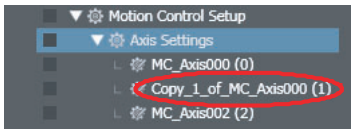


The specified Axis Variable is copied.

2 Right-click **Axis Settings** in the Multiview Explorer and select ***Paste*** from the menu.



A copy of the Axis Variable is registered with ‘Copy_1_of’ added to the front of the name of the Axis Variable that was copied.



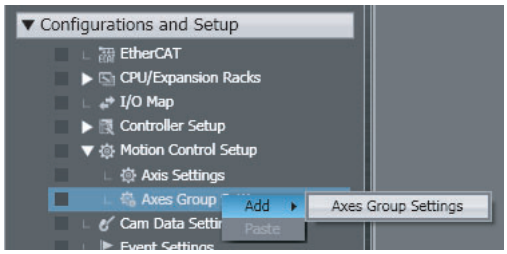
Creating Axes Group Variables

- Axes Group Variables
  An Axes Group Variable is a structure variable that is used to specify an axes group that represents axes linked for synchronization or interpolation in programs.

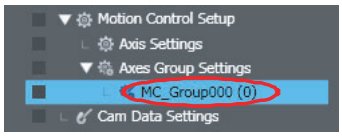
● Creating Axes Group Variables

When you create an axes group, the Axes Group Variable is automatically added as a global variable.

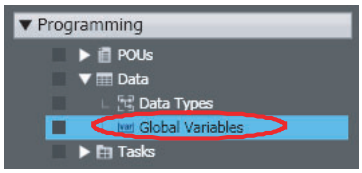
1 Right-click **Axes Group Settings** under **Configurations and Setup - Motion Control Setup** in the Multiview Explorer and select ***Add - Axes Group Settings*** from the menu.



MC_Group000 is added to the tree.



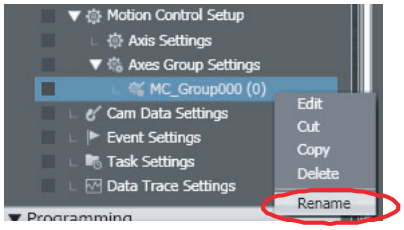
2 Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer.



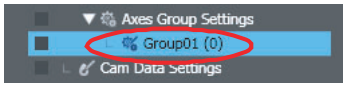
You can confirm that the *MC_Group000* Axes Group Variable was automatically added.

● Changing Axes Group Names

1 Right-click the Axes Group Variable to rename in the Multiview Explorer and select ***Rename*** from the menu.

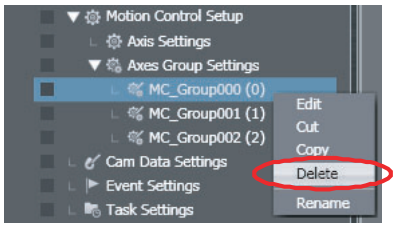


2 Enter a new name for the axes group.

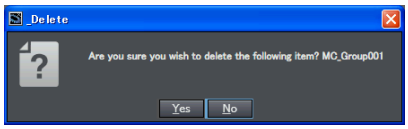


Deleting Axes Group Variables

1 Right-click the Axes Group Variable to delete in the Multiview Explorer and select ***Delete*** from the menu.



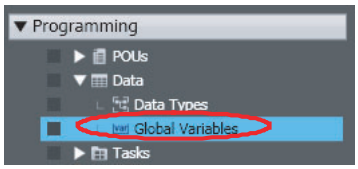
A deletion confirmation dialog box is displayed.



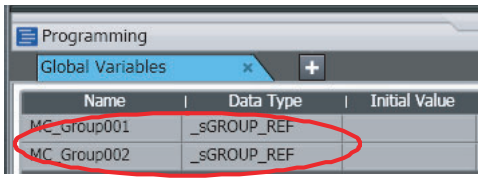
2 Click the **Yes** Button.

The selected Axis Group Variable is deleted.

3 Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer.

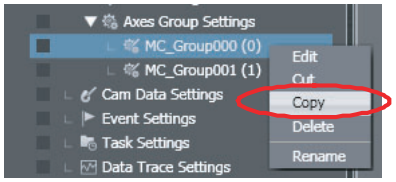


You can confirm that the Axes Group Variable was automatically deleted.



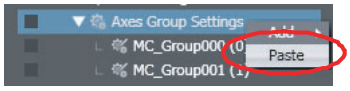
Copying Axes Group Variables

1 Right-click the Axes Group Variable to copy in the Multiview Explorer and select ***Copy*** from the menu.

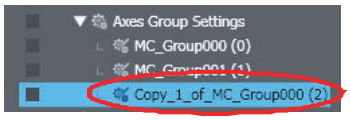


The specified Axes Group Variable is copied.

2 Right-click the Axes Group Variable in the Multiview Explorer and select ***Paste*** from the menu.



A copy of the Axes Group Variable is registered with ‘Copy_1_of’ added to the front of the name of the Axes Group Variable that was copied.



Creating Cam Data Variables

- Cam Data Variables
  A cam data variable defines the motion of a slave axis in relation to a master axis for synchronization and interpolation motions for electronic gears and cams. This allows you to use variables in programs to define cam motions.

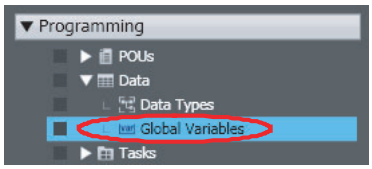
● Creating Cam Data Variables

When you create cam data, the cam data variable is automatically added as a global variable.

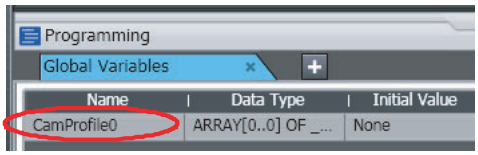
1 Right-click **Cam Data Settings** under **Configurations and Setup** in the Multiview Explorer and select ***Add - CamProfile*** from the menu.

Cam profile 0 is added to the tree.

2 Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer.

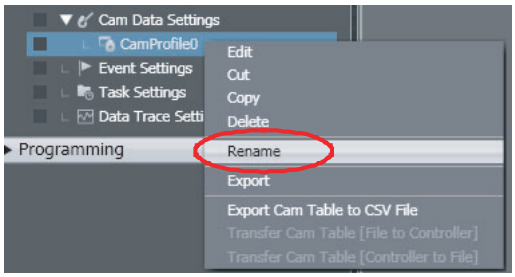


You can confirm that the cam data variable was automatically added.

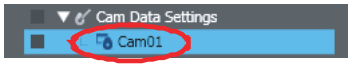


● Changing Cam Data Variable Names

1 Right-click the cam data variable to rename in the Multiview Explorer and select ***Rename*** from the menu.

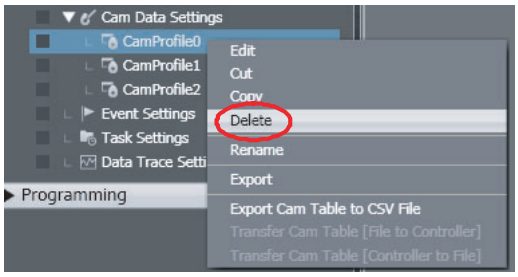


2 Enter a new cam data variable name.

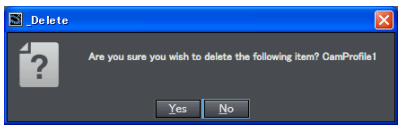


● Deleting Cam Data Variables

1 Right-click the cam data variable to delete in the Multiview Explorer and select ***Delete*** from the menu.

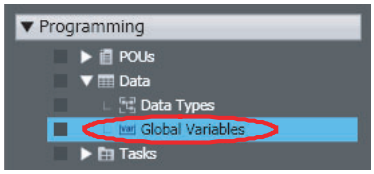


A deletion confirmation dialog box is displayed.

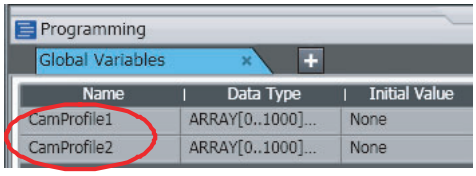


2 Click the **Yes** Button.

3 Double-click **Global Variables** under **Programming - Data** in the Multiview Explorer.

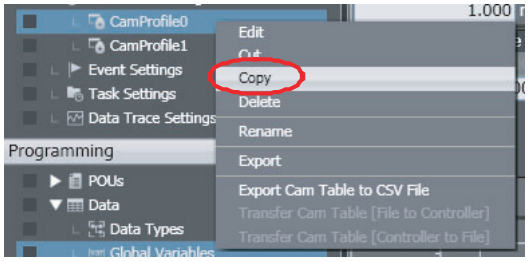


You can confirm that the cam data variable was automatically deleted.

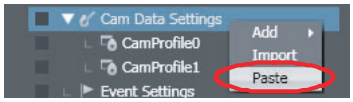


● Copying Cam Data Variables

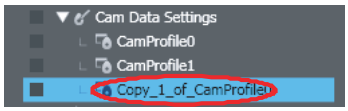
1 Right-click the cam data variable to copy (*CamProfile2* in this example) in the Multiview Explorer and select ***Copy*** from the menu.



2 Right-click **Cam Data Settings** under **Configurations and Setup** in the Multiview Explorer and select ***Paste*** from the menu.



A copy of the cam data variable is registered with 'Copy_1_of' added to the front of the name of the cam data variable that was copied.

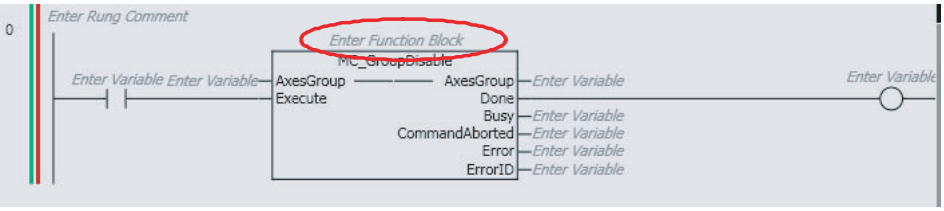


Creating Function Block Instance Variables

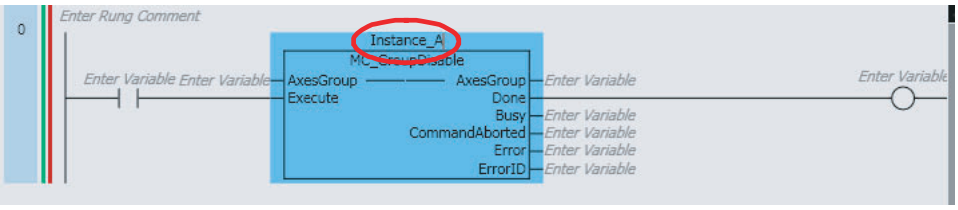
- Function Block Instance Variables
  When you create an instance of a function block, the function block instance is registered in the local variable table as a data type. Specify the instance name when you call a function block from another POU.

● Creating Function Block Instance Variables

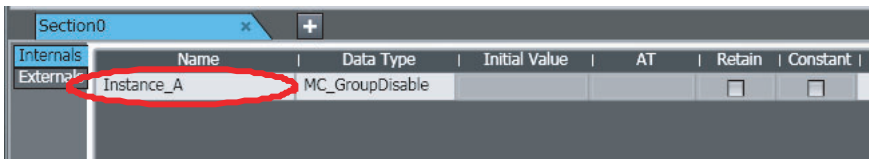
1 Click *Enter Instance Variable Name* for the instance of the function block instruction created in the Ladder Editor.



2 Enter an instance name and press the **Enter** Key.



When you set an instance name, the function block instance is registered as an instance variable in the local variable table.

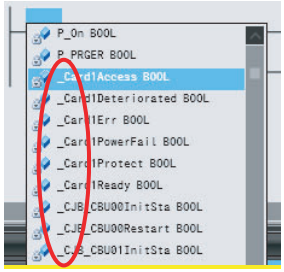


● Editing, Deleting, Copying, and Pasting Function Block Instance Variables

You can edit, delete, copy, and paste function block instance variables with the same procedures as for global variables.

Creating Variables with Derivative Data Types

- Variables with Derivative Data Types
  A derivative variable groups together data with the same or different data types. You can easily change data and add new data if you place your data into a structure.
- You can use system-defined variables as soon as you register the Controller on the Sysmac Studio. (One NJ501 Controller is registered by default.)
- System-defined variable names start with an underbar, as shown below.



- You can select them from lists in the Ladder Editor or ST Editor.
- There are system-defined variables for each of the four function modules, as listed in the following table.

Function module	Type of system-defined variable
PLC Function Module	System-defined variables for PLC Function Module
Motion Control Function Module	System-defined variables for motion control
EtherNet/IP Function Module	System-defined variables for EtherNet/IP
EtherCAT Master Function Module	System-defined variables for EtherCAT master

Refer to *4-1-3 Creating Data Types* for more information on creating variables with derivative data types.

System-defined Variables

- System-defined Variables
  System-defined variables are pre-defined by the system. All system-defined variable attributes are fixed. You can use system-defined variables as soon as you create the Controller. For information on system-defined variables, refer to ***System-defined Variable Reference*** on the Help Menu, or to the appendices of the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

Entering Variable Attributes

This section describes how to enter variable attributes. The following table shows which attributes exist for different variable types and POUs (programs, functions, and function blocks).

● Attributes Supported by Each Type of Variable

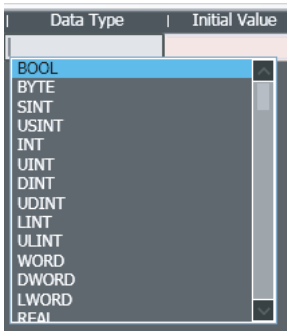
Type of variable	Global variables	Programs		Function blocks			Functions					
		Local variables	External variables	Internal variables	In-out variables	External variables	Internal variables	Input variables	Output variables	In-out variables	External variables	Return variables
Name	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.
Data Type	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.
Initial Value	Supported.	Supported.	Not supported.	Supported.	Supported.	Not supported.	Supported.	Supported.	Supported.	Not supported.	Not supported.	Not supported.
AT Specification	Supported.	Supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.
Retain	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Not supported.	Not supported.	Not supported.	Not supported.	Supported.	Not supported.
Constant	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.
Network Publish	Supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.	Not supported.
Comment	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Supported.	Not supported.
In/Out	Not supported.	Not supported.	Not supported.	Supported.	Supported.	Not supported.	Supported.	Supported.	Supported.	Supported.	Not supported.	Not supported.
Edge	Not supported.	Not supported.	Not supported.	Not supported.	Supported.	Not supported.	Not supported.	Supported.	Not supported.	Supported.	Not supported.	Not supported.

For information on attributes, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501). For information on input value ranges and character restrictions, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

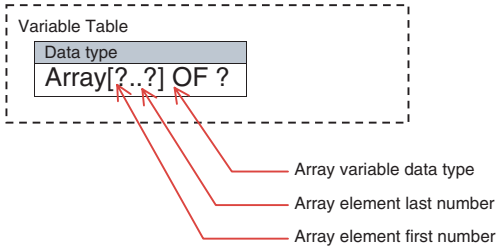
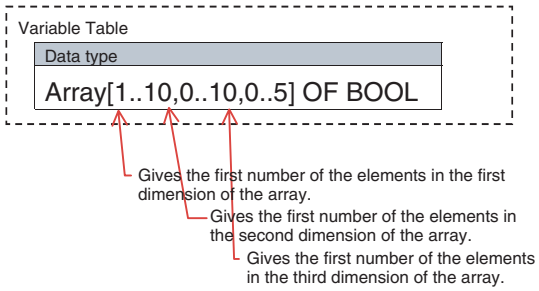
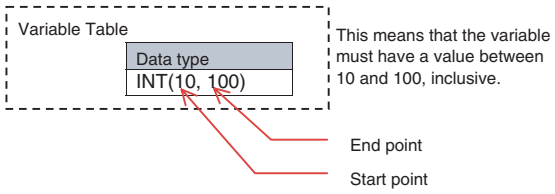
Name Attribute

Enter a string for the name.

Data Type Attribute



Enter a data type directly or select one from the list. You can select from the following data types.

Classification	Data type		Data type name
Basic data types	Boolean		BOOL
	Bit strings		BYTE, WORD, DWORD, and LWORD
	Integers	Signed	SINT, INT, DINT, and LINT
		Unsigned	USINT, UINT, UDINT, and ULINT
	Real numbers		REAL and LREAL
	Durations		TIME
	Dates		DATE
	Times		TIME_OF_DAY
	Date and times		DATE_AND_TIME
	Text strings		STRING[256] After you select STRING[256] as the data type, edit the value inside the brackets to specify the size of the string including the NULL character.
	Data type attributes	Array specification	Array[?..?] OF ? After you select ARRAY[?..?] OF ? as the data type, edit the question marks as follows: Example: Array[0..9] OF INT This specifies an array variable that contains 10 INT elements from 0 to 9.  **Note** You can also enter a space in the locations marked by △ below to increase readability. Array[△?△..△?△] OF ? Specifying Multi-dimensional Arrays: 
		Range specification	You can specify that an integer variable (INT, SINT, DINT, LINT, UINT, USINT, UDINT, and ULINT) contains only values within a certain range. 

Classification	Data type	Data type name
Derivative data types	Structures	Specify a user-defined structure data type or a system-defined structure data type in the Structure group of the Data Type Editor.
	Unions	Specify a user-defined union data type or a system-defined union data type in the Union group of the Data Type Editor.
	Enumerations	Specify a user-defined enumerated data type or a system-defined enumerated data type in the Enumerated group of the Data Type Editor.
POU instances		Specify a system-defined function block name, or a user-defined function block name.

Initial Value Attribute

Specify a value for the variable for one of the following situations when the Retain attribute is not specified.

- When the power supply is turned ON
- When the operating mode is changed
- When you specify to initialize the value when the program is transferred
  Enter a value directly or select an item from the list (the values in the list depend on the data type).
  If you do not enter an initial value, 0 is used as the initial value.
  Select *None* for no initial value.
- Initial Values for Union Members: The initial values for union members cannot be edited and are always 0.

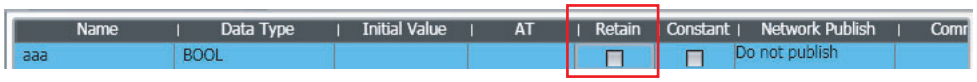
AT Specification Attribute

- When Specifying an Address in Memory Used for CJ-series Units:
  This is shown in the following table.

Area	Setting range	Format to enter
CIO Area	CIO 0 to CIO 6143	%0 to %6143
Work Area	W000 to W511	%W0 to %W511
Holding Area	H0 to H1535	%H0 to %1535
DM Area	D0 to D32767	%D0 to %D32767
EM Area	E0_0 to E18_32767	%E0_0 to %E18_32767

- For Device Variables Specified in the I/O Map:
  The contents of the AT Fields of the device variables are displayed automatically.

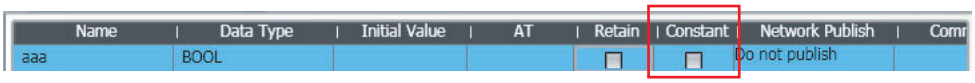
Retain Attribute



Specify whether to retain the value of the variable in the following cases.

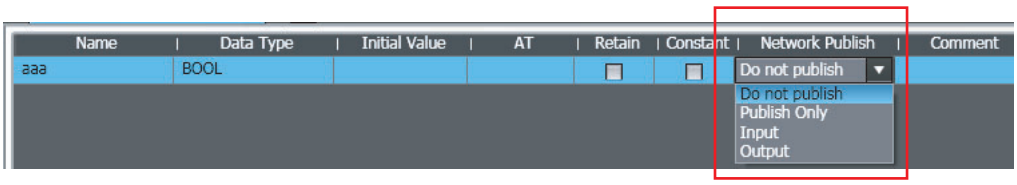
- When power is turned ON after a power interruption
- When the operating mode changes to RUN mode
- To specify to not initialize the values when the program is transferred, select the check box to retain the values.

Constant Attribute



If you set the Constant attribute, you can set the initial value of the variable when it is downloaded, but you cannot overwrite the value afterward.

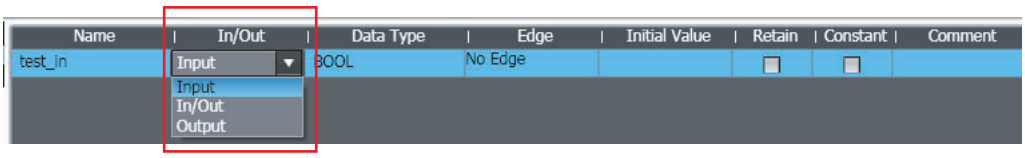
Network Publish Attribute (Global Variables Only)



Select the setting for the Network Publish attribute from the list. You can select from the following.

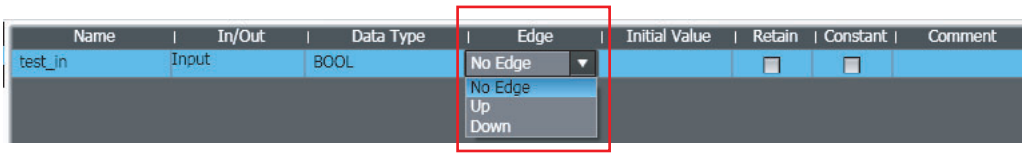
Network Publish attribute setting		Description
Do not publish		The variable cannot be accessed from external devices. However, Support Software can still access the variable regardless of this setting.
Publish	Publish Only	You can access a variable with this attribute from external devices through CIP communications. Tag data links are not possible for variables with this attribute setting.
	Input	You can access a variable with this attribute from external devices through CIP communications or a tag data link. For tag data links, this will be a variable for data input (from another Controller to the local Controller).
	Output	You can access a variable with this attribute from external devices through CIP communications or a tag data link. For tag data links, this will be a variable for data output (from the local Controller to another Controller).

In/Out Attribute (Input/Output Variable Group Only)



For the input/output variable group used in functions or function blocks, specify either an input variable, output variable, or in-out variable from the list.

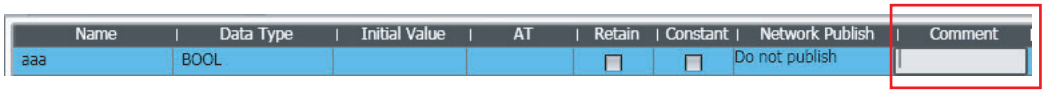
Edge (Input/Output Variable Group Only)



The Edge attribute makes a BOOL variable pass TRUE to a function block when the variable changes from FALSE to TRUE or when it changes from TRUE to FALSE. This attribute is for function block input variables only. Select an attribute setting from the list. You can select from the following.

Edge attribute setting	Description
No edge	No edge
Up	FALSE to TRUE
Down	TRUE to FALSE

Comment Attribute



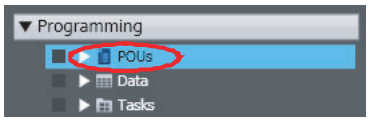
Enter a comment.

4-1-2 Registering POUs

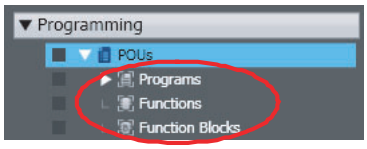
- POUs (Program Organization Units)
  A POU is a unit used to build a program. A POU can be a program, function, or function block. Refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501) for more information. You begin by first registering a program, function, or function block under **Programming - POUs** in the Multiview Explorer, and then coding the POU.

Displaying POUs

Click **POUs** under **Programming** in the Multiview Explorer.



Programs, **Functions**, and **Function Blocks** are displayed under **POUs**.

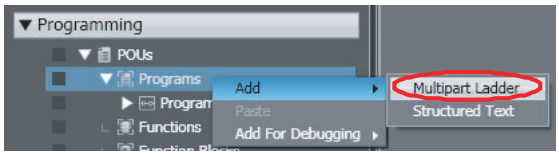


Registering POUs

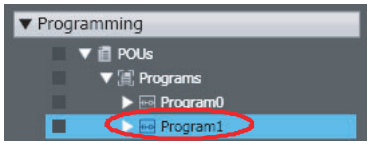
- Registering Programs
  You must create programs that define the control operations. You can design programs as ladder diagrams or ST, and then assign them to tasks for execution. You can use functions and function blocks in programs. For a detailed explanation of programs, refer to information on POUs in the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

● Registering Ladder Diagram Programs

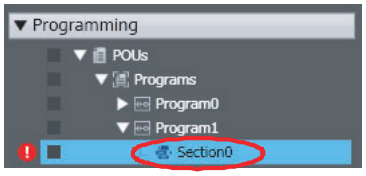
1 Right-click **Programs** under **Programming - POUs** and select ***Add - Multipart Ladder*** from the menu.



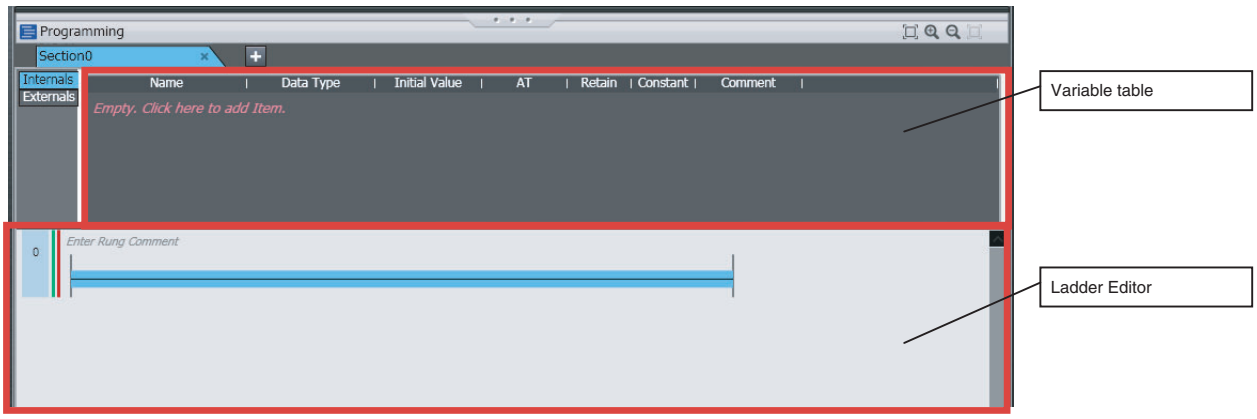
A program with the name *Program1* is added (along with a section) under the **Programs** Layer. *Program0* is registered in advance.



2 Double-click the section.



The variable table and Ladder Editor are displayed in the Programming Layer of the Edit Pane. From here you can create local variables and create ladder diagram rungs.

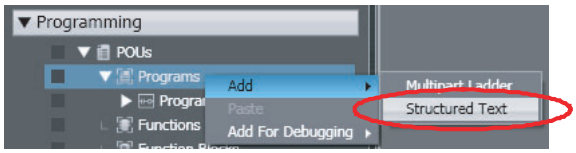


Additional Information

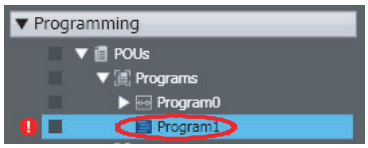
To add a new section, right-click the ladder diagram program and select ***Add - New Section*** from the menu.

● Registering ST Programs

1 Right-click **Programs** under **Programming - POUs** and select ***Add - Structured Text*** from the menu.

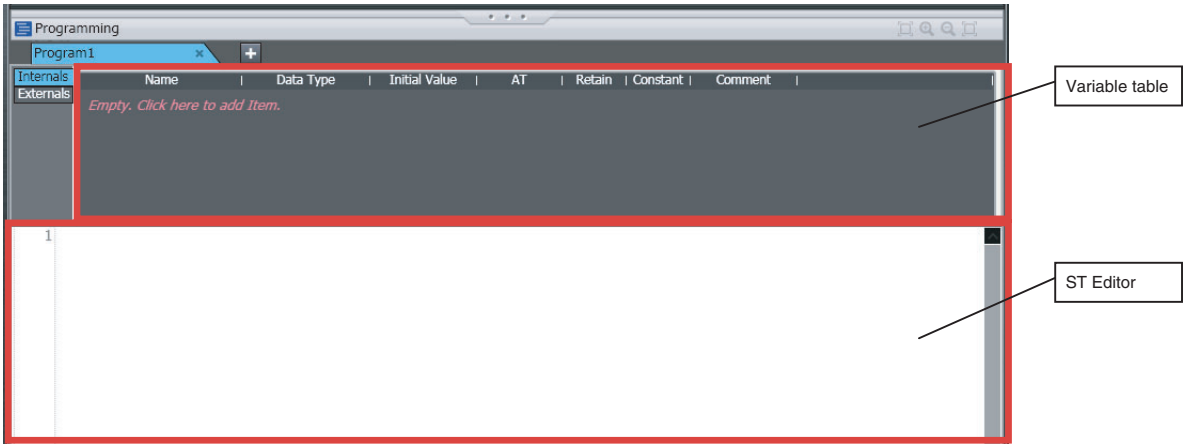


Program1 is added under **Programs**. (ST programs do not have sections.) *Program0* for a ladder diagram is registered in advance.



2 Double-click the ST program.

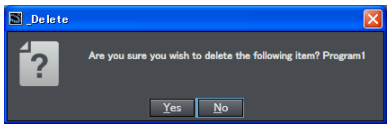
The variable table and ST Editor are displayed in the Programming Layer of the Edit Pane. From here you can create local variables and create ST statements.



Deleting Programs

Right-click the program to delete in the Multiview Explorer and select ***Delete*** from the menu.

A deletion confirmation dialog box is displayed.

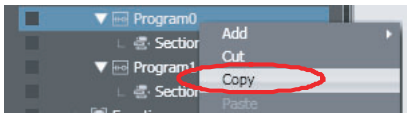


Click the **Yes** Button.

The program is deleted.

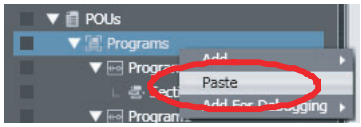
Copying and Pasting Programs

1 Select the program to copy in the Multiview Explorer and press the **Ctrl+C** Keys. Or, right-click the program and select ***Copy*** from the menu.

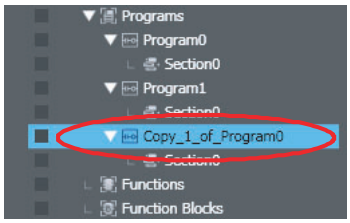


The program is copied.

2 Select **Programs** in the Multiview Explorer and press the **Ctrl+V** Keys. Or, right-click **Programs** and select ***Paste*** from the menu.



The copied program is registered with “Copy_1_of_” added to the front of the name of the program that was copied. Any local variables and data in the program are also copied at the same time.



Precautions for Correct Use

When you delete a program, all local variables in that program and section data are deleted with it.

Additional Information

You can change the name of a program or section. Right-click the section or program to rename and select ***Rename*** from the menu.

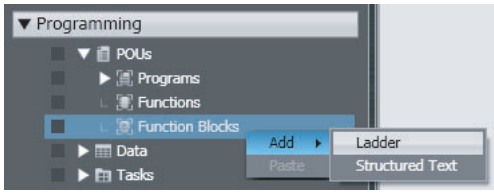
Registering Function Blocks

- Function Blocks
  Function blocks are instructions that define operations. Function blocks are written as ladder diagrams or ST. You can call them from programs as required. You can use functions inside function blocks. For a detailed explanation of function blocks, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

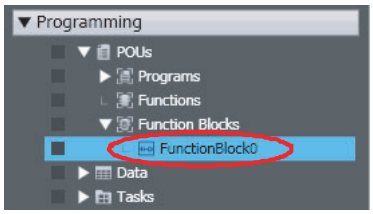
Registering Function Blocks

The following procedure shows how to register a user-defined function block. A ladder function block is used as an example. Function block instructions are registered in the Sysmac Studio in advance. You do not need to register function block instructions to use them. You can register ST function blocks in the same way.

1 Right-click **Function Blocks** under **Programming - POUs** in the Multiview Explorer and select ***Add - Ladder*** from the menu.

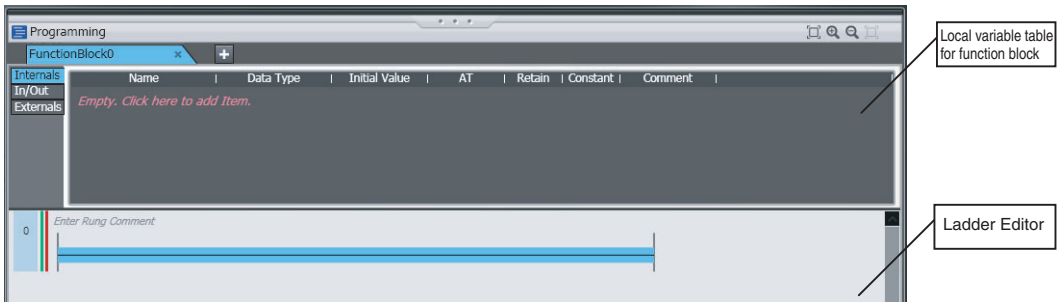


A function block named *FunctionBlock0* is added under **Function Blocks**.



2 Double-click the new function block.

The variable table for the function block and the Ladder Editor are displayed in the Programming Layer of the Edit Pane. From here you can create local variables and create ladder diagram rungs.



Deleting, Copying, and Pasting Function Blocks

You can delete, copy, and paste function blocks with the same procedures as for programs.

Precautions for Correct Use

When you delete a function block, all local variables and data in that function block are deleted with it.

Additional Information

After you use a function block in a program (that is, after you have created an instance), you can use that function block as a local variable data type for that program.

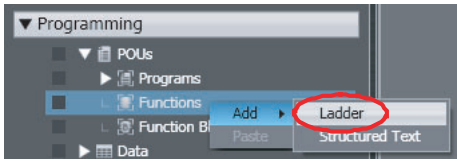
Registering Functions

- Functions
  A function is an instruction that performs a single function. Functions are written as ladder diagrams or ST. You can call them from programs or function blocks as required. For a detailed explanation of functions, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

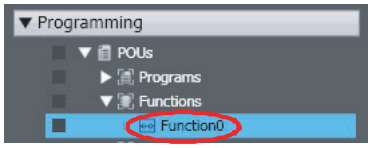
Registering Functions

The following procedure shows how to register a user-defined function. A ladder function is used as an example. Function instructions are registered in the Sysmac Studio in advance. You do not need to register function instructions to use them. You can register ST functions in the same way as described in this example.

1 Right-click **Functions** under **Programming - POUs** in the Multiview Explorer and select ***Add - Ladder*** from the menu.

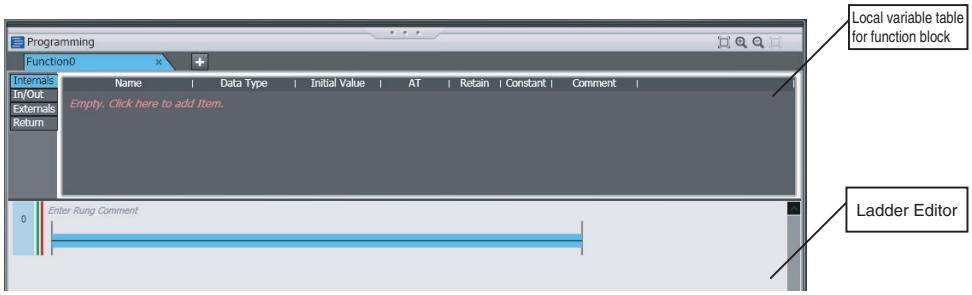


A function named *Function0* is added under **Function**.



2 Double-click the new function.

The local variable table and Ladder Editor for the function are displayed in the Programming Layer of the Edit Pane. From here you can create local variables and create ladder diagram rungs.



Deleting, Copying, and Pasting Functions

You can delete, copy, and paste functions with the same procedures as for programs.

Precautions for Correct Use

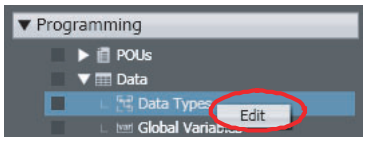
When you delete a function, all local variables and data in that function are deleted with it.

4-1-3 Creating Data Types

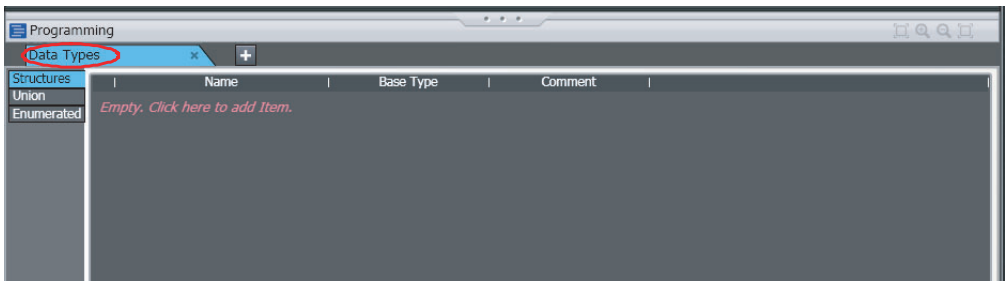
- Creating Data Types
  Creating a data type involves defining a new data type by combining existing data types. Data types registered using the Data Type Editor can be selected from the list of data types in the Variable Editor and used like any other data type. You can define data types that are structures, unions, or enumerations. For information on data types, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

Opening the Data Types Tab Page

1 Double-click **Data Types** under **Programming - Data** in the Multiview Explorer. Or, right-click **Data Types** under **Programming - Data** and select ***Edit*** from the menu.



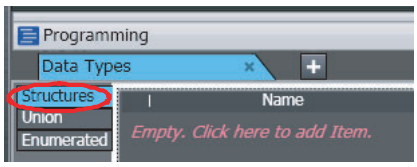
The Data Types Editor is displayed in the Programming Layer.



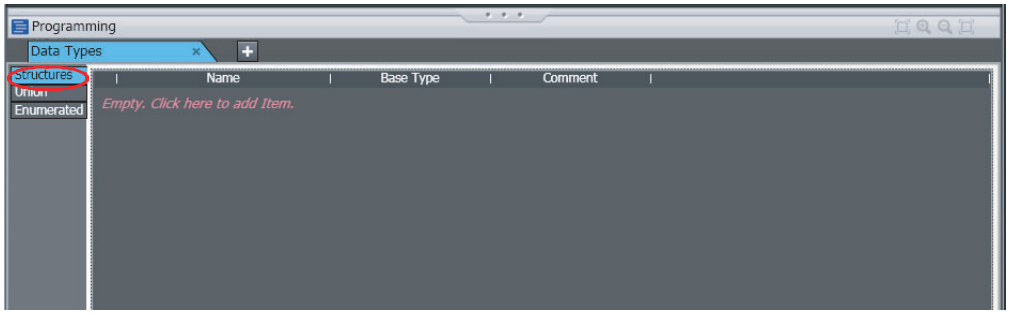
Creating Structure Data Types

After you register the data type, add members.

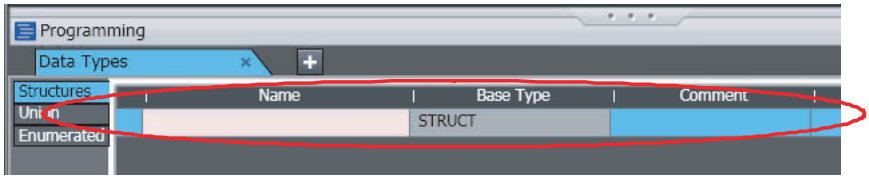
1 Click the **Structures** Side Tab in the Data Type Editor.



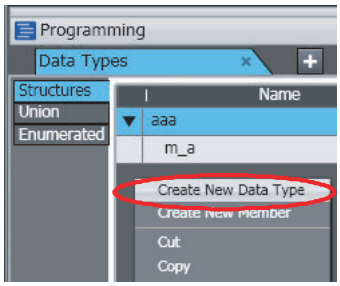
The Structure Data Type Editor is displayed.



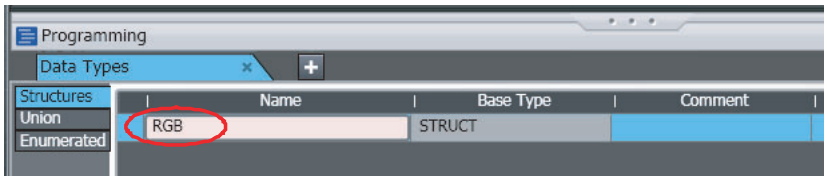
2 If, as in this example, no data types are registered, click the Data Type Editor. A data type registration line is displayed.



If you have already registered at least one data type, but you want to add more, press the **Insert** Key with the cursor inside the Data Type Editor. Or, right-click inside the Data Type Editor and select ***Create New Data Type*** from the menu.

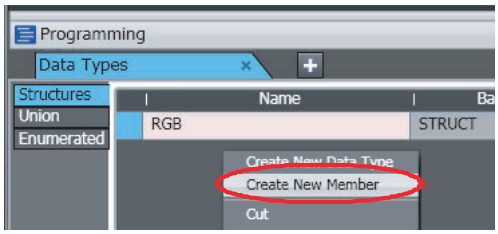


3 Enter values for each item, and then press the **Enter** Key.



The data type is registered. Refer to *Entering Data Type Attributes* on page 4-36 for information on entering values for attributes.

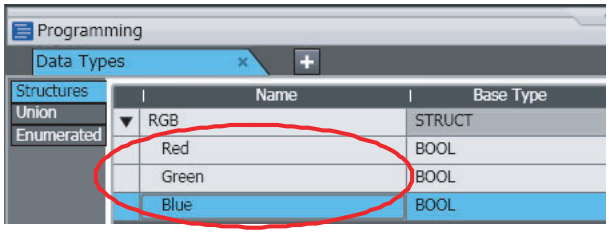
4 Next, add a member. Right-click the data type you just registered and select ***Create New Member*** from the menu.



The member is created.

5 Enter values for each item, and then press the **Enter** Key.

The new member is added to the structure data type.



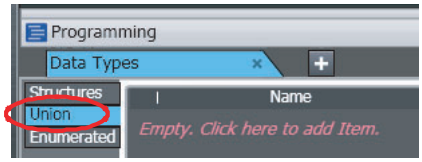
Refer to *Entering Data Type Attributes* on page 4-36 for information on entering values for attributes.

6 Repeat steps 4 and 5 to add additional members as required.

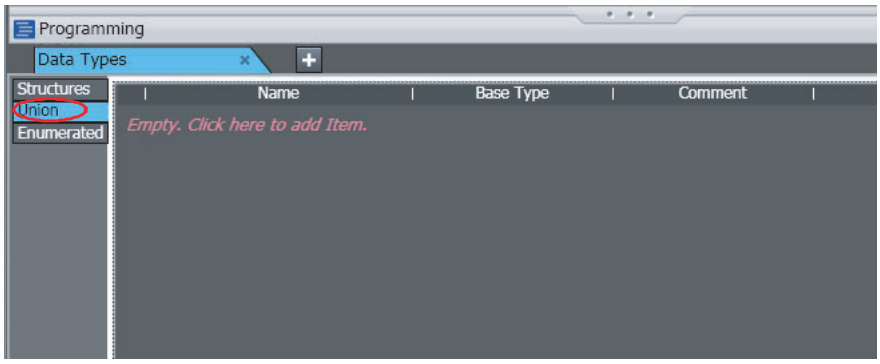
Creating Unions

After you register the data type, add members.

1 Click the **Union** Side Tab in the Data Type Editor.

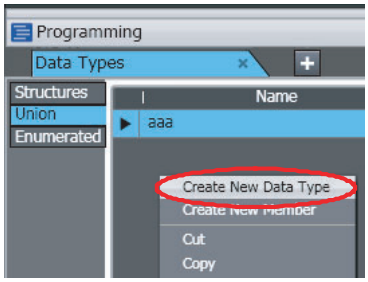


The Union Data Type Editor is displayed.

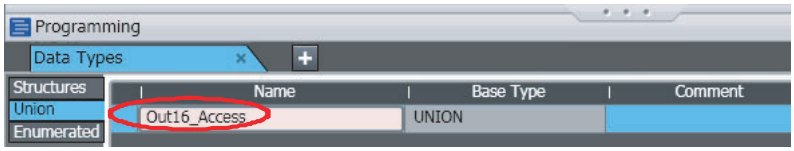


2 If, as in this example, no data types are registered, click the Data Types Editor. A data type registration line is displayed.

If you have already registered at least one data type, but you want to add more, press the **Insert** Key with the cursor inside the Data Type Editor. Or, right-click inside the Data Type Editor and select ***Create New Data Type*** from the menu.

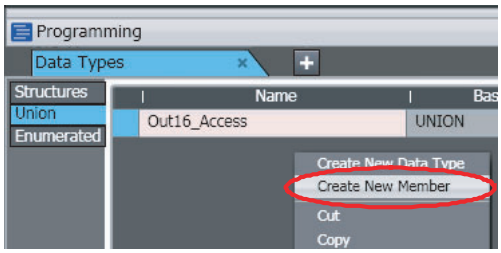


3 Enter values for each item, and then press the **Enter** Key.

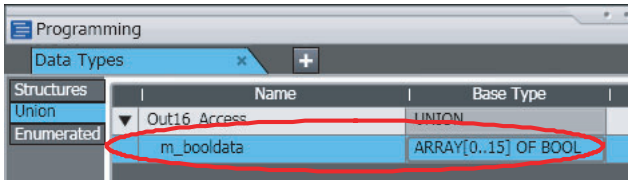


The data type is registered. Refer to *Entering Data Type Attributes* on page 4-36 for information on entering values for attributes.

4 Next, add a member. Right-click the data type you just registered and select ***Create New Member*** from the menu.



5 Enter values for each item, and then press the **Enter** Key.



The new member is added to the union data type. Refer to *Entering Data Type Attributes* on page 4-36 for information on entering values for attributes.

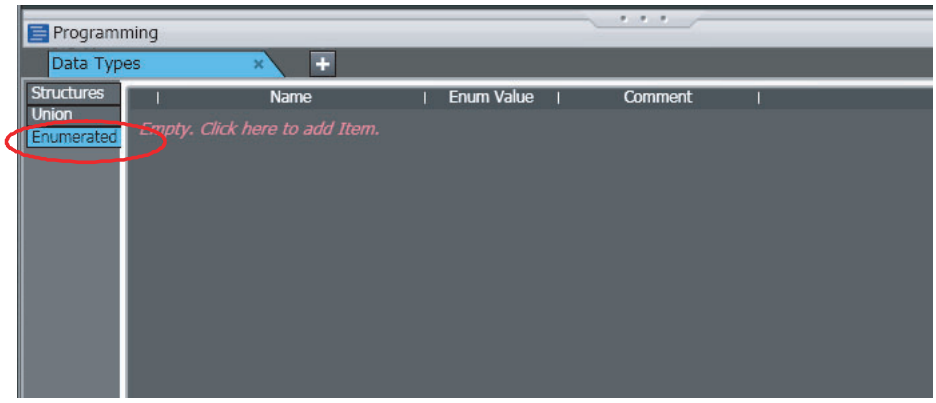
6 Repeat steps 4 and 5 to add additional members as required.

● Creating Enumerations

After you register the data type, add members.

1 Click the **Enumerated** Side Tab in the Data Type Editor.

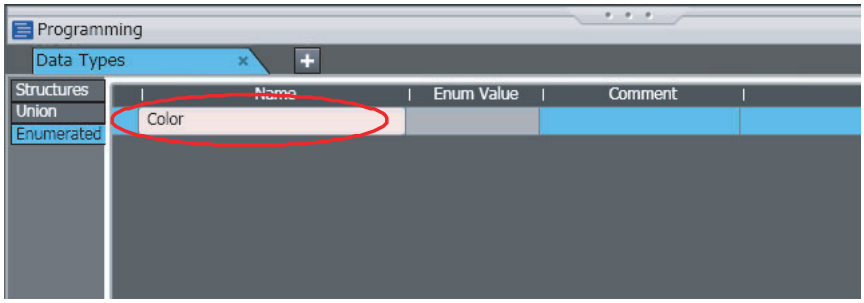
The Enumeration Data Type Editor is displayed.



2 If, as in this example, no data types are registered, click the Data Type Editor. A data type registration line is displayed.

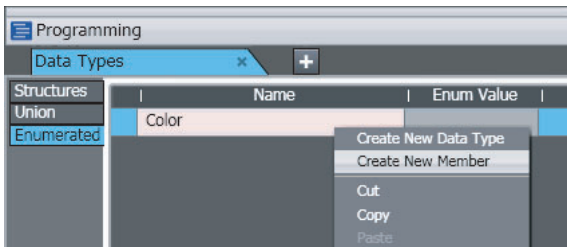
If you have already registered at least one data type, but you want to add more, press the **Insert** Key with the cursor inside the Data Type Editor. Or, right-click inside the Data Type Editor and select ***Create New Data Type*** from the menu.

3 Enter values for each item, and then press the **Enter** Key.



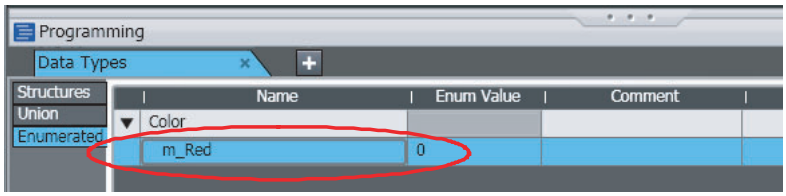
The data type is registered. Refer to *Entering Data Type Attributes* on page 4-36 for information on entering values for attributes.

4 Next, add a member (i.e., an enumerator). Right-click the data type you just registered and select ***Create New Member*** from the menu.



The new member (enumerator) is added to the enumeration data type.

5 Enter values for each item, and then press the **Enter** Key.

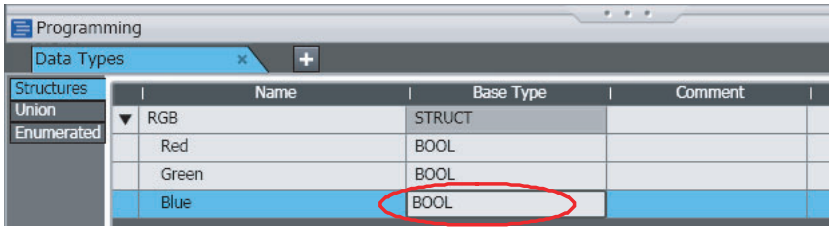


Refer to *Entering Data Type Attributes* on page 4-36 for information on entering values for attributes.

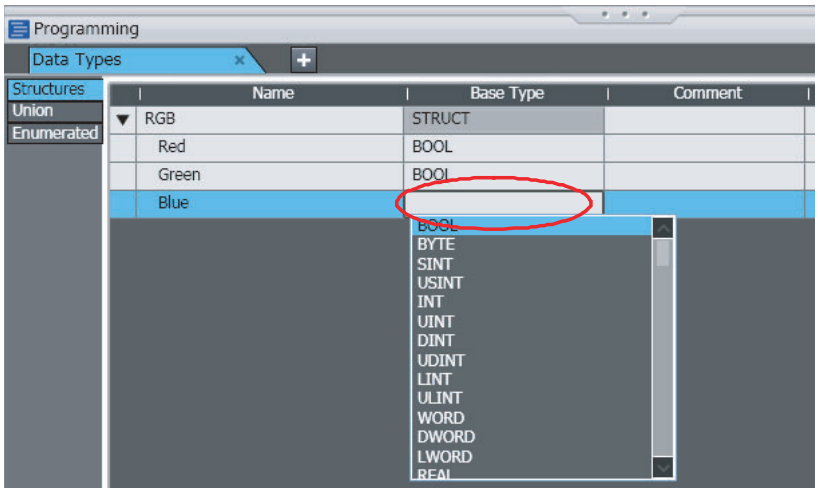
6 Repeat steps 4 and 5 to add additional members as required.

● Changing Data Types and Members

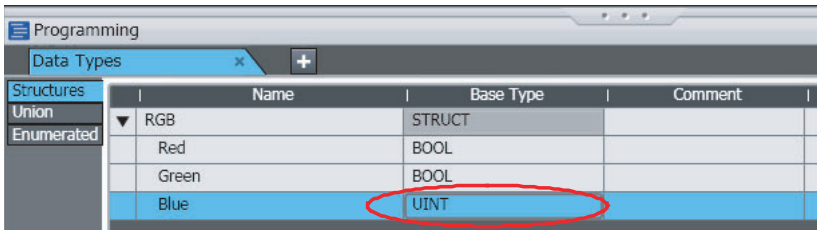
1 Click the cell to edit in the data type or member.



2 Change the setting, and then press the **Enter** Key.



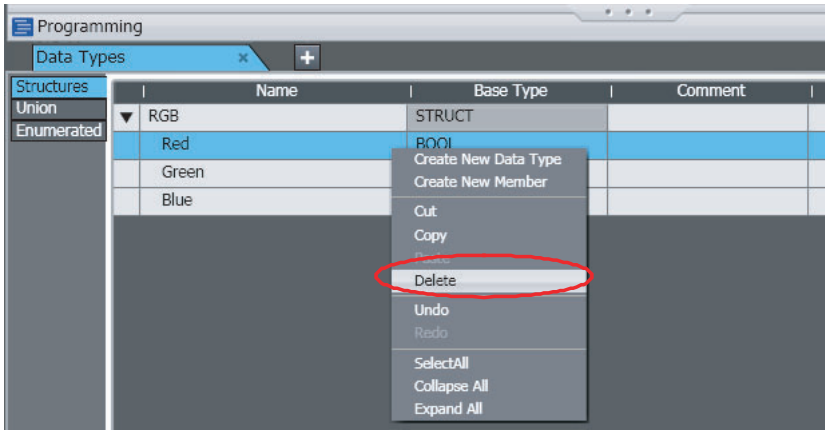
The change is applied to the data type or member.



Deleting Data Types and Members

1 Click any cell on the line of the data type or member to delete to select the entire line.

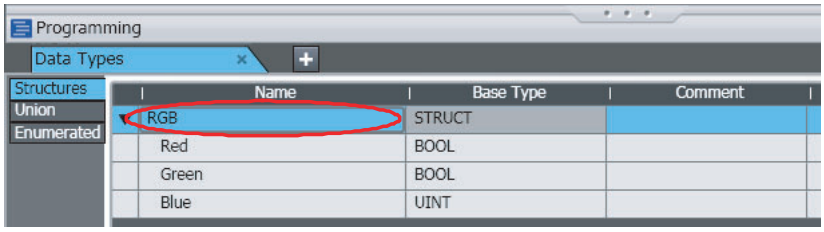
2 Press the **Delete** Key. Or, right-click a row and select ***Delete*** from the menu.



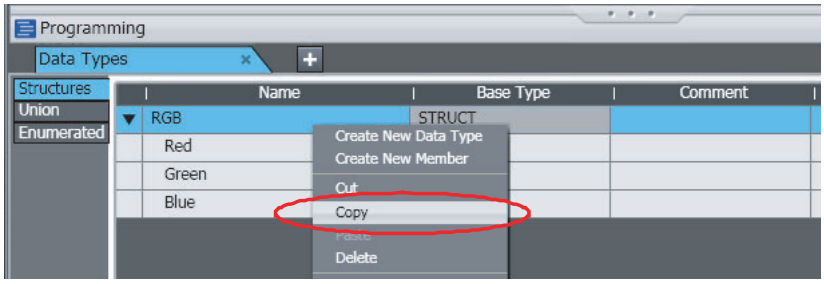
The data type or member is deleted.

Copying and Pasting Data Types and Members

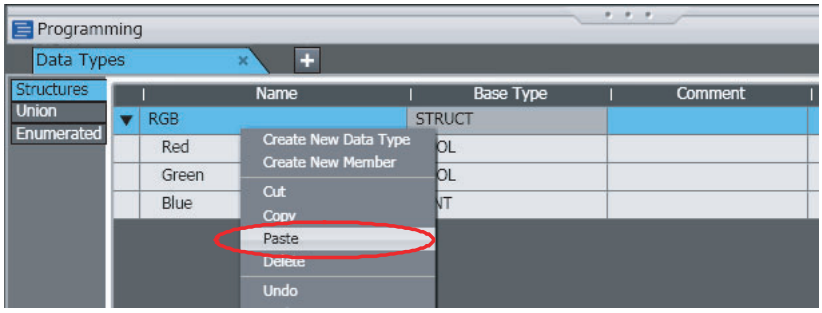
1 Click any cell on the line of the data type or member to copy.



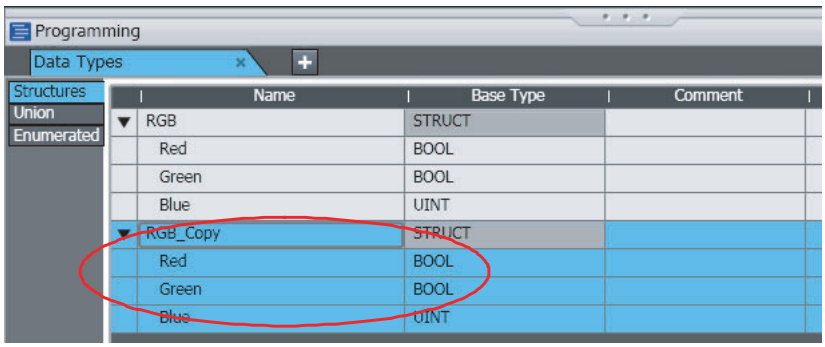
2 Press the **Ctrl + C** Keys. Or, right-click the row and select ***Copy*** from the menu.



3 Press the **Ctrl + V** Keys. Or, right-click and select ***Paste*** from the menu.



The data type or member is copied with "_Copy" added to the name of the data type or member that was copied.

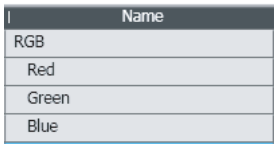
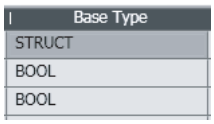
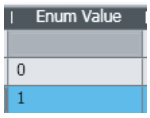
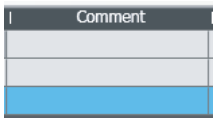


Precautions for Correct Use

If you use another structure as a member of a structure, you cannot specify a structure that results in recursion or a loop. An error is detected during the program check.

Entering Data Type Attributes

This section describes how to enter data type attributes. For more information on attributes, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501). For information on input value ranges and character restrictions, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

Data type attribute		Description
Name		Enter a text string for the name.
Base Type		Enter a data type directly or select one from the list. However, structures must be STRUCT and unions must be UNION.
Enum Value		Enter the integer value that corresponds to the enumerator.
Comment		Enter a comment.

4-1-4 Programming

The following sections describe how to enter programming code. You can use either ladder diagrams (LD) or ST (structured text) to code the algorithms used in POUs (programs, functions, or function blocks).

Additional Information

Entering Constants (Literals) for Function Block Parameters

- Use the following formats to enter constants (literals) for the parameters of function blocks that you insert in a program.
- *data_type_name#base#numeric_value*
  Examples: Entering a hexadecimal number: INT#16#001A
  Entering a decimal number: INT#10#26
  Entering a binary number: INT#2#00000000 to INT#2#000011010
- *data_type_name#numeric_value*
  Example: INT#26

Note The base is assumed to be 10 (i.e., a decimal number).

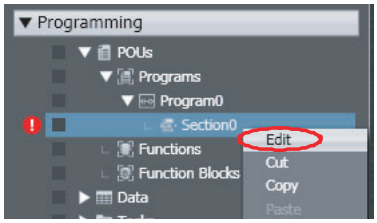
4-1-5 Programming Ladder Diagrams

- Programming Ladder Diagram
  Programming a ladder diagram involves connecting circuit parts with connecting lines to build algorithms. You can enter circuit parts and connecting lines in the Ladder Editor.

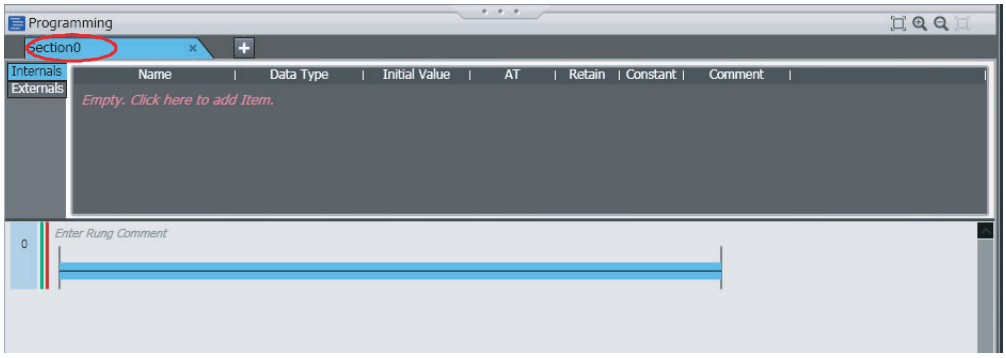
Opening and Using the Ladder Editor

● Programs

Double-click a section of a ladder diagram program under **Programming - POUs - Programs** in the Multiview Explorer. Or, right-click the section and select ***Edit*** from the menu.



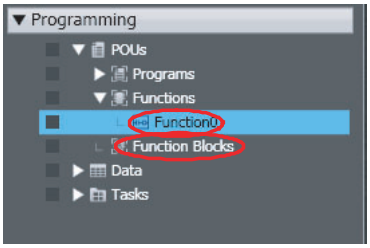
The Ladder Editor for the program is displayed.



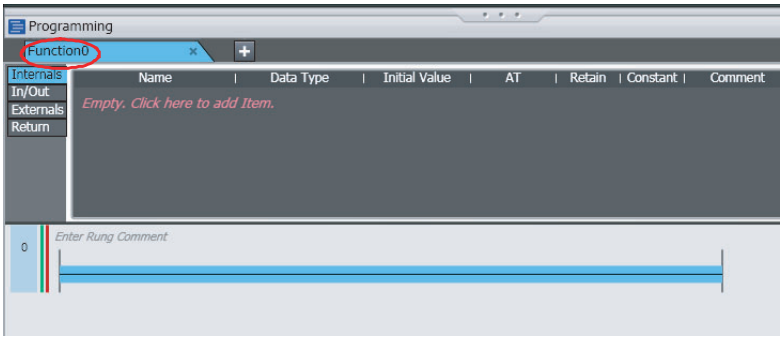
Refer to *Registering POUs* on page 4-25 for the procedure to register a ladder diagram program.

Functions and Function Blocks

Double-click a ladder diagram function under **Programming - POUs - Functions** or a ladder diagram function block under **Programming - POUs - Function Blocks** in the Multiview Explorer. Or, right-click a ladder diagram function or function block and select ***Edit*** from the menu.



The Ladder Editor for the function or function block is displayed.



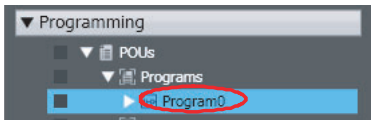
For information on registering ladder diagram functions or function blocks, refer to *Registering Function Blocks* on page 4-28 or *Registering Functions* on page 4-29.

Adding and Deleting Sections

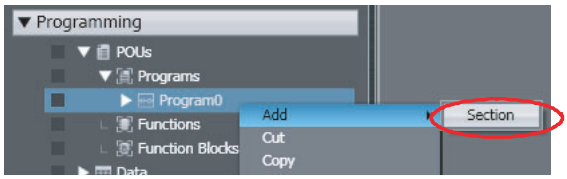
- Sections
  You can divide ladder diagrams into smaller units for easier management. These units of division are called sections.

Adding Sections

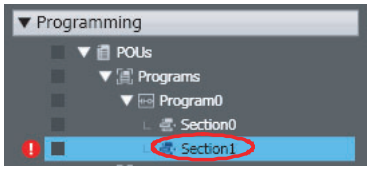
1 Select a ladder diagram program under **Programming - POUs - Programs** in the Multiview Explorer.



2 Right-click the ladder diagram program and select ***Add - Section*** from the menu.



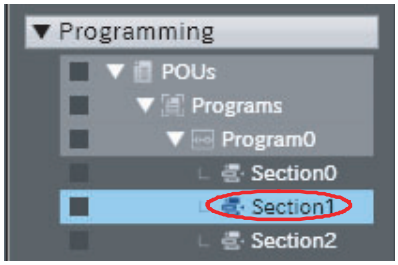
A section is added under the selected ladder diagram program.



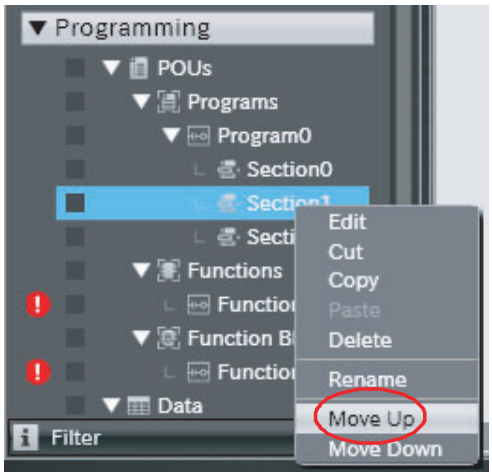
Changing the Order of Sections

Programs are executed from top to bottom in the order that the sections are displayed in the Multiview Explorer. To change the order of execution, you must change the order of the sections.

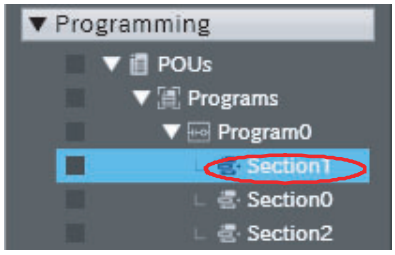
1 Select the section to change the order of under **Programming - POUs - Programs** in the Multiview Explorer.



2 Right-click the section and select ***Move Up*** from the menu to move the section up, or select ***Move Down*** from the menu to move the section down. You can also drag the sections to change the order.

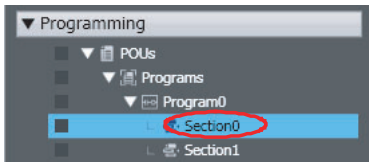


The selected section is moved up or down.

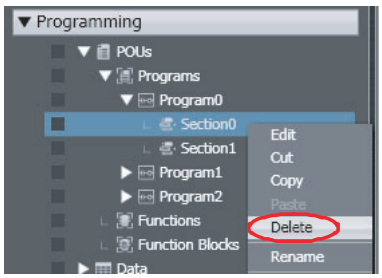


Deleting Sections

1 Select the section to delete from a ladder diagram program under **Programming - POUs - Programs** in the Multiview Explorer.



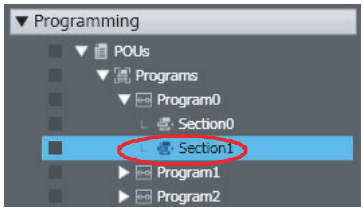
2 Right-click the section and select ***Delete*** from the menu. Or, select ***Delete*** from the ***Edit*** menu. You can also press the **Delete** Key to delete the section.



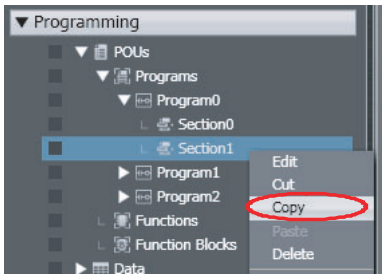
The selected section is deleted.

Copying and Pasting Sections

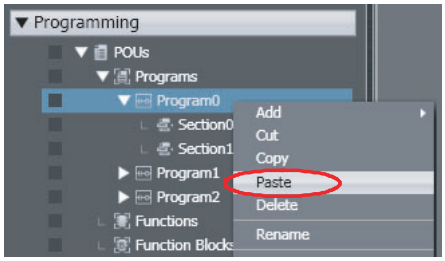
1 Select the section to copy from a ladder diagram program under **Programming - POUs - Programs** in the Multiview Explorer.



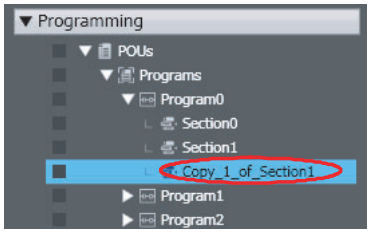
2 Press the **Ctrl + C** Keys. Or, right-click the section and select ***Copy*** from the menu.



3 Press the **Ctrl + V** Keys. Or, right-click and select ***Paste*** from the menu.



The copied section is added. If another section already exists with the same name, the section is added with “Copy_1_of” added to the end of the source section name.

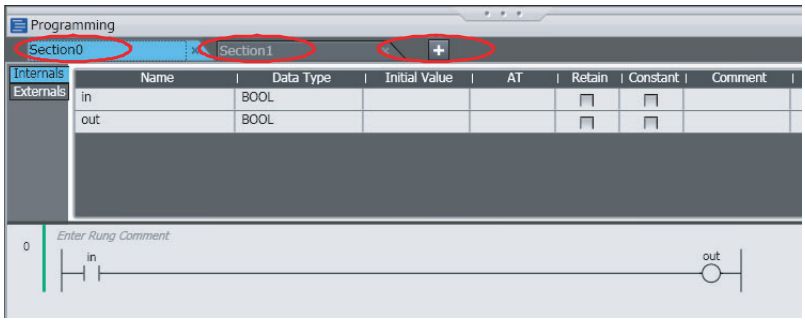


Precautions for Correct Use

- You cannot undo or redo actions performed on sections in the Multiview Explorer. After you delete a section, you cannot restore it.
- Changes that you make to a program affect all sections under that program as well.

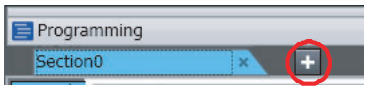
Additional Information

- To switch between different sections, click the tab of the section to display across the top of the Programming Layer.



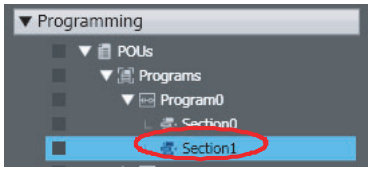
Use the following procedure to add a tab page.

1. Click the **Add Tab Page** Button.



A blank tab page is displayed.

2. Select a section from a ladder diagram program under **Programming - POUs - Programs** in the Multiview Explorer.

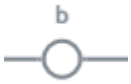
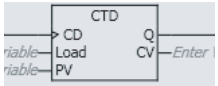
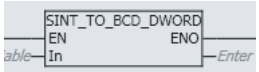


The section is added to the top tab page in the Programming Layer.

- You can use up to 1,000 sections in a single ladder diagram program.

Basic Circuit Part Operations

- Inserting Circuit Parts
  You insert circuit parts in the Ladder Editor to create an algorithm. The following circuit parts are supported.

Circuit Part		Description
Input		A program input.
Output		A program output.
Function block		An instruction that defines an operation.
Function		An instruction to perform a single function.
Jump		A jump starting point to another rung.
Jump label		A label that designates a jump destination.
Bookmark		A symbol that you can place on any rung.
Rung comment		A comment related to a rung.

Methods for Inserting Circuit Parts

There are four basic ways to insert circuit parts.

Method (1) Drag a circuit part from the Toolbox.

Method (2) Right-click a connecting line and select ***Insert Circuit Part*** from the menu.

Method (3) Select a connecting line and press the shortcut key to insert a circuit part.

Method (4) Select a connecting line and then select a circuit parts from ***Insert - Circuit Parts*** on the Main Menu.

Inserting and Deleting Program Inputs and Outputs

Inserting a Program Input in an AND Structure

There are four methods to insert an input in an AND structure.

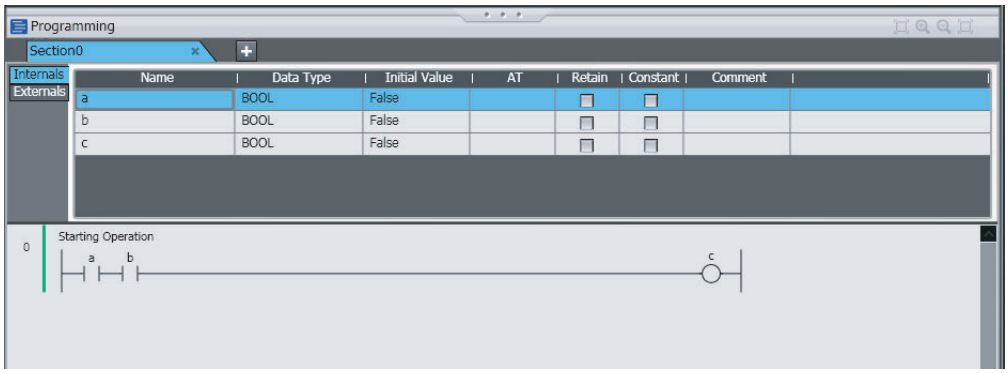
Method (1) Drag an input from the Toolbox.

Method (2) Right-click a connecting line and select ***Insert Input*** from the Menu.

Method (3) Select a connecting line and press the **C** Key.

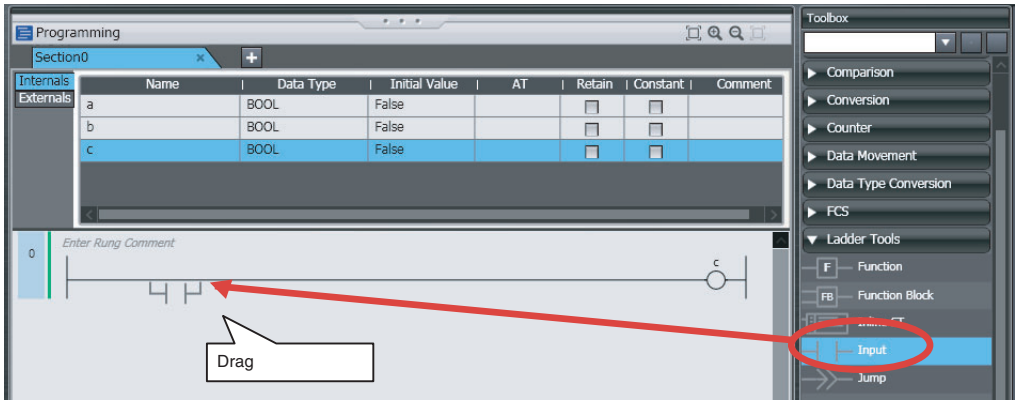
Method (4) Select the location at which to insert the input and select ***Insert - Circuit Parts - N.O. Input.***

The procedures to insert the input that is shown in the following figure are given below.



Method (1) Dragging an Input from the Toolbox

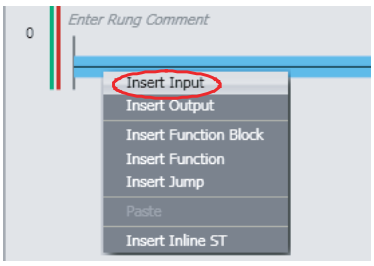
Select **Input** in the **Ladder Tools** in the Toolbox and drag it to the location where you want to insert it in the Ladder Editor.



The input is inserted.

Method (2) Right-clicking a Connecting Line and Selecting *Insert Input* from the Menu

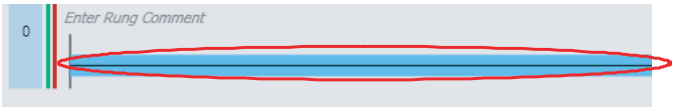
Right-click the connecting line where you want to insert the input and select **Insert Input** from the menu.



The input is inserted.

Method (3) Selecting a Connecting Line and Pressing the C Key

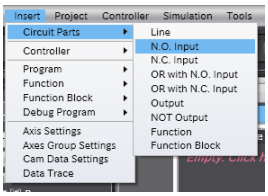
Select a connecting line and then press the **C** Key.



The input is inserted.

Method (4) Selecting the Location at Which to Insert the Input and Selecting *Insert - Circuit Parts - N.O. Input.*

Select the location at which to insert the input and then select ***Insert - Circuit Parts - N.O. Input.***



The input is inserted.

● Inserting a Program Input in an OR Structure

There are five ways to insert an input in an OR structure.

Method (1) Drag an input from the Toolbox to the input that is above where you want to insert the input.

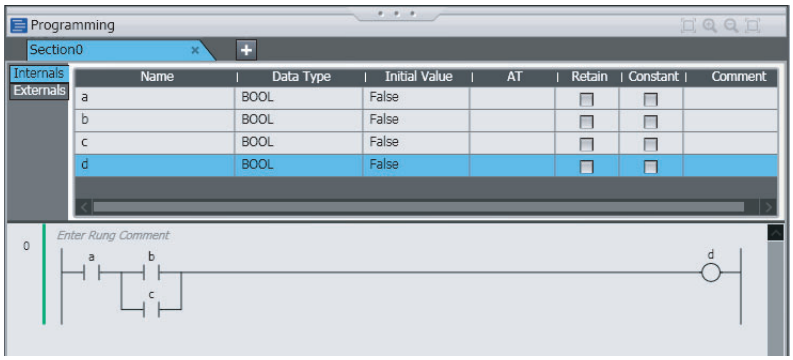
Method (2) Right-click the input where you want to insert the OR input and select ***Insert Parallel Input Above*** or ***Insert Parallel Input Below*** from the menu.

Method (3) Drag the connecting line from the start point to insert the input to the connecting line at the end point.

Method (4) Select an input and press the **W** Key. For a NOT input, press the **X** Key.

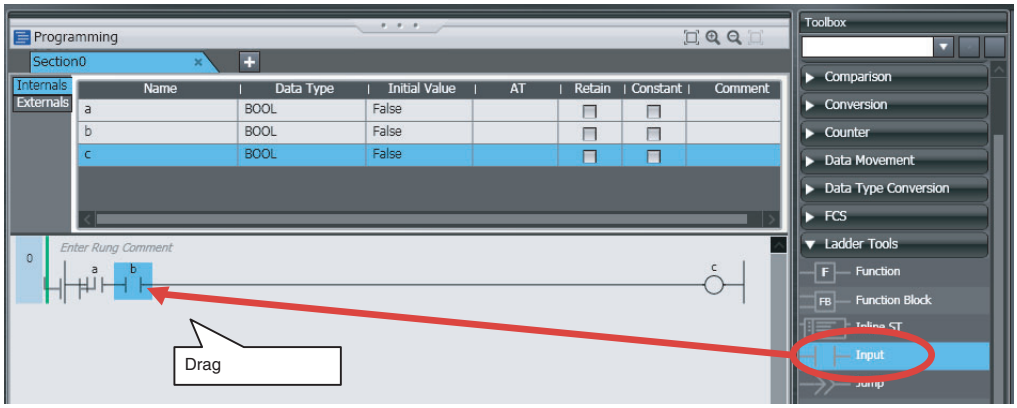
Method (5) Select the location at which to insert the input and select ***Insert - Circuit Parts - N.O. Input OR.***

The procedures to insert the input that is shown in the following figure are given below.

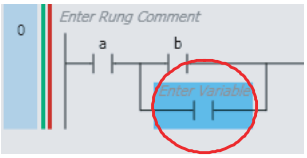


Method (1) Dragging an Input from the Toolbox to the Input that Is Above Where You Want to Insert the Input

Select **Input** in the **Ladder Tools** in the Toolbox and drag the input to the input that is above the location where you want to insert it in the Ladder Editor.

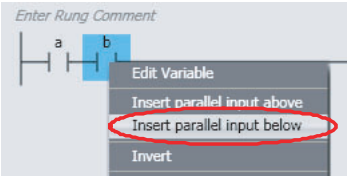


The input is inserted in an OR structure.

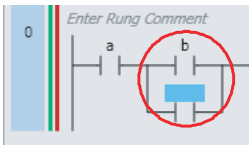


Method (2) Right-clicking the Input Where You Want to Insert the OR Input and Selecting *Insert Parallel Input Above* or *Insert Parallel Input Below* from the Menu

Right-click the input where you want to insert the OR input and select ***Insert parallel input below*** from the menu.



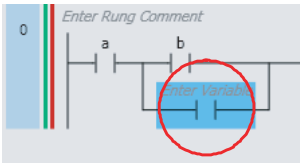
The input is inserted in an OR structure.



Method (3) Dragging the Connecting Line from the Start Point to Insert the Input to the Connecting Line at the End Point

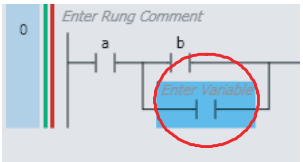
Drag the connecting line from the start point where you want to insert the input to the end point.

The input is inserted in an OR structure.

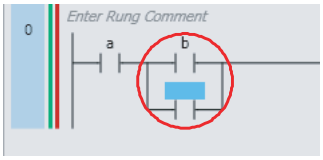


Method (4) Selecting an Input and Pressing the W Key For a NOT input, press the X Key.

Select the input above the location where you want to insert the input and press the **W** Key.

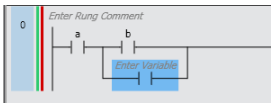


The input is inserted in an OR structure.

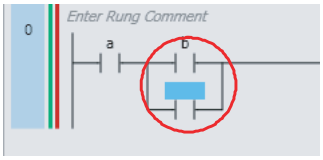


Method (5) Selecting the Location at Which to Insert the Input and Selecting *Insert - Circuit Parts - N.O. Input OR*

Select the input above the location at which to insert the input and then select ***Insert - Circuit Parts - N.O. Input OR.***



The input is inserted in an OR structure.



● Inserting Program Outputs in Series in an AND Structure

There are four ways to insert outputs in series.

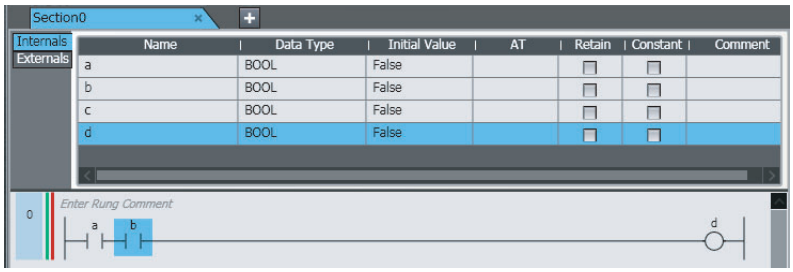
Method (1) Drag an output from the Toolbox.

Method (2) Right-click a connecting line and select ***Insert Output*** from the menu.

Method (3) Select a connecting line and then press the **O** Key. For a NOT output, press the **Q** Key.

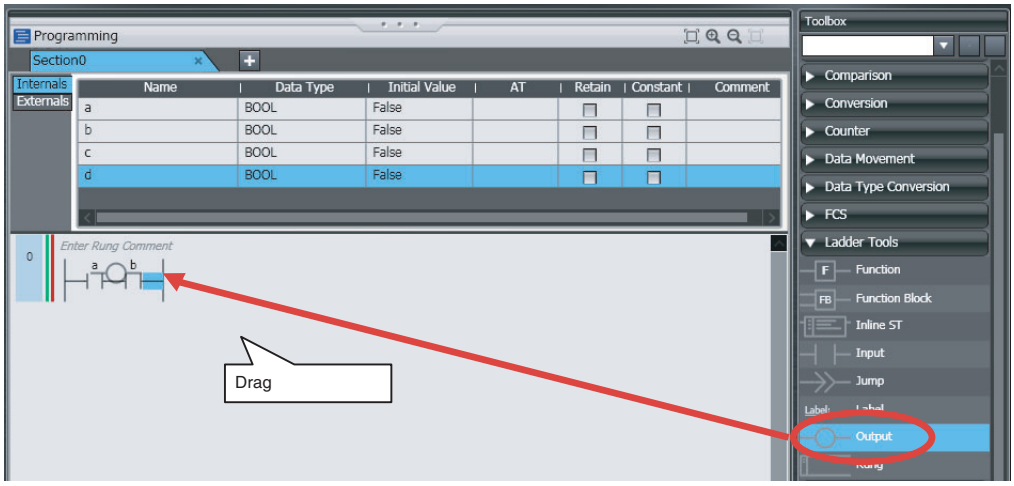
Method (4) Select the location at which to insert the input and select ***Insert - Circuit Parts - Output.***

The procedures to insert the output that is shown in the following figure are given below.



Method (1) Dragging an Output from the Toolbox

Select **Output** in the **Ladder Tools** in the Toolbox and drag it to the location where you want to insert it in the Ladder Editor.

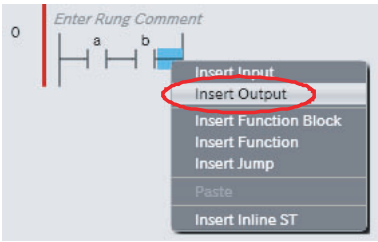


The output is inserted.

If you drop the output on a connecting line, the output is inserted in series.

Method (2) Right-clicking a Connecting Line and Selecting *Insert Output* from the Menu

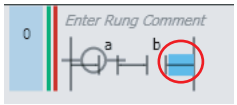
1 Right-click the connecting line where you want to insert the output and select ***Insert parallel output*** from the menu.



The output is inserted.

Method (3) Selecting a Connecting Line and Pressing the O Key For a NOT output, press the Q Key.

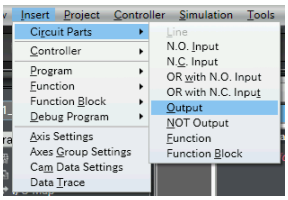
Select the output above the location where you want to insert the output and press the **O** Key.



The output is inserted.

Method (4) Selecting the Location at Which to Insert the Input and Selecting *Insert - Circuit Parts - Output.*

Select the location at which to insert the output and then select ***Insert - Circuit Parts - Output.***



The output is inserted.

● Inserting Program Outputs in an OR Structure

There are three ways to insert outputs.

Method (1) Drag an output from the Toolbox to the location above the coil with which an OR structure is required.

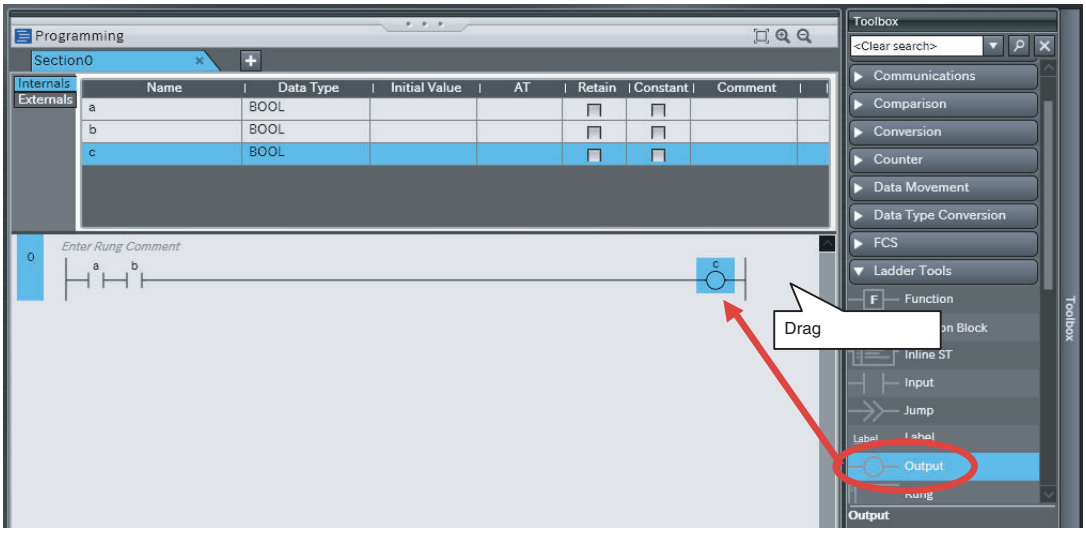
Method (2) Drag the connecting line from the start point to insert the output to the end point at the right bus bar.

Method (3) Right-click the output where you want to create the OR structure in the Ladder Editor and select ***Insert Output*** from the menu.

The procedures to insert the output that is shown in the following figure are given below.

Method (1) Dragging an Output from the Toolbox

Select **Output** in the **Ladder Tools** in the Toolbox and drag it to the location where you want to insert it in the Ladder Editor.

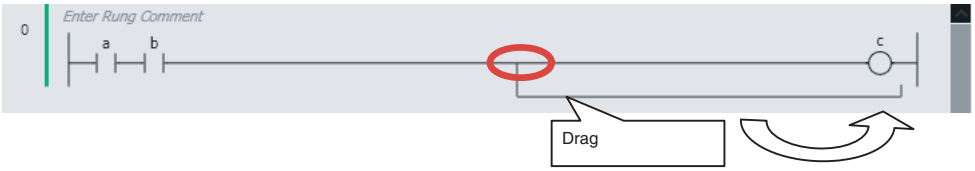


The output is inserted.

If you drop the output on a connecting line, the output is inserted in series.

Method (2) Dragging the Connecting Line from the Start Point to Insert the Output to the End Point at the Right Bus Bar

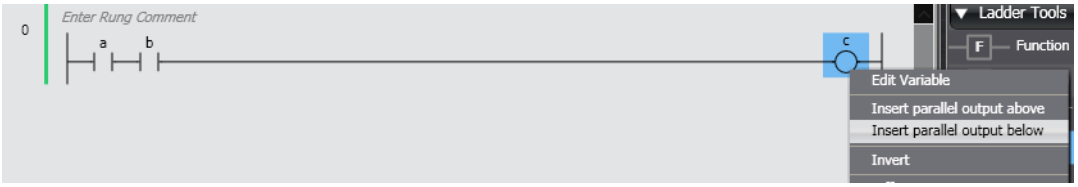
Drag the connecting line from the start point where you want to insert the output to the right bus bar at the end point.



The output is inserted.

Method (3) Right-clicking the Output Where You Want To Create the OR Structure in the Ladder Editor and Selecting *Insert Parallel Output* from the Menu

Right-click the output where you want to insert the OR output and select ***Insert parallel output above*** or ***Insert parallel output below*** from the menu.



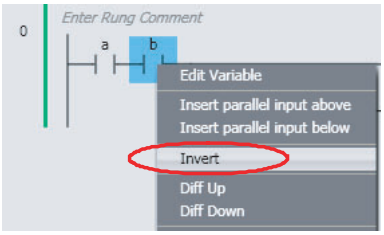
The output is inserted in an OR structure.

● Procedures for Changing Circuit Parts

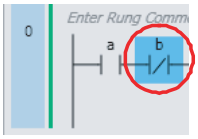
Editing Program Inputs and Outputs

Negating Inputs and Outputs

Select an input or an output, and then press the **/** Key. Or, right-click the input or output and select ***NOT*** from the menu.

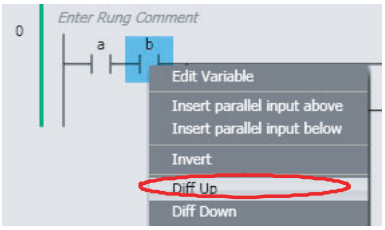


The N.O./N.C. state of the input or output is reversed.

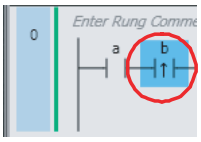


Setting Differentiation

To set upward differentiation, right-click the input or output and select ***Diff Up*** from the menu. To set downward differentiation, select ***Diff Down*** from the menu.



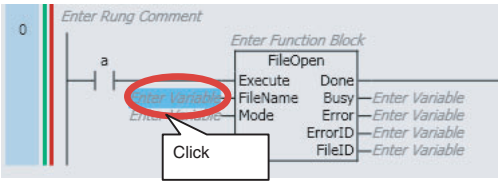
Upward differentiation or downward differentiation is set.



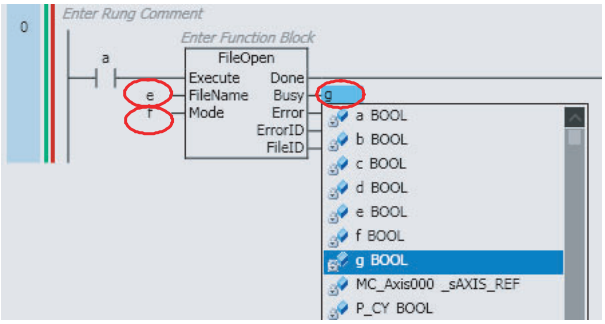
Editing Function Blocks

Entering Parameters

1 Click the parameter you want to edit in the function block.

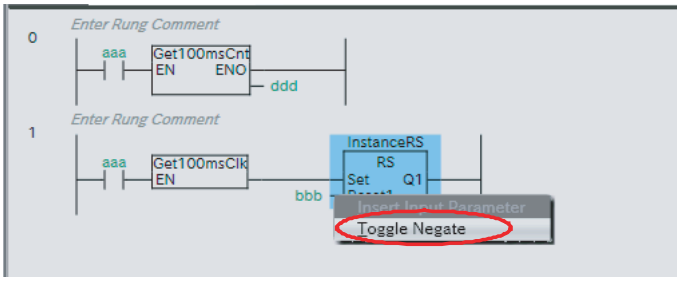


2 Enter the variable name to use. If there are variable names with a usable data type, you can also select from the variables displayed in the list.

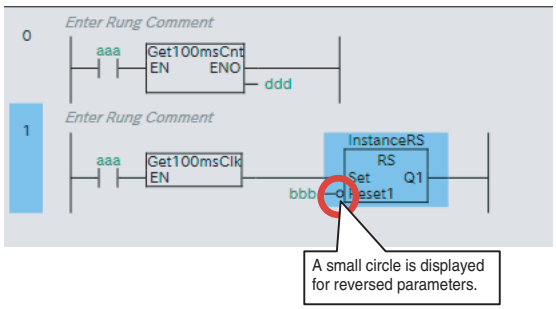


Reversing Inputs

Right-click a BOOL input variable name in the function block and select ***Toggle Negate*** from the menu.



The input to the selected parameter or the output from the selected parameter is reversed.



Editing Functions

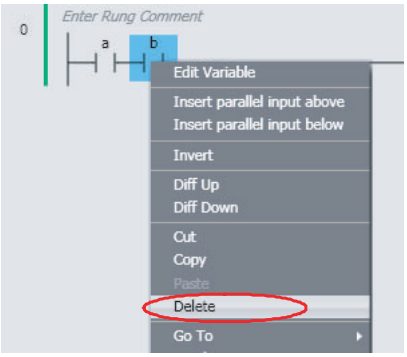
Entering Parameters

Parameters are entered in the same way as for function blocks.

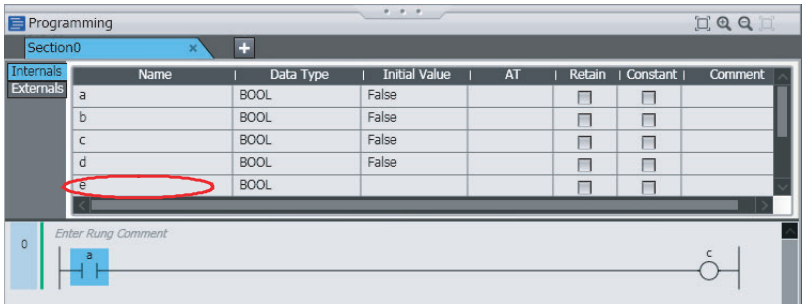
● Procedures for Deleting Circuit Parts

Deleting Program Inputs

Right-click the input you want to delete and select ***Delete*** from the menu. Or, select the input and press the **Delete** Key.



The selected input is deleted.

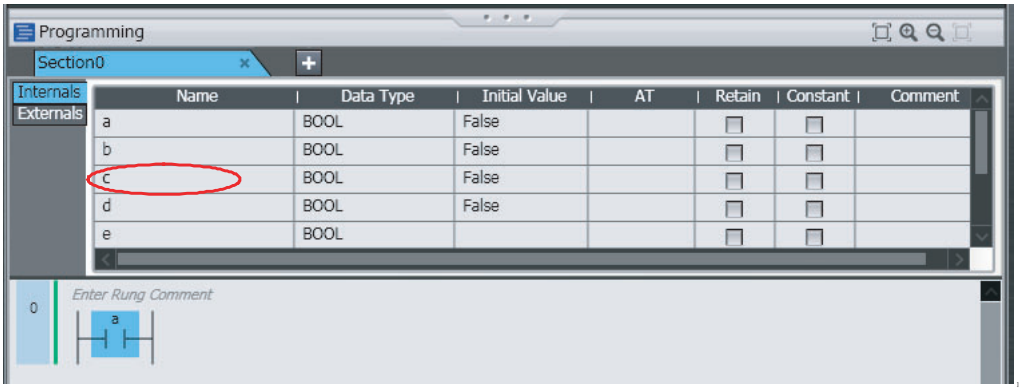


In this case, any variables assigned to the input are not deleted from the local variable table or global variable table.

Deleting Outputs

Right-click the output you want to delete and select ***Delete*** from the menu. Or, select the output and press the **Delete** Key.

The selected output is deleted.



In this case, any variables assigned to the output are not deleted from the local variable table or global variable table.

Entering Variables in Circuit Parts

Use the following method to enter variables into a program input or output that you have inserted. All variables with the correct data type are displayed in the list.

Entering Global Variables

Method (1) Select a variable that is already registered in the global variable table from the list in the Ladder Editor.

Local Variables

Method (1) Select a variable that is registered in the local variable table from the list in the Ladder Editor.

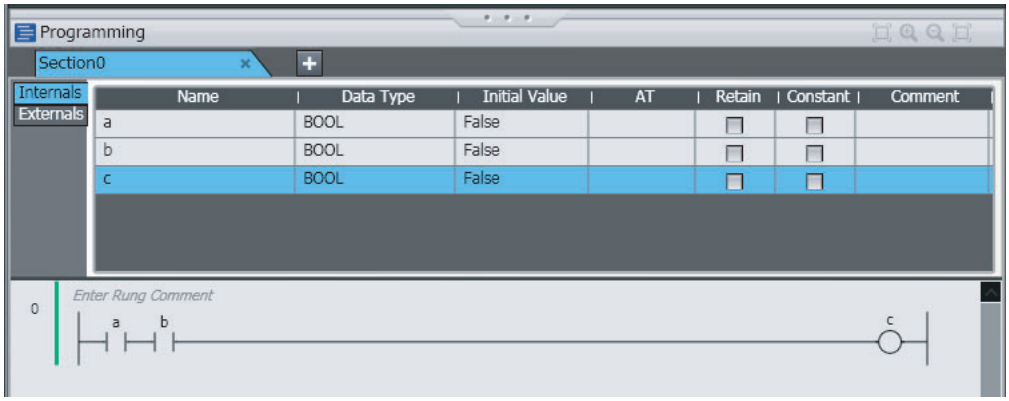
Method (2) Drag a variable from the local variable table of the POUs to the Ladder Editor.

Method (3) Enter a variable in the Ladder Editor (or the ST Editor) before you register the variable in the local variable table.

Additional Information

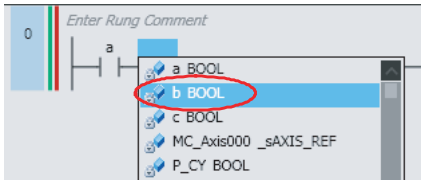
- Members of derivative variables also appear in the list as long as they have the correct data type.
- You cannot convert variables registered as local variables to global variables.
- You cannot view addresses in memory for CJ-series Units or I/O ports in the Ladder Editor, only the variable names. You also cannot see if a variable has an AT specification.
- Variables entered directly into the Ladder Editor or ST Editor are treated as local variables. They are entered with the data type that is required for the instruction. If the data type cannot be determined, the cell will be blank and displayed in red. You must enter the data type.
- You can identify the following types of variables in the Ladder Editor by their color.
  - Global variables: Green
  - Local variables: Gray

The procedures to enter the variables that are shown in the following figure are given below.

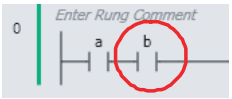


Method (1) Selecting a Variable in the Ladder Editor

1 Select the input, click *Enter Variable,* and then select a variable from the list.

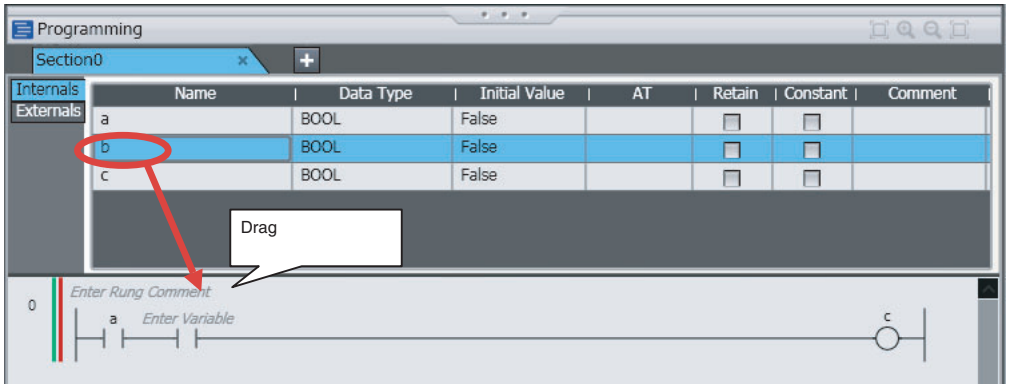


The variable is entered.

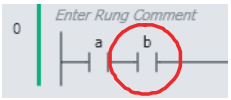


Method (2) Dragging a Variable from the Local Variable Table of the POUs

Drag the variable you want from the local variable table to the input.

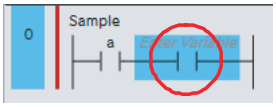


The variable is entered.

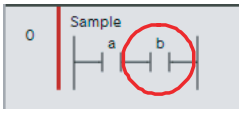


Method (3) Enter a variable in the Ladder Editor (or the ST Editor) before you register the variable in the local variable table.

Select a program input, click *Enter Variable,* and enter the variable directly.



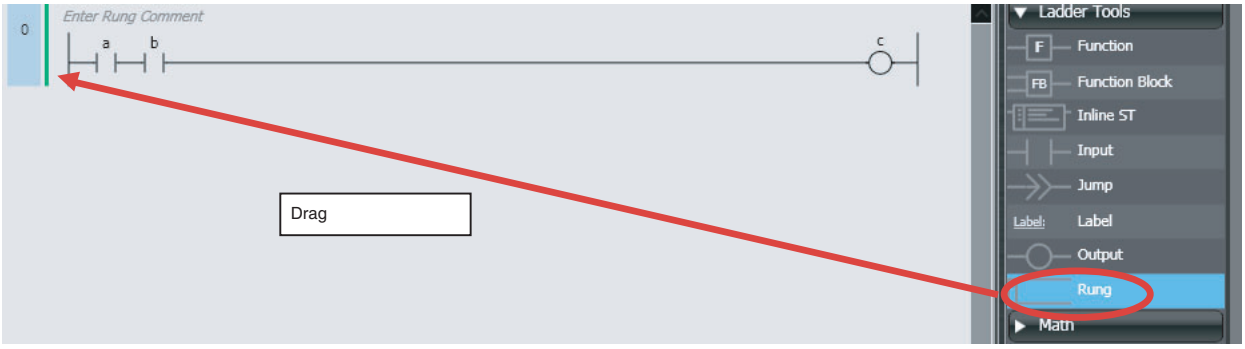
The variable is entered.



Inserting Rungs

You can use the following procedures to insert rungs.

(1) Select **Rung** under **Ladder Tools** in the Toolbox and then drag the rung to the beginning of the rung in front of the location where you want to insert the rung.



(2) Select the start of a rung and press the **R** Key. (Press the **Shift** + **R** Keys to insert a rung above the selected rung.)

(3) Right-click a rung and select ***Insert rung above*** or ***Insert rung below***.

A rung is inserted above or below the selected rung.

Inserting and Deleting Function Block Instructions and User-defined Function Blocks

● Inserting Function Blocks

You can use the following methods to insert function block instructions and user-defined function blocks (collectively called “function blocks” below).

Function Block Instructions

Method (1) Drag a function block instruction from the Toolbox.

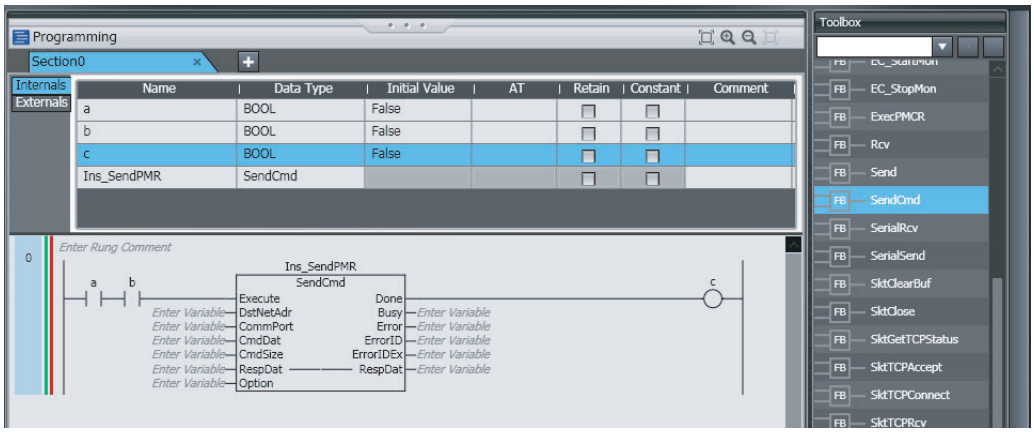
User-defined Function Blocks or Function Block Instructions

Method (1) Drag a function block from the Toolbox.

Method (2) Right-click the desired location and select ***Insert Function Block*** from the menu.

Method (3) Move the cursor to the insertion position and press the **F** Key.

The procedures to insert the function block that is shown in the following figure are given below.

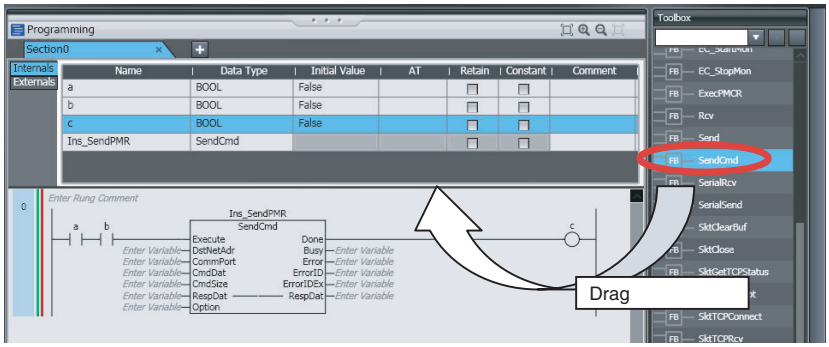


Inserting Function Block Instructions

The following example is for a communications instruction.

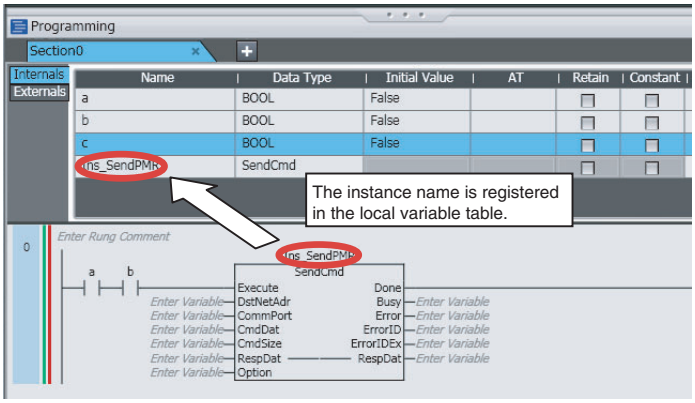
Method (1) Dragging a Function Block Instruction from the Toolbox

1 Select **SendCmd** under **Communications** in the Toolbox and then drag it to the location where you want to insert it.



A rung for the SendCmd function block is inserted.

2 Click *Enter Instance Variable Name* at the top of the function block you inserted and enter an instance name for the function block. If the function block instance is registered in the local variable table, you can also select this instance.

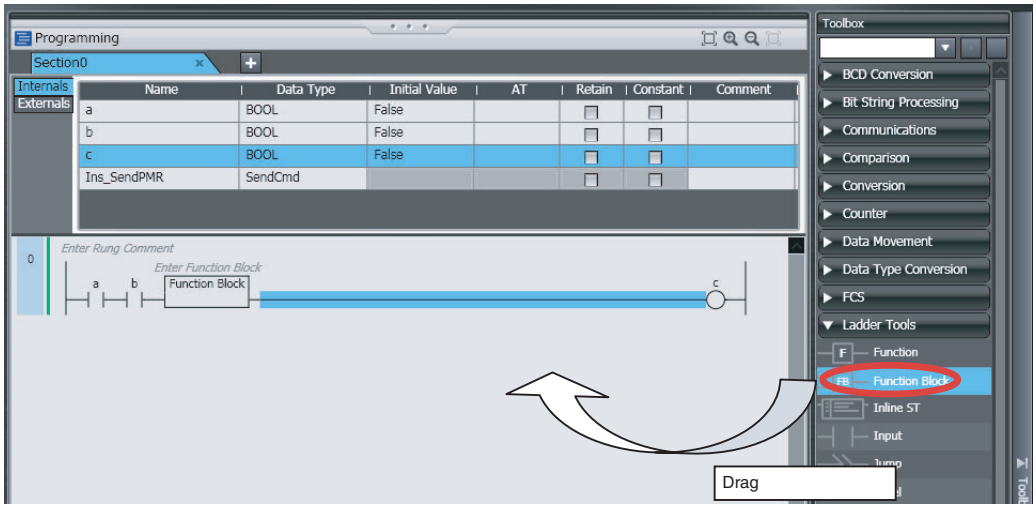


This completes the insertion of the function block. If you entered a new instance name, it is registered in the local variable table.

Inserting User-defined Function Blocks and Function Block Instructions

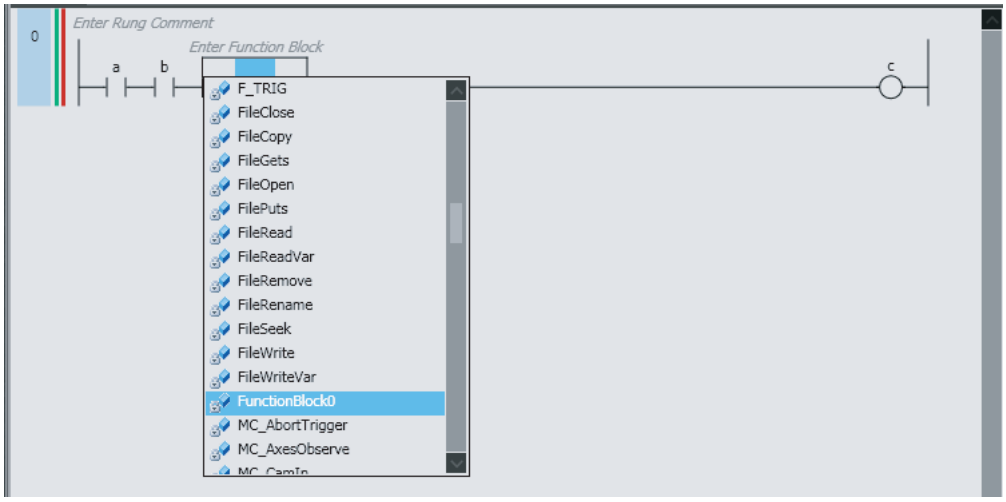
Method (1) Dragging a Function Block from the Toolbox

1 Select **Function Block** under **Ladder Tools** in the Toolbox and then drag it to the location where you want to insert it. Or, right-click the desired location and select ***Insert Function Block*** from the menu.



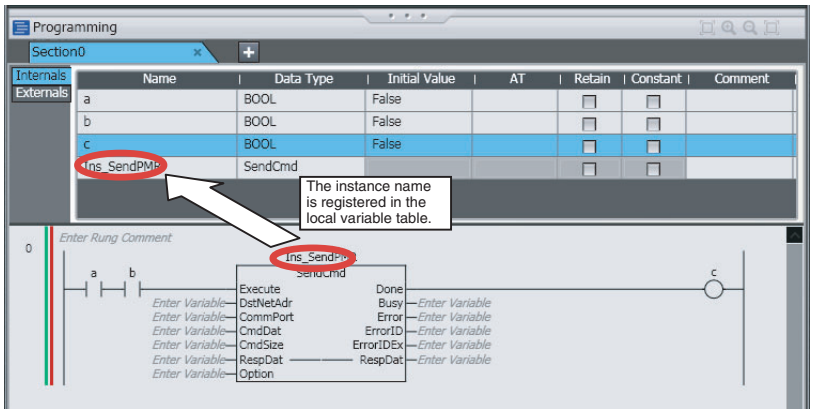
A rung for the function block is added.

2 Click *Function Block* inside the function block you inserted and then select a function block or function block instruction from the list.



The selected function block is displayed.

3 Click *Enter Instance Variable Name* in the function block you inserted and enter an instance name for the function block. If the function block instance is registered in the local variable table, you can also select this instance.

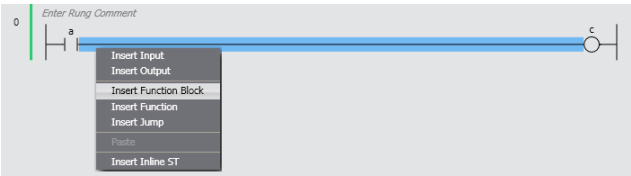


This completes the insertion of the function block. If you entered a new instance name, it is registered in the local variable table.

For the following methods 2 and 3, you first must register a function block definition as a data type in the local variable table.

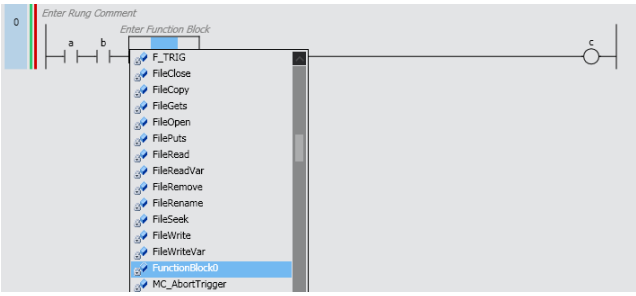
Method (2) Right-clicking the Desired Location and Selecting ***Insert Function Block*** from the Menu

1 Right-click a connecting line and ***select Insert Function Block*** from the menu.



The function block is added.

2 Click *Enter Instance Variable Name* at the top of the function block you inserted and enter an instance name for the function block. If the function block instance is registered in the local variable table, you can also select this instance.



This completes the insertion of the function block. If you entered a new instance name, it is registered in the local variable table.

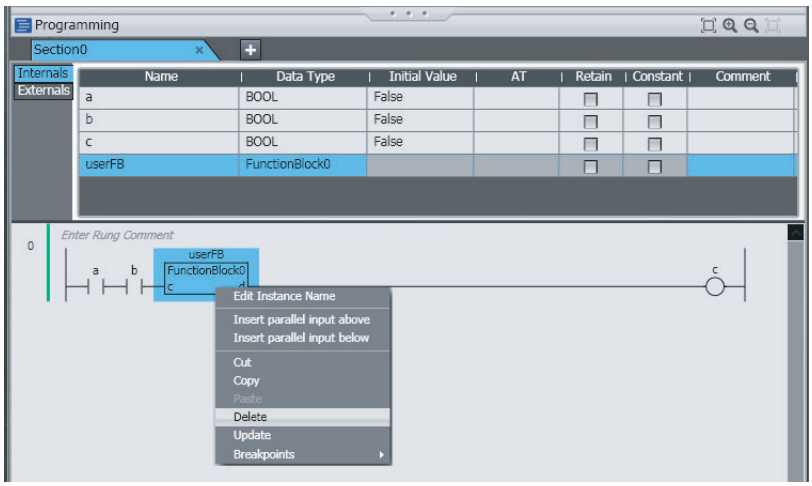
Method (3) Moving the Cursor to the Insertion Position and Pressing the **F** Key

1 Select the connecting line at the insertion location and press the **F** Key. The function block is added.

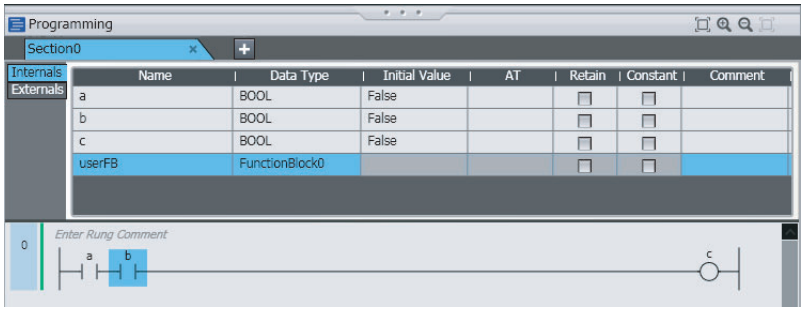
Select the connecting line at the insertion location and press the **F** Key An empty function block is added.

● Deleting Function Block Instances

Right-click the function block instance to delete and select ***Delete*** from the menu. Or, select the function block instance and press the **Delete** Key.



The selected function block instance is deleted. However, function block instances that are registered in a variable table and the variables used for parameters are not deleted.



Entering Parameters in Function Blocks

Use the following method to enter parameters into a function block that you have inserted. All variables with the correct data type are displayed in the list.

Global Variables

Method (1) Select a variable that is registered in the global variable table from the list in the Ladder Editor.

Local Variables

Method (1) Select a variable that is registered in the local variable table from the list in the Ladder Editor.

Method (2) Drag a variable from the local variable table of the POUs to the Ladder Editor.

Method (3) Enter a variable in the Ladder Editor (or the ST Editor) before you register the variable in the local variable table.

Additional Information

- Members of derivative variables also appear in the list as long as they have the correct data type.
- You cannot convert variables registered as local variables to global variables.
- You cannot view addresses in the Ladder Editor, only the variable names. You also cannot see if a variable has an AT specification.
- Variables entered directly into the Ladder Editor or ST Editor are treated as local variables. They are entered with the data type that is required for the instruction. If the data type cannot be determined, the cell will be blank and displayed in red. You must enter the data type.
- You can identify the following types of variables in the Ladder Editor by their color.
  - Global variables: Green
  - Local variables: Gray

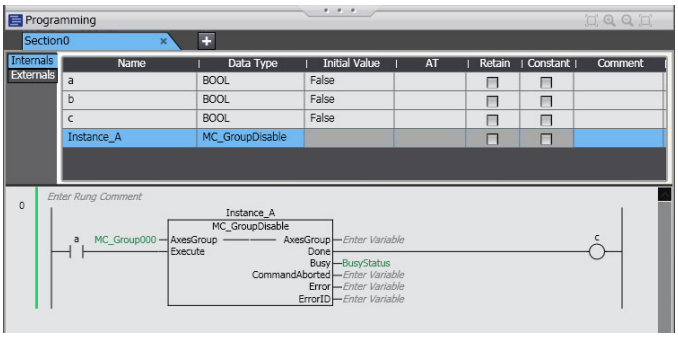
Additional Information

Entering Constants (Literals) for Function Parameters

- Use the following formats to enter constants (literals) for the parameters of functions that you insert in a program.
  - *data_type_name#base#numeric_value*
    Examples: Entering a hexadecimal number: INT#16#001A
    Entering a decimal number: INT#10#26
    Entering a binary number: INT#2#00000000 to INT#2#00011010
  - *data_type_name#numeric_value*
    Example: INT#26

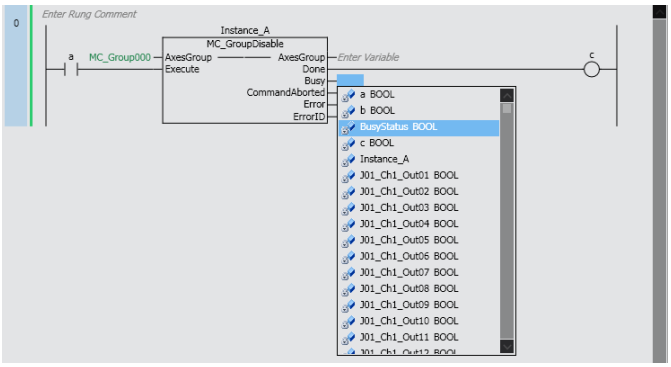
Note The base is assumed to be 10 (i.e., a decimal number).

The procedures to enter the variables that are shown in the following figure are given below.



Method (1) Selecting a Variable in the Ladder Editor

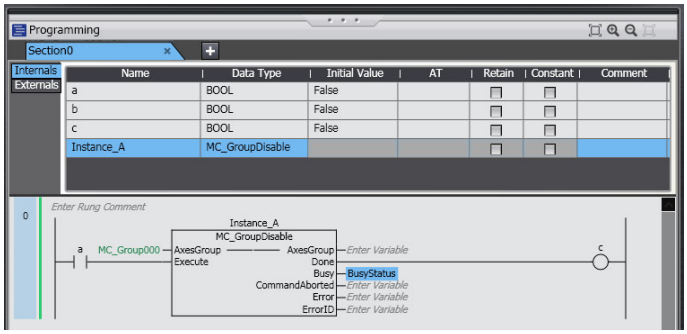
Select the function block, click *Enter Variable,* and select a variable from the list.



All variables with the correct data type are displayed in the list. The selected variable is entered into the function block.

Method (2) Dragging a Variable from the Local Variable Table of the POUs

Drag the variable you want from the local variable table to the function block parameter.



The variable is entered.

Inserting and Deleting Function Instructions and User-defined Functions

● Inserting Functions

You can use the following methods to insert function instructions and user-defined functions (collectively called “functions” below).

Function Instructions

Method (1) Drag a function instruction from the Toolbox.

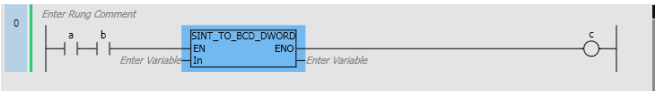
User-defined Functions and Function Instructions

Method (1) Drag a function from the Toolbox.

Method (2) Right-click the desired location and select ***Insert Function*** from the menu.

Method (3) Move the cursor to the insertion position and press the **I** Key.

The procedures to insert the function that is shown in the following figure are given below.

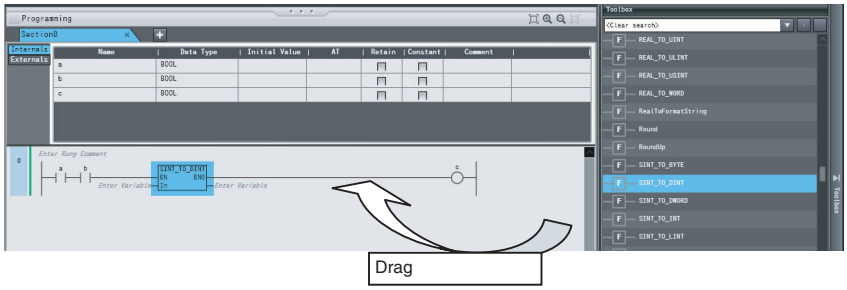


Function Instructions

Method (1) Dragging a Function Instruction from the Toolbox

The following example is for the SINT_TO_DWORD instruction.

Select **SINT_TO_DWORD** under **Data Type Conversions** in the Toolbox and then drag it to the location where you want to insert it. Or, right-click the desired location and select ***Insert Function*** from the menu. The function is inserted.



The selected function is inserted.

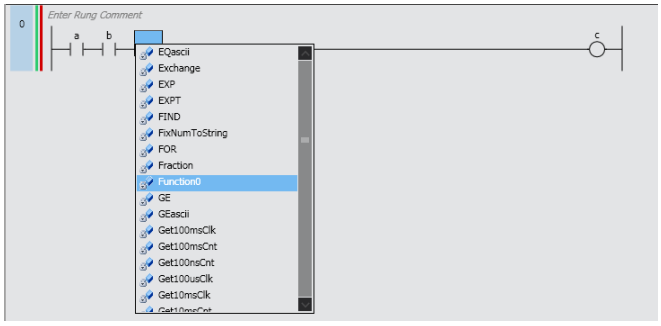
User-defined Functions and Function Instructions

Method (1) Dragging a Function from the Toolbox

1 Select **Function** from **Ladder Tools** in the Toolbox and then drag it to the location where you want to insert it.

The function is inserted.

2 Click *Enter Function Name* in the function you inserted and then select a function or function instruction from the list.



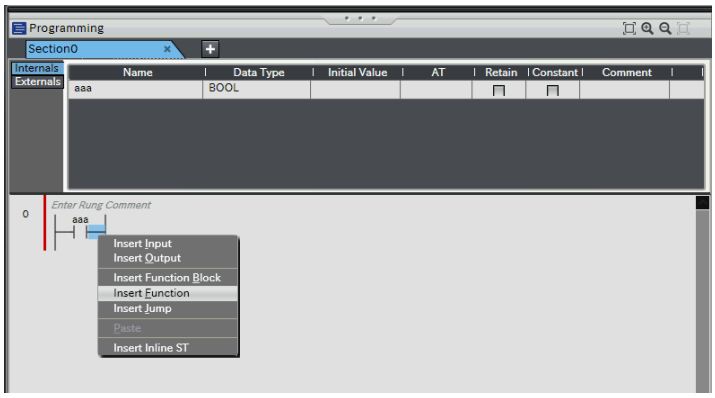
The selected function is inserted.

Additional Information

You can connect multiple functions or function blocks together with connecting lines. For information on the possible connection forms, refer to information on ladder diagrams in the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

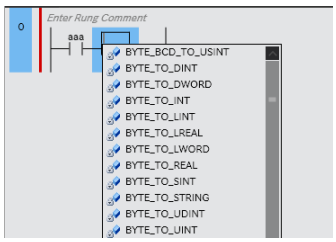
Method (2) Right-clicking the Desired Location and Selecting Insert Function from the Menu

1 Right-click a connecting line in the Ladder Editor and select ***Insert Function*** from the menu.



An empty function is added.

2 Enter the function name and select the specific function to use.



If you enter characters, registered functions that start with those characters are displayed.

Method (3) Moving the Cursor to the Insertion Position and Pressing the **I** Key

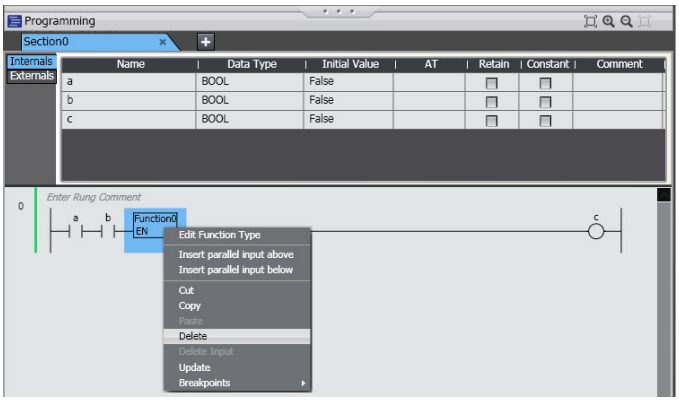
1 Select the connecting line at the insertion location and press the **I** Key

An empty function is added.

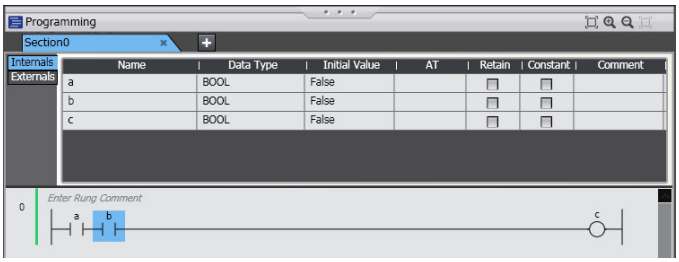
The rest of the procedure is the same as for method 2.

● Deleting Functions

Right-click the function to delete and select ***Delete*** from the menu. Or, select the function and press the **Delete** Key.



The selected function is deleted. Variables used as parameters are not deleted.



Additional Information

When you insert or delete circuit parts, connecting lines are automatically created to connect the circuit parts together.

Entering Parameters in Functions

Use the following method to enter parameters into a function that you have inserted. All variables with the correct data type are displayed in the list.

Global Variables

Method (1) Select a variable that is registered in the global variable table from the list in the Ladder Editor.

Local Variables

Method (1) Select a variable that is registered in the local variable table from the list in the Ladder Editor.

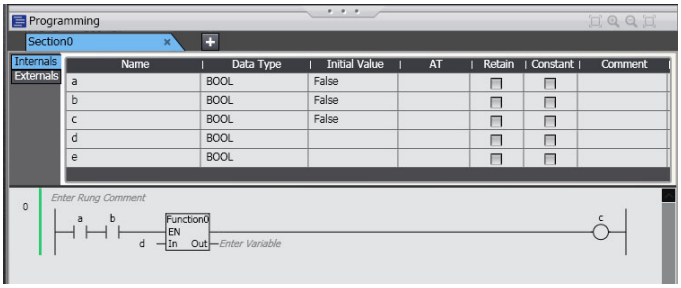
Method (2) Drag a variable from the local variable table of the POUs to the Ladder Editor.

Method (3) Enter a variable in the Ladder Editor (or the ST Editor) before you register the variable in the local variable table.

Additional Information

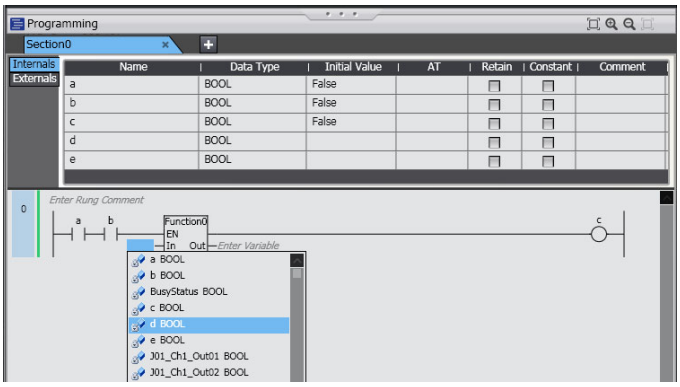
- Members of derivative variables also appear in the list as long as they have the correct data type.
- You cannot convert variables registered as local variables to global variables.
- You cannot view addresses in the Ladder Editor, only the variable names. You also cannot see if a variable has an AT specification.
- Variable names entered directly into the Ladder Editor or ST Editor are treated as local variables. They are entered with the data type that is required for the instruction.
- You can identify the following types of variables in the Ladder Editor by their color.
  - Global variables: Green
  - Local variables: Gray

The procedures to enter the variables that are shown in the following figure are given below.



Method (1) Selecting a Variable in the Ladder Editor

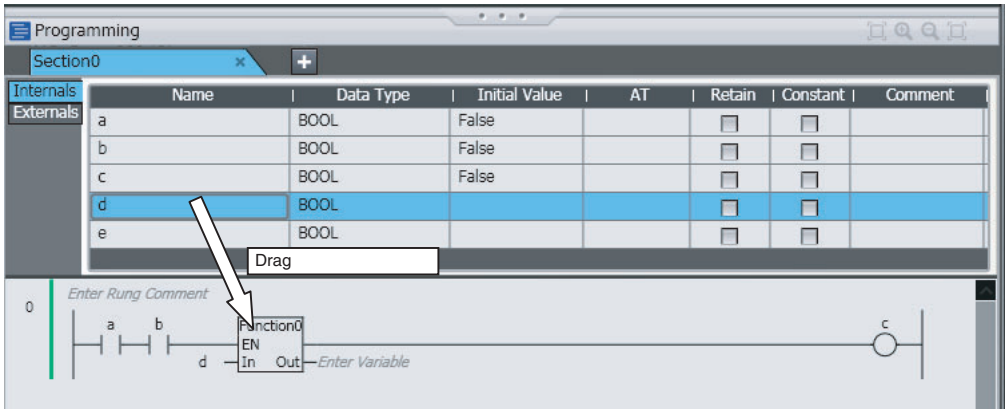
Select the function, click *Enter Variable,* and select a variable from the list.



All variables with the correct data type are displayed in the list. The selected variable is entered into the function.

Method (2) Dragging a Variable from the Local Variable Table of the POUs

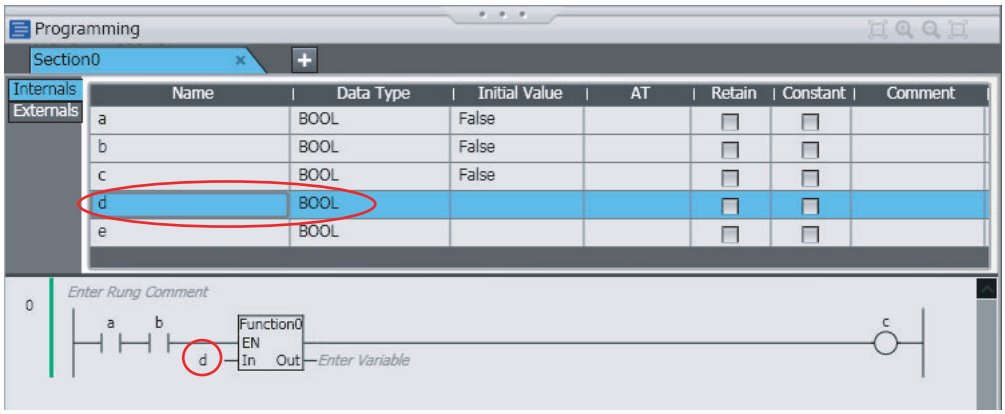
Drag the variable you want from the local variable table to the function parameter.



The variable is entered.

Method (3) Entering Variables Names Directly in the Ladder Editor or ST Editor

Enter a variable name directly before you register the variable in the local variable table.



The device variable is entered and registered in the local variable table.

Additional Information

Entering Constants (Literals) for Function Parameters

- Use the following formats to enter constants (literals) for the parameters of functions that you insert in a program.
  - *data_type_name#base#numeric_value*
    Examples: Entering a hexadecimal number: INT#16#001A
    Entering a decimal number: INT#10#26
    Entering a binary number: INT#2#00000000 to INT#2#00011010
  - *data_type_name#numeric_value*
    Example: INT#26

Note The base is assumed to be 10 (i.e., a decimal number).

Inserting and Deleting Inline ST

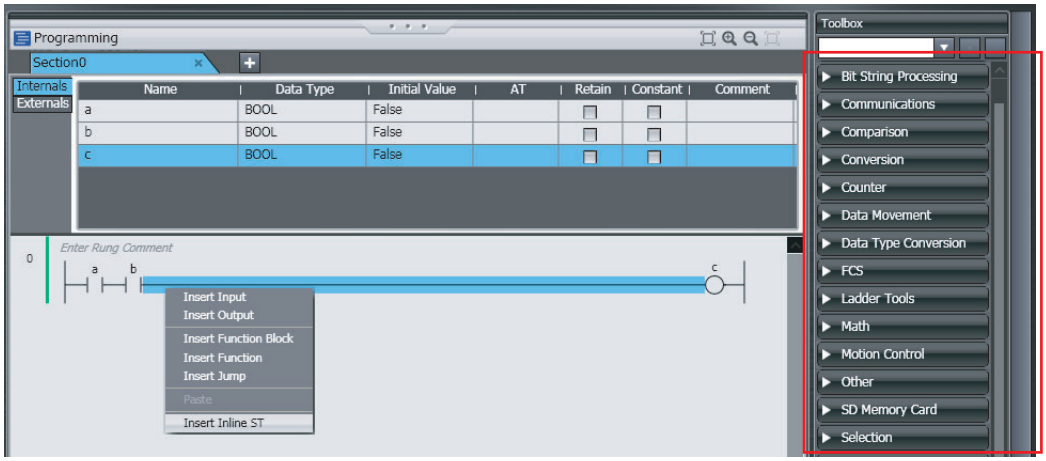
- Inserting Inline ST
  You can insert a box in a ladder diagram to enable programming in ST. This allows you to include ST in a ladder diagram.

Precautions for Correct Use

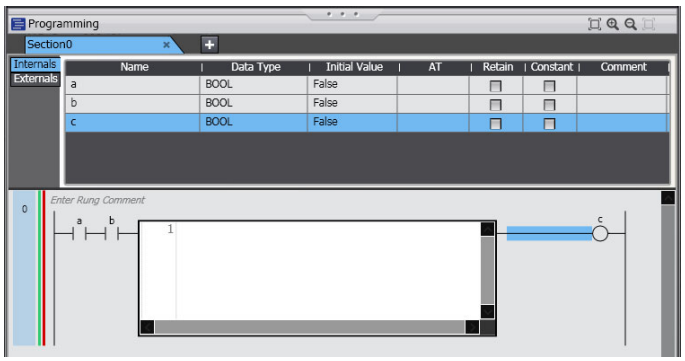
- You can write up to 1,000 lines of code in an inline ST box. If you write more than 1,000 lines, an error is detected during the program check or when the user program is built.
- You can insert only one inline ST box per rung. If you insert more than one, an error is detected during the program check or when the user program is built.
- You cannot insert any circuit Parts between an inline ST box and the right bus bar. If you insert one, an error is detected during the program check or when the user program is built.

Inserting Inline ST

1 Right-click the connecting line where you want to insert the inline ST and select **Insert Inline ST** from the menu. Or, drag **Inline ST** under **Ladder Tools** in the Toolbox.

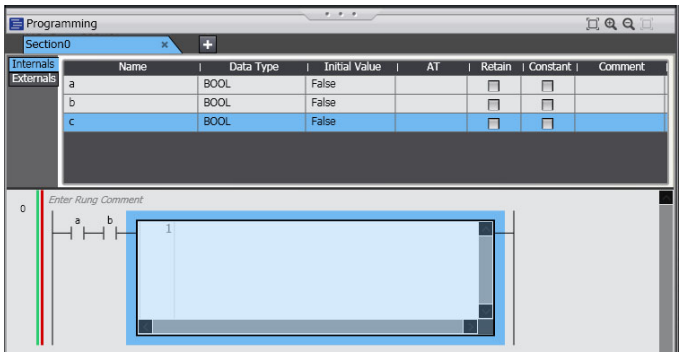


An inline ST box is inserted.



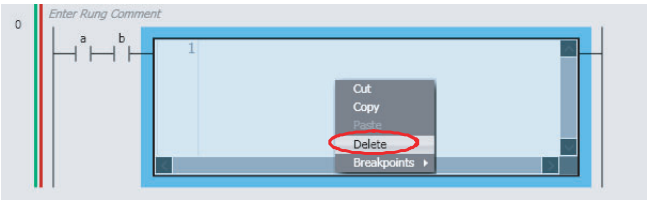
2 If there are any circuit parts between the inline ST box and the right bus bar, they are deleted.

Refer to *Editing ST* on page 4-74 for information on programming in ST.



● Deleting an Inline ST Box

Right-click the inline ST box to delete and select ***Delete*** from the menu. Or, select the inline ST box and press the **Delete** Key.



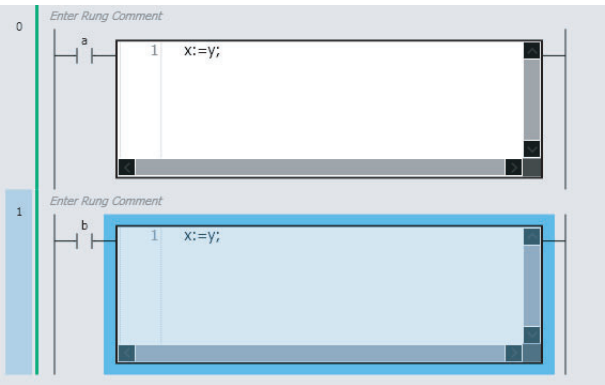
The inline ST box is deleted.

● Copying and Pasting Inline ST Boxes

1 Right-click the inline ST box to copy and select ***Copy*** from the menu.

2 Right-click the connecting line where you want to paste the inline ST box and select **Paste** from the menu.

The inline ST box is pasted.



Additional Information

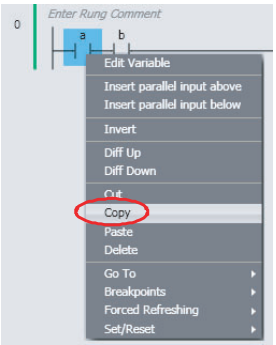
You can drag an inline ST box in the Ladder Editor to move it. Drag the inline ST box to the connecting line where you want to move it.

Editing Circuit Parts

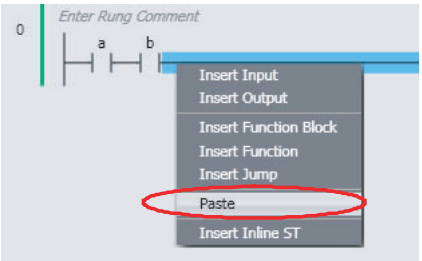
● Procedures for Copying and Pasting Circuit Parts

Copying and Pasting Program Inputs

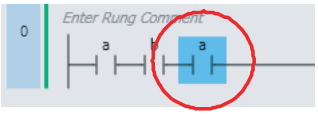
1 Right-click the input to copy and select ***Copy*** from the menu. Or, select the input and press the **Ctrl + C** Keys.



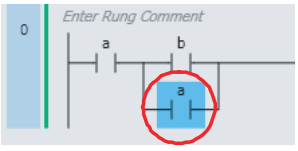
2 Right-click the connecting line where you want to paste the input and select **Paste** from the menu. To paste the input in an OR structure, right-click the input above the location where you want the OR structure and select **Paste** from the menu.



The input is pasted.

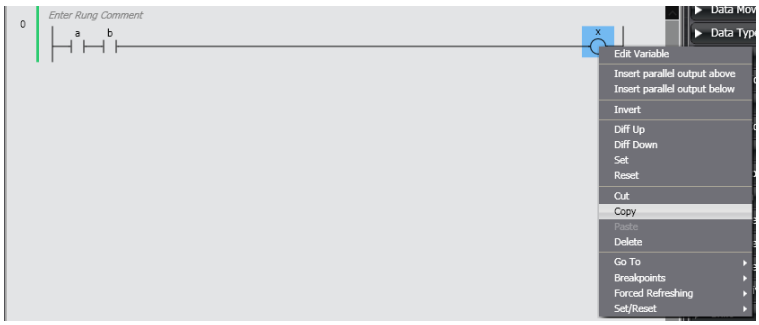


If an input is selected, the input is pasted under that input.

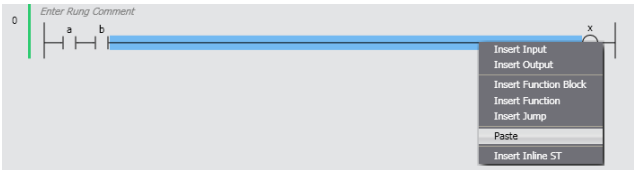


Copying and Pasting Outputs

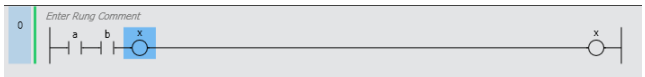
1 Right-click the output to copy and select ***Copy*** from the menu. Or, select the output and press the **Ctrl + C** Keys.



2 Right-click the connecting line where you want to paste the output and select ***Paste*** from the menu. To paste the output in an OR structure, right-click the output above the location where you want the OR structure and select ***Paste*** from the menu.



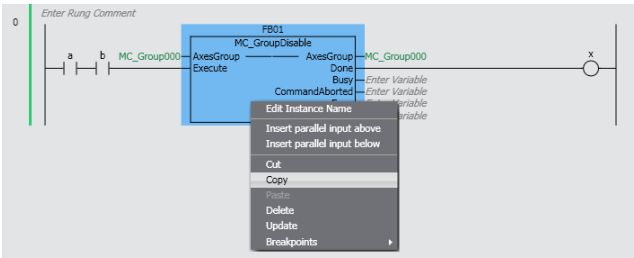
The output is pasted.



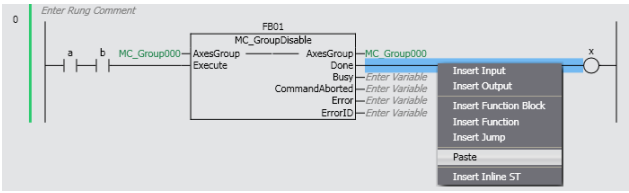
If an output is selected, the output is pasted under that output.

Copying and Pasting Function Blocks

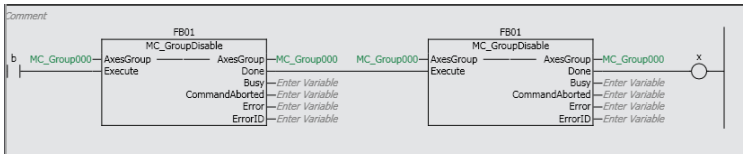
1 Right-click the function block instance to copy and select ***Copy*** from the menu. Or, select the function block instance and press the **Ctrl + C** Keys.



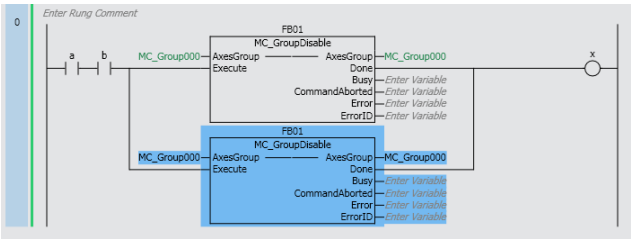
2 Right-click the connecting line where you want to paste the function block instance and select ***Paste*** from the menu. To paste the function block instance in an OR structure, right-click the circuit part above the location where you want the OR structure and select ***Paste*** from the menu.



The function block instance is pasted. Any variables assigned to parameters for the function block instance are also pasted.

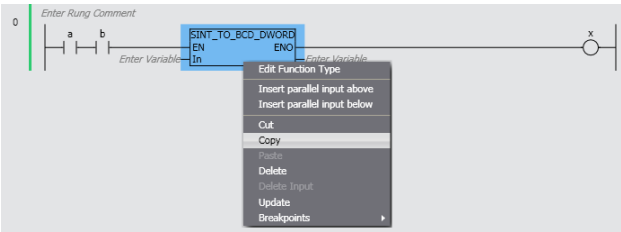


If a circuit part is selected, the function block instance is pasted under that circuit part.

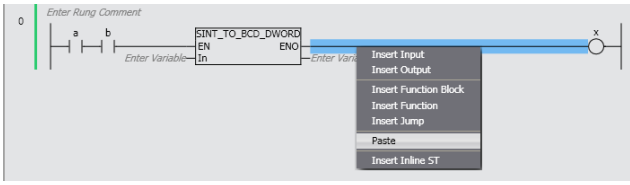


Copying and Pasting Functions

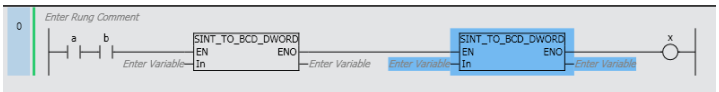
1 Right-click the function to copy and select ***Copy*** from the menu. Or, select the function and press the **Ctrl + C** Keys.



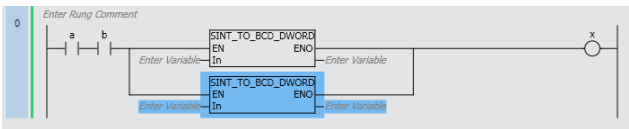
2 Right-click the connecting line where you want to paste the function and select ***Paste*** from the menu. To paste the function in an OR structure, right-click the circuit Part above the location where you want the OR structure and select ***Paste*** from the menu.



The function is pasted. Any variables assigned to parameters for the function are also pasted.



If a circuit part is selected, the function is pasted under that circuit part.



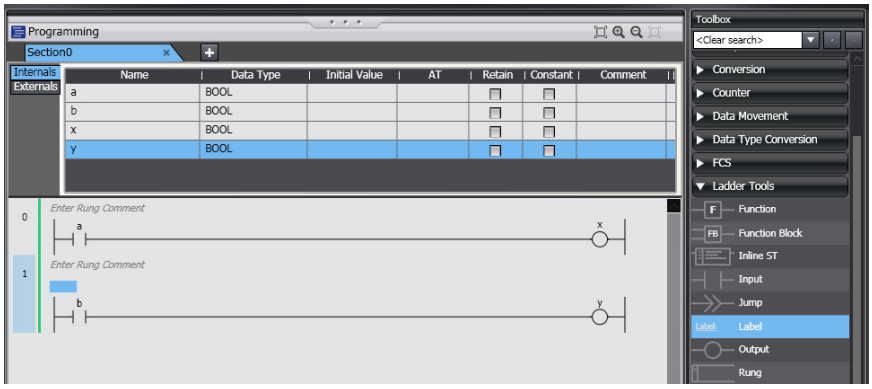
Inserting and Deleting Jump Labels and Jumps

You can insert a jump label in the rung to jump to and then specify the jump label when you insert a jump.

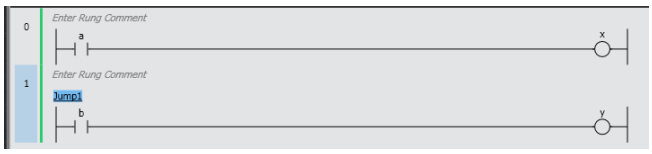
● Inserting Jump Labels

1 Right-click the beginning of the rung to jump to and select ***Insert Jump Label*** from the menu. Or, drag a **Label** under **Ladder Tools** in the Toolbox to the beginning of the rung.

A jump label entry field is inserted.



2 Enter the name of the jump label.



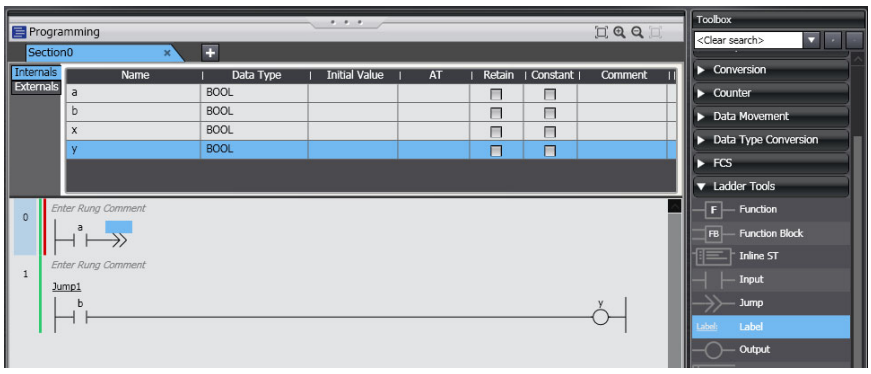
● Inserting Jumps

1 Right-click the connecting line immediately before or after the output for the rung to jump from and select ***Insert Jump*** from the menu. Or, drag a **Jump** under **Ladder Tools** in the Toolbox to the connecting line.

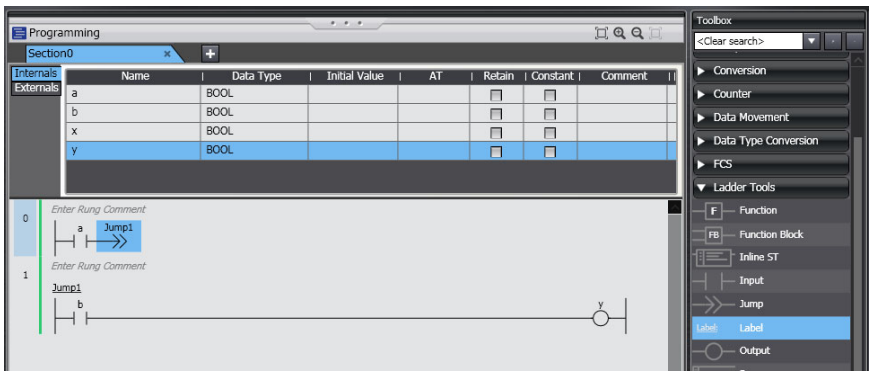
A jump circuit part is displayed.

Precautions for Correct Use

All circuit parts to the right of where you insert a jump are deleted.



2 Click *Enter Jump Label* for the jump circuit part and enter the name of the label to jump to.



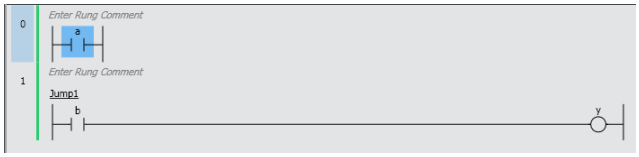
Deleting Jump Labels and Jumps

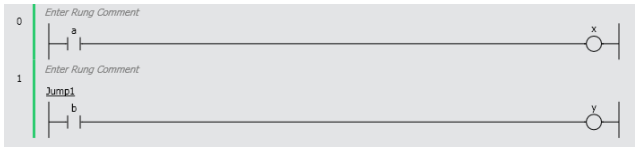
Deleting Jumps

1 Right-click the jump you want to delete and select ***Delete*** from the menu. Or, select the jump and press the **Delete** Key.

The jump is deleted. The right bus bar is displayed where the jump was deleted.

2 Select the connecting line to the left of the right bus bar and insert an output, function, or function block to construct the rung.





Deleting Jump Labels

1 Right-click the jump label you want to delete and select ***Delete*** from the menu. Or, select the jump label and press the **Delete** Key.

The jump label is deleted.

Inserting and Deleting Bookmarks

You can add bookmarks to the beginning of rungs and move between them.

1 Right-click the beginning of a rung and select ***Bookmarks - Toggle Bookmark*** from the menu.

A bookmark is displayed at the beginning of the rung.

2 To delete a bookmark for a rung, right-click the beginning of a rung where you have set a bookmark and select ***Bookmarks - Toggle Bookmark*** from the menu just as you did to insert a new bookmark. The bookmark for the selected rung is deleted.

3 To delete all bookmarks at once, right-click the beginning of a rung and select ***Bookmarks - Clear All Bookmarks*** from the menu.

All bookmarks are deleted.

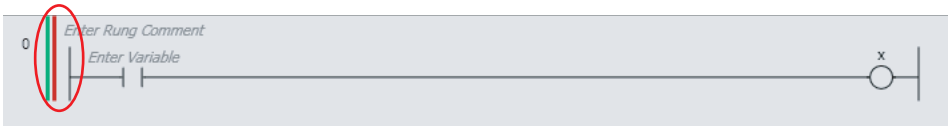
Entering Rung Comments

Click *Enter Rung Comment* in the rung and enter a comment.

Displaying Rung Errors

When you enter a circuit part, the format is always checked and any mistakes are displayed as errors. If there are any errors, a red line is displayed between the rung number and the left bus bar.

Error Rung



Place the mouse over the red line to view information on the rung error.

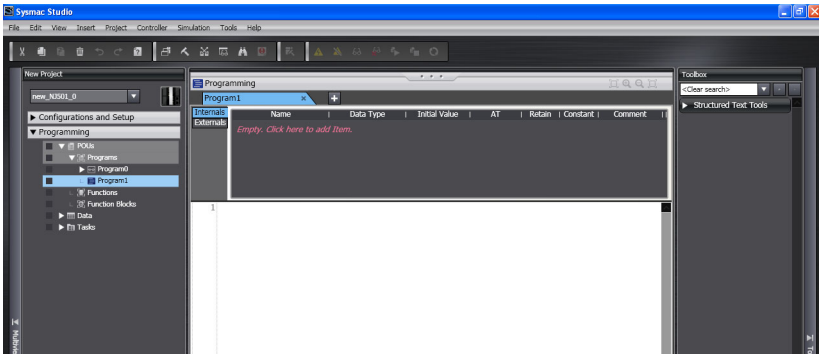
4-1-6 Programming Structured Text

- Programming Structured Text
  ST (structured text) programming involves using the ST language to build algorithms. To do this, you enter data processing in the ST Editor.

Starting the ST Editor

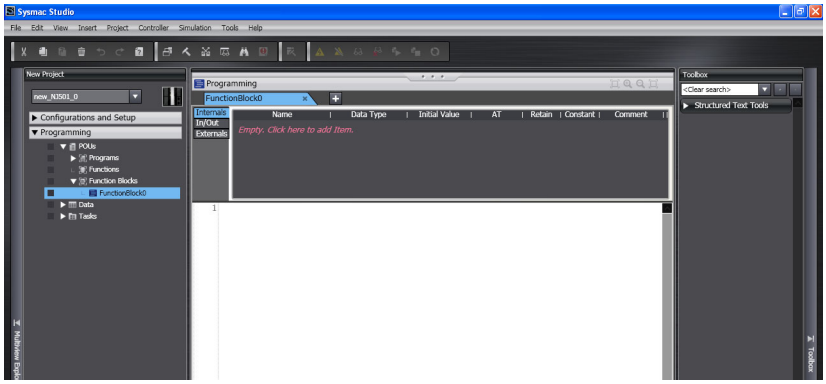
● Programs

Double-click an ST program under **Programming - POUs - Programs** in the Multiview Explorer. Or, right-click the ST program and select ***Edit*** from the menu. Refer to *Registering POUs* on page 4-25 for the procedure to register a program. The ST Editor for the program is displayed.



● Functions and Function Blocks

1 Double-click an ST function under **Programming - POUs - Functions** or an ST function block under **Programming - POUs - Function Blocks** in the Multiview Explorer. Or, right-click the ST function or function block and select ***Edit*** from the menu. For information on registering ST functions or function blocks, refer to *Registering Function Blocks* on page 4-28 or *Registering Functions* on page 4-29. The ST Editor for the function or function block is displayed.



Editing ST

- Editing ST
  You combined different ST statements to build algorithms. For information on statement structures and expressions, refer to information on the structured text language in the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

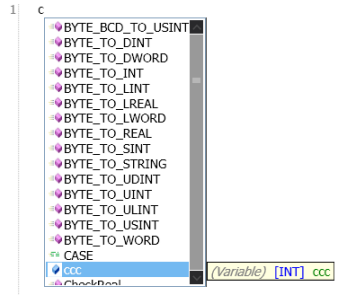
● Entering Assignment Statements

The following example shows how to assign the sum of variables *aaa* and *bbb* into variable *ccc* (*aaa*, *bbb*, and *ccc* must be registered as variables in advance).

ccc := aaa + bbb ;

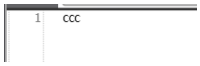
1 Enter the first letter of the variable *ccc* into the ST Editor.

2 A list of possible variable candidates is displayed in a list.



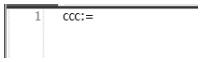
3 Select the variable *ccc* and press the **Enter** Key.

The variable *ccc* is entered.



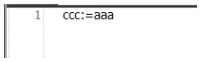
4 Enter a space and a : (colon) character.

The assignment keyword *:=* is entered automatically.



5 Enter the first letter of the variable *aaa*.

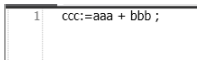
6 Select the variable *aaa* from the list of variable candidates and press the **Enter** Key. The variable *aaa* is entered.



7 Enter a space and a *+* (plus) character and then enter the first letter of the variable *bbb*.

8 Select the variable *bbb* from the list of variable candidates, enter a semi-colon (;), and press the **Enter** Key.

This completes the assignment statement.



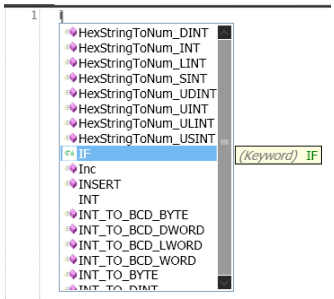
● Entering Control Statements

The following example shows how to enter an IF construct.

```
IF aaa = bbb THEN
    ccc := aaa;
END_IF
```

1 Enter the first letter of the IF statement (i) into the ST Editor.

2 A list of possible variable candidates is displayed in a list.



3 Select the *IF* keyword and press the **Enter** Key.

The IF keyword is entered.

```
1  IF
```

4 Press the **Tab** Key.

The other keywords that make up an IF construct are entered automatically.

```
1  IF expression THEN
2      statement_group
3  ELSIF expression THEN
4      statement_group
5  ELSE
6      statement_group
7  END_IF;
```

5 Enter the statement *aaa = bbb*.

```
1  IF aaa = bbb THEN
2      statement_group
3  ELSIF expression THEN
4      statement_group
5  ELSE
6      statement_group
7  END_IF;
```

6 Delete ELSIF, THEN, and ELSE and then enter *ccc* := *aaa* ;.

```
1  IF aaa = bbb THEN
2      ccc = aaa;
3  END_IF;
```

Additional Information

- Press the **Tab** Key after entering the first keyword of a construct to automatically complete the rest of the construct.
- If there is a problem with the format of a construct, a red wavy line is displayed to the right of the statement keywords.

Entering Calls to Functions and Function Blocks

They are two ways to enter the calls.

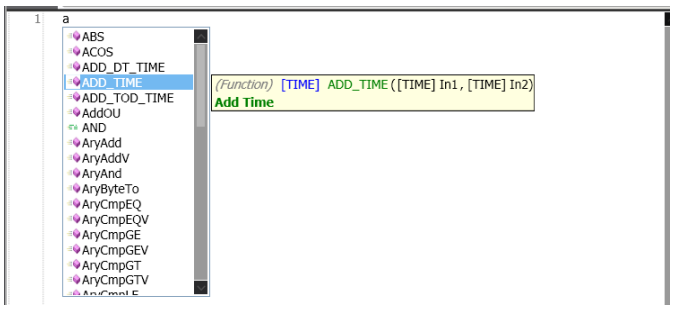
Method (1) Enter the instance name into the ST Editor directly.

Method (2) Drag the function or the function block from the Toolbox.

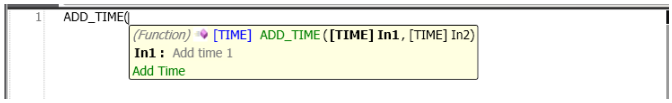
Method (1) Entering the Instance Name into the ST Editor Directly

1 Enter the first letter of the instance name of the function or the function block into the ST Editor.

2 Select the function name or the function block instance name from the list and press the **Enter** Key.



The selected function or function block instance is displayed along with a description of its parameters.



3 Enter the required arguments for the parameters and complete the statement.

```
1   ADD_TIME(t1, t2);
```

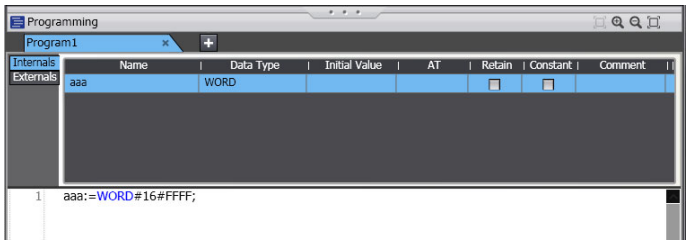
Entering Constants

The following example shows how to assign the hexadecimal value FFFF to variable *aaa*.

1 Enter *aaa :=* into the ST Editor.

2 Enter the constant as *WORD#16#FFFF*.

For information on the formats for entering other constants, refer to information on the types of constants in the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).



Entering Comments

Enter "(*" at the beginning and "*)" the end of any text to be treated as a comment in the ST Editor. If you only want to comment out a single line, enter a double forward slash (//) at the beginning of the line.

```
1   aaa:=WORD#16#FFFF;
2   IF aaa = bbb THEN (*if aaa = bbb, ccc = true*)
3       ccc := TRUE;
4   END_IF;
5   //End of program1.
```

Deleting ST Elements

1 Select the text to delete.

2 Press the **Delete** Key or the **Backspace** Key to delete the text.

Copying and Pasting ST Elements

1 Select the text to copy.

2 Right-click the text and select ***Copy*** from the menu. Or, select the text and press the **Ctrl + C** Keys.

3 Right-click at the location where you want to paste and select ***Paste*** from the menu. Or, press the **Ctrl + V** Keys.

Indenting

You can indent nested statements to make them easier to read.

Right-click at the beginning of the line to indent and select ***Increase Line Indent*** from the menu. Or, press the **Tab** Key. The indent moves the starting position of the characters on that line to the right. To bring the indent back, right-click the text and select ***Decrease Line Indent*** from the menu or press the **Delete** Key.

Moving to a Specified Line

You can specify a line number to jump directly to that line.

1 Right-click in the ST Editor and select ***Go To*** from the menu.

A Jump Dialog Box is displayed.

```
1  aaa:=WORD#16#FFFF;
2  IF aaa = bbb THEN (*if aaa = bbb, ccc = true*)
3      ccc := TRUE;
4  END_IF;
5  //End of program1.
```

Goto:

2 Enter a line number and press the **Enter** Key.

The cursor moves to the beginning of the line you entered.

```
1  aaa:=WORD#16#FFFF;
2  IF aaa = bbb THEN (*if aaa = bbb, ccc = true*)
3      ccc := TRUE;
4  END_IF;
5  //End of program1.
```

● Bookmarks

You can add bookmarks to any lines and move between them.

Toggle Bookmarks

Right-click a line number in the ST Editor and select ***Toggle Bookmark*** from the menu. A bookmark is displayed at the beginning of the line.

Moving to the Next Bookmark

Right-click a line number in the ST Editor and select ***Next Bookmark*** from the menu. The cursor moves to the next bookmarked line.

Moving to the Previous Bookmark

Right-click a line number in the ST Editor and select ***Previous Bookmark*** from the menu. The cursor moves to the previous bookmarked line.

Deleting a Specific Bookmark

Right-click a line number with the bookmark and select ***Toggle Bookmark*** from the menu. The bookmark is deleted.

Deleting All Bookmarks

Right-click in the ST Editor and select ***Clear Bookmarks*** from the menu. All bookmarks are deleted.

● Statement Error Displays

When you enter a statement, the format is always checked and any mistakes are displayed as errors.

A wavy line is displayed under any line where an error is detected.

Error: Red wavy line

```
1  aaa := 1;
```

Warning: Blue wavy line

Place the mouse over the wavy line to view information on the error.

```
1  aaa:=WORD#16#FFFF;
2  IF aaa = bbb THEN (*if aaa = bbb, ccc = true*)
3      ccc := TRUE;
4  END_IF;
5  //End of program1.
```

Conversion from WORD to BOOL is impossible.

Refer to *10-2 Error Messages for Structured Text Checks* for information on errors.

Precautions for Correct Use

- For information on ST input restrictions (restrictions on the number of operators, the number of nested POU calls, and the number of nested conditional/iterative statements), refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).
- A single POU (program, function, or function block) can contain up to 10,000 lines of code.
- To use variables in the ST Editor, you must register them in a variable table first. You cannot create variables in the ST Editor.

Additional Information

- Press the **Tab** Key after entering the first keyword of a construct to automatically complete the rest of the construct.
- If there is a problem with the format of a construct, a red wavy line is displayed to the right of the statement keywords.

4-1-7 Searching and Replacing

● Searching and Replacing

You can search and replace strings in the data of a project.

Scope of Searching and Replacing

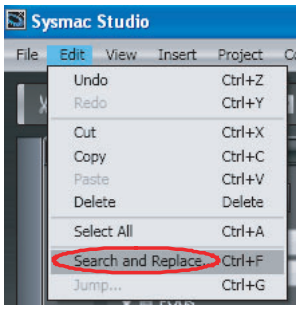
You can search and replace text strings in the following items.

Variable tables	Ladder diagrams	ST
Variable names Variable comments	Rung comments Variable names Function names Function block definition names	Text strings

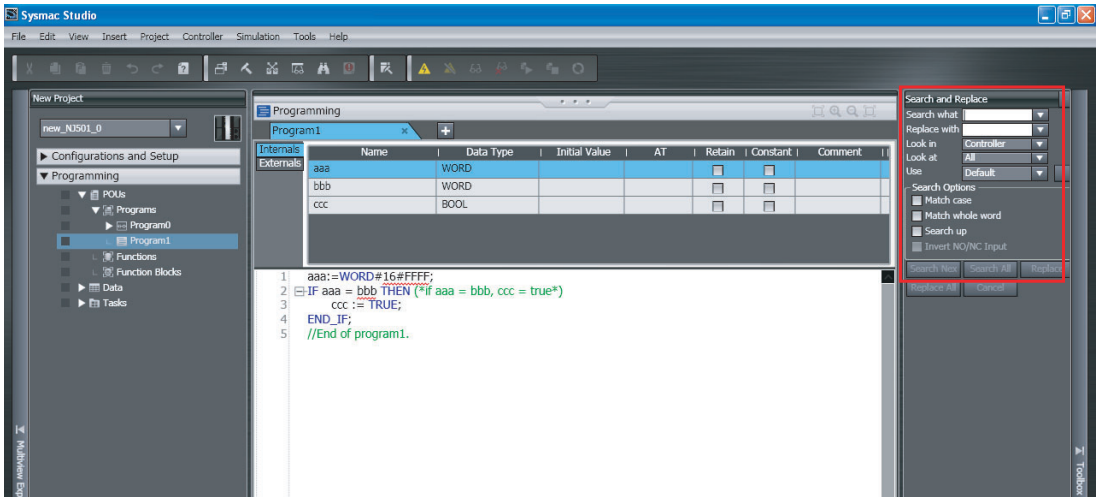
Search and Replace Pane

Use the following procedure to display the Search and Replace Pane in place of the Toolbox.

1 Select ***Search and Replace*** from the ***Edit*** Menu.

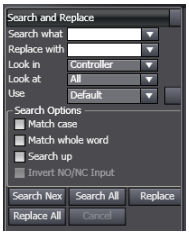


The Search and Replace Pane is displayed.



Items to Set

The settings in the Search and Replace Pane are explained below.



Setting	Description
Search what	• Enter a search string. • You can select from previous search strings in the list.
Replace with	• Enter the string to replace the search string with. • You can select from previous replacement strings in the list. You cannot use wildcard characters. (If you try to use them, they are treated as normal text strings.)
Look in	Specify the range to search. You can select from the following. Programming: The entire Programming Layer of the Controller is searched. Current View: The current view is searched.
Look at	Specify the items to search. You can search for text strings in the following items. All: Search the entire project. Variable name: Searches all variable names. (See note.)
Use	Specify if you want to use wildcard characters. Default: Do not use wildcard characters. Wildcard: Use wildcard characters. If you select to use wildcard characters, you can click the ▼ Button to the right to view a list of characters used for wildcard characters. Select any of these characters to enter them in the search string.

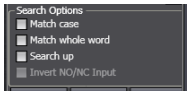
Note You cannot search variable names in ST programs.

You can use the following wildcard characters.

● Wildcards

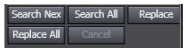
Meaning	Syntax	Description	Example
Any single character	?	Searches for a text string with a variable character.	“A?C” matches “ABC”, “AdC”, and “AzC”.
Any one character or series of characters	*	Searches for a text string that contains a variable text string	“new*” matches “newfile.txt”.
Any single number	#	Searches for any single number.	“7#” matches “71”. “ABC#” matches “ABC5”.
Character in a set	[ ]	Searches for a single character in the set.	“ABC[xyz]” matches both “ABCx” and “ABCy”. “ABC[x-z]” matches both “ABCx” and “ABCy”.
Character not in a set	[!]	Searches for a single character that is not in the set.	“ABC[!xyz]” matches both “ABCa” and “ABCd”. “ABC[!x-z]” matches both “ABCa” and “ABCd”.

● Search Options



Item	Description
Match case	When this option is selected, searches are case sensitive.
Match whole word	When selected, only exact string matches are returned.
Search up	When selected, the search is performed backward from the cursor position.
Invert NO/NC input	Replaces N.O. with N.C. and N.C. with N.O. for all occurrences of a BOOL variable used in a ladder diagram. (Outputs are not affected.)

● Button Functions



Item	Description
Search Next	Performs a search according to the selected options.
Search All	Searches all items and displays the results in an Output Tab Page.
Replace	Performs a replace according to the selected options.
Replace All	Replaces all items and displays the results in an Output Tab Page.
Cancel	Cancels the current search and replace operation.

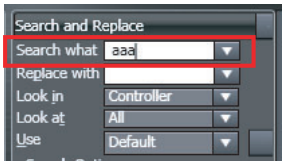
Searching

The procedures for searching are given in this section.

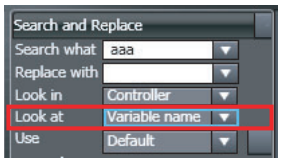
● Searching for Variables and Comments

Use the following procedure to search.

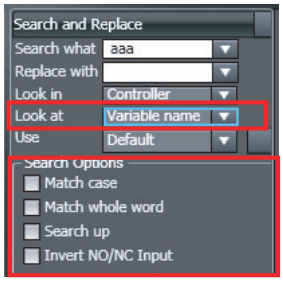
1 Enter the search string in the *Search what* Field.



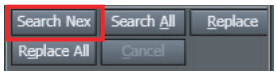
2 Select *Variables* in the *Look at* Field to search for variables.



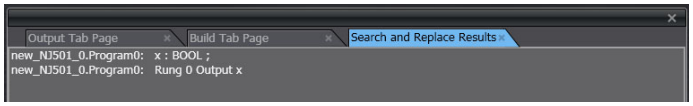
3 Set the *Look in* Field and search options as required.*



4 Click the **Search Next** Button.



The Search and Replace Results Tab Page is displayed.



* For information on the *Look in* Field and search options, refer to *Items to Set* on page 4-80.

Additional Information

Press the **Alt + N** Keys to search again.

Replacing

Use the following procedure to search and replace a text string.

1 Enter the search string that you want to replace in the *Search what* Field.

2 Enter the replace string in the *Replace with* Field.

3 Set the *Look in* Field and *Look at* Field, and select search options as required.*

4 Click the **Search Next** Button to search for the string to replace.

5 If the string is found, click the **Replace** Button to replace the string.

* For information on the *Look in* Field, the *Look at* Field, and search options, refer to *Items to Set* on page 4-80.

Searching All

Use the following procedure to search for all occurrences. The search results is displayed in an Output Tab Page.

1. Enter the search string in the *Search what* Field.
2. Set the *Look in* Field and *Look at* Field, and select search options as required.*
3. Click the **Search All** Button.

   * For information on the *Look in* Field, the *Look at* Field, and search options, refer to *Items to Set* on page 4-80.

Replacing All

Use the following procedure to search and replace all occurrences of a text string. The replacement results are displayed in an Output Tab Page.

1. Enter the search string that you want to replace in the *Search what* Field.
2. Enter the replace string in the *Replace with* Field.
3. Set the *Look in* Field and *Look at* Field, and select search options as required.*
4. Click the **Replace All** Button.

   * For information on the *Look in* Field, the *Look at* Field, and search options, refer to *Items to Set* on page 4-80.

Replacing All N.O. and N.C. Inputs

Use the following procedure to search and replace all N.O. and N.C. inputs. The replacement results are displayed in an Output Tab Page.

1. Enter the variable used in the input to replace in the *Search what* Field.
2. Specify *Variables* in the *Find what* Field.
3. Select the *Invert NO/NC Input* option.
4. Set the *Look in* Field and search options as required.*
5. Click the **Replace All** Button.

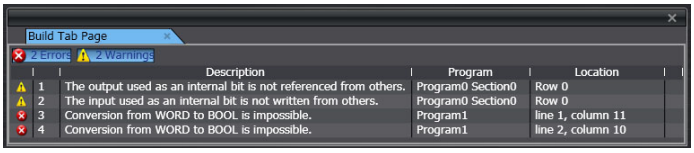
   * For information on the *Look in* Field, the *Look at* Field, and search options, refer to *Items to Set* on page 4-80.

4-1-8 Program Checks

- Program Checks
  You can check the programs to detect any errors in the POUs (programs, functions, or function blocks) that you created. There are two types of program checks.
  - Check All Programs
    Checks all programs in the project.
  - Check Selected Programs
    Checks only the selected programs.

● Check All Programs

Select ***Check All Programs*** from the Project Menu. The results of the program check are displayed in the Build Tab Page.

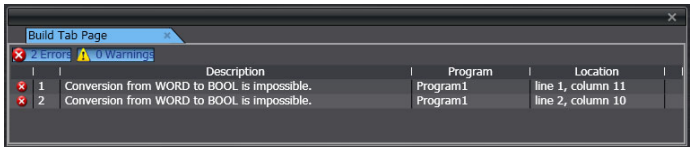


● Check Selected Programs

1 Select the POUs or sections to check in the Multiview Explorer.

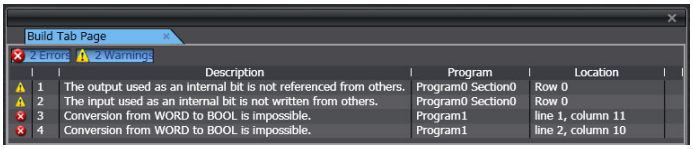
2 Select ***Check Selected Programs*** from the Project Menu.

The results of the program check are displayed in the Build Tab Page.

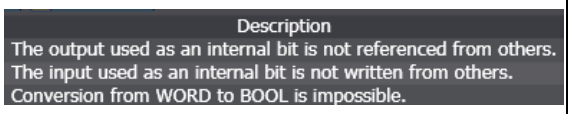
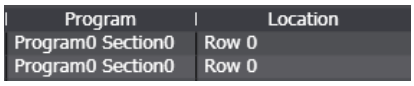


● Program Check Result Displays

The results of a program check are displayed in the Build Tab Page as follows:

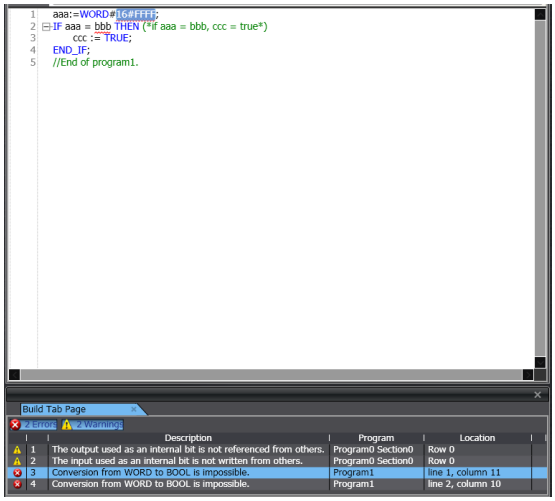


Item	Example	Meaning	Remarks
Number of errors		Displays the total number of errors.	
Number of warnings		Displays the total number of warnings.	

Item	Example	Meaning	Remarks
Error or warning number		Displays the errors or warnings in the order in which they were found.	
Description		Displays a description of the error or warning.	
Location		Displays the location where the error or warning occurred.	You can jump directly to the location of the error.

● Jumping to the Location of an Error

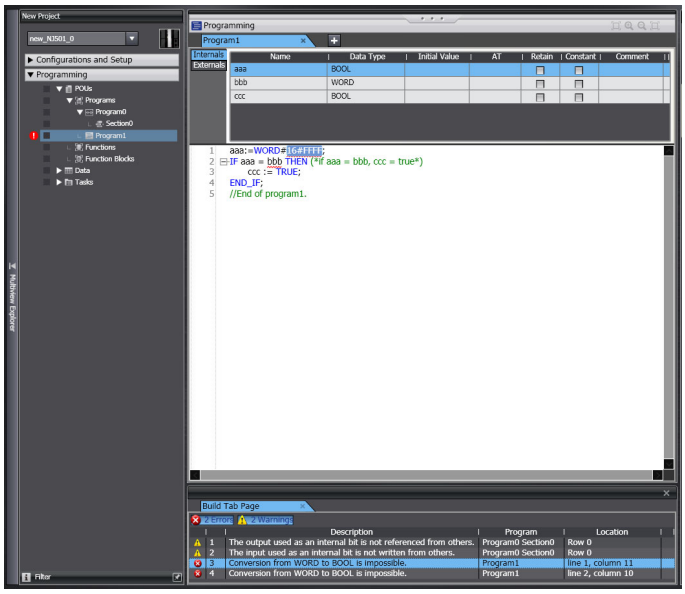
In the Build Tab Page, double-click the line of the error to jump to. The location of the error is displayed in the Programming Layer.



Refer to *10-1 Error Messages for Ladder Program Checks* and *10-2 Error Messages for Structured Text Checks* for information on errors.

● Error Displays in the Multiview Explorer

POUs that contain an error are marked with an exclamation mark (!) icon.



4-1-9 Building and Rebuilding

- Building
  Building is the process of converting your project programs into a format that is executable on the CPU Unit. A check is performed on the programs and variable data during this process. If there are any errors, the build is not performed and the errors are displayed in the Build Tab Page. After the first build, only programs that are changed are built again.

Automatic Building

The programs are automatically built when the user makes changes to them. You can also build programs manually.

● Execution Timing of Automatic Building

If you perform no operations for five seconds after you change data types, global variables, or POUs (including local variables and algorithms), building the programs is started automatically.

● Progress of Automatic Building

The progress of building or rebuilding the programs is displayed in a progress bar at the lower right of the window.

Manual Building

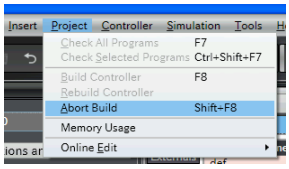
You cannot check all or some of the programs while building or rebuilding the programs is in progress. You can abort automatic building and then build the programs manually.

Use the following procedure.

● Aborting a Build Operation

Use the following procedure to abort a build operation so that you can build the programs manually.

1 Select ***Abort Build*** from the Project Menu.

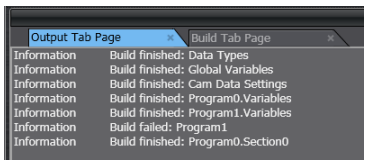


The build operation is aborted and a message that says it was aborted is displayed in the Output Tab Page.

● Manually Building

1 Select ***Build Controller*** from the Project Menu.

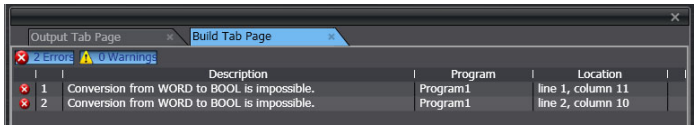
The build is started and the status during the build is displayed in the Output Tab Page.



The build is completed.

2 Click the Build Tab Page to display the Build Tab Page.

If there are any errors, a list of them is displayed.



3 Double-click any error line to display the location of the error, and then correct the error.

Refer to *4-1-8 Program Checks* for information on the Build Tab Page. Refer to *10-1 Error Messages for Ladder Program Checks* and *10-2 Error Messages for Structured Text Checks* for information on errors that occur when building.

● Rebuilding

A rebuild is used to build project programs that have already been built. All programs are built again.

Select ***Rebuild Controller*** from the Project Menu. The build is started and the status during the build is displayed in the Output Tab Page. The build is complete.

Precautions for Correct Use

After the first build, only errors from programs that were changed are displayed in the Build Tab Page. To view errors in all programs again, select ***Rebuild Controller***.

Additional Information

The results of automatic or manual building are displayed for each of the following in the Output Tab Page.

- Data types
- Global variables
- Cam data settings
- Variable tables in POUs
- Algorithms in POUs

4-2 Controller Configurations and Setup

The following is a list of the configurations and setups for NJ-series Controllers.

- EtherCAT Configuration and Settings
- CPU/Expansion Rack Configuration and Setup
- Controller Setup
- Motion Control Setup
- Cam Data Settings
- Task Settings

Precautions for Safe Use

- Check the parameters for proper execution before you use them for actual operation.
- If verifying revisions is not selected in the Revision Check Method parameter in the master settings in EtherCAT configuration, parameters are also transferred to slaves with different revisions. If an incompatible revision of a slave is connected, incorrect parameters may be set and operation may not be correct. If you select the revision check, make sure that only compatible slaves are connected before transferring the parameters.

4-2-1 EtherCAT Configuration and Settings

- EtherCAT Configuration and Settings
  This is the configuration in the Sysmac Studio of the EtherCAT slaves connected to the built-in EtherCAT port of the NJ-series CPU Unit, and the settings of EtherCAT masters and slaves in that configuration. In the Sysmac Studio, you can construct an EtherCAT configuration just like you would put together with the actual physical devices. Select **Configurations and Setup - EtherCAT** in the Multiview Explorer to open the Edit Pane to create the EtherCAT Configuration. You can set up devices by dragging slaves from the device list displayed in the Toolbox Pane to the locations where you want to connect them.

● Procedure to Open the EtherCAT Tab Page

Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select ***Edit*** from the menu. The EtherCAT Tab Page appears in the Configurations and Setup Layer.

● Registering Slaves Offline to Configure the Network

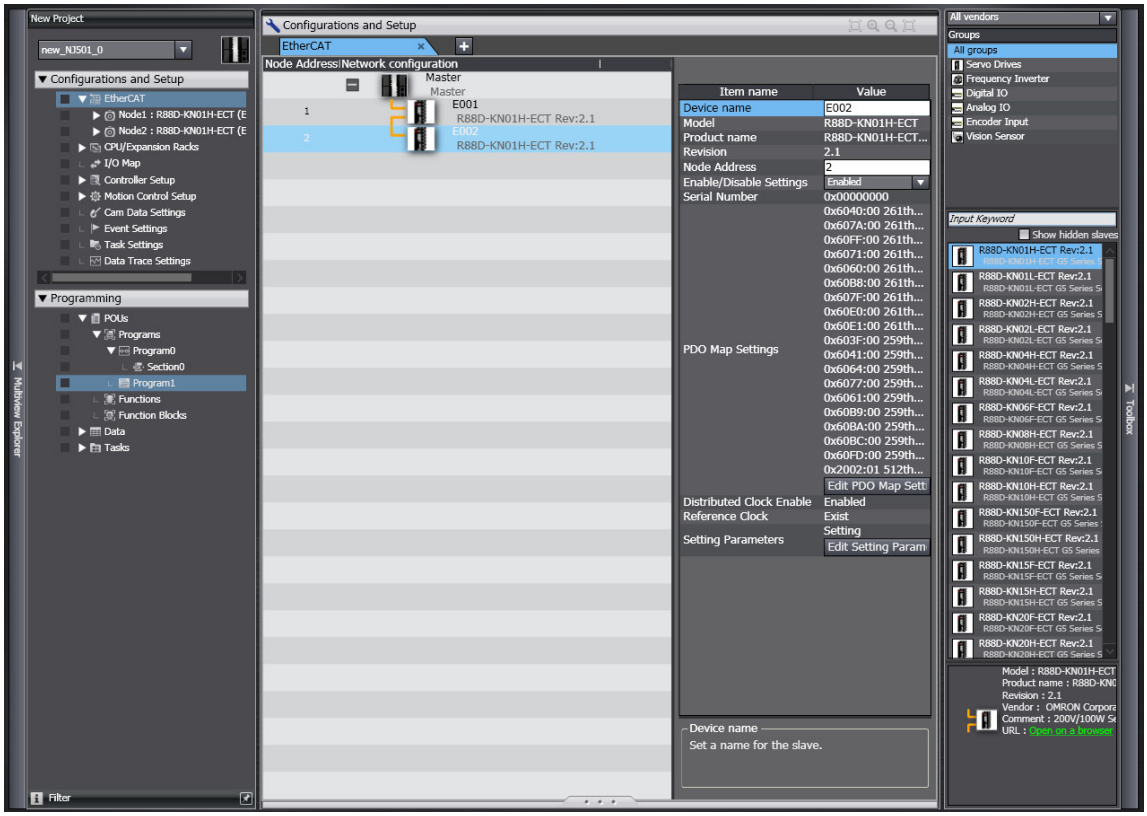
Procedure to Add Slaves to the EtherCAT Tab Page

1 Drag a slave from the Toolbox to the master in the EtherCAT Tab Page. Or, select the master on the EtherCAT Tab Page, and then double-click the slave in the Toolbox.

The slave is added under the master.

2 As in step 1, drag a slave from the Toolbox to the slave to connect it to in the EtherCAT Tab Page. Or, select the slave to connect to on the EtherCAT Tab Page, and then double-click the slave in the Toolbox.

The slave is added under the selected slave.



3 The node address of the slave that you added to the EtherCAT Tab Page changes to the node address of the physical slave.

Additional Information

You can right-click a slave in the Edit Network Configuration Tab Page and select ***Reset Node Address*** from the menu to set the node address to the lowest node address that is not used by another slave.

Procedure to Delete Slaves from the EtherCAT Tab Page

Right-click the slave to delete and select Delete from the menu. The slave is deleted.

Procedure to Cut and Paste Slaves on the EtherCAT Tab Page

1 Right-click the first slave to move and select ***Cut*** from the menu.

2 Right-click the master or slave to which to connect the slaves that you cut and select ***Paste*** from the menu.

The result is that the slaves are moved in the network.

Additional Information

The cut/paste operation for slaves moves the selected slave and all the slaves that are connected after it.

Procedure to Copy and Paste Slaves on the EtherCAT Tab Page

1 Right-click the first slave to copy and select ***Copy*** from the menu.

2 Right-click the slave to connect the copied slaves to and select ***Paste*** from the menu.

A copy of the slave is pasted.

Additional Information

The copy/paste operation for slaves copies the selected slave and all the slaves that are connected after it. When you copy a slave, all settings except for the device name and node address are copied with it. When you paste a slave, the device name and node address are automatically set to values that are not used by other slaves.

● Registering Slaves Online to Configure the Network

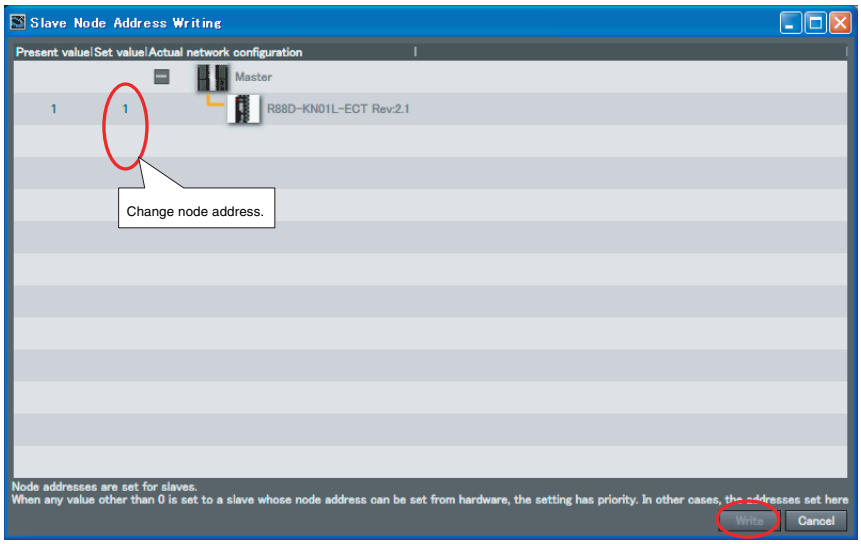
Procedure to Automatically Create the Network Configuration on the Sysmac Studio from the Actual Network Configuration

1 Go online and right-click the master in the EtherCAT Tab Page and select ***Slave Node Address Writing***.

The Slave Node Address Writing Dialog Box is displayed.

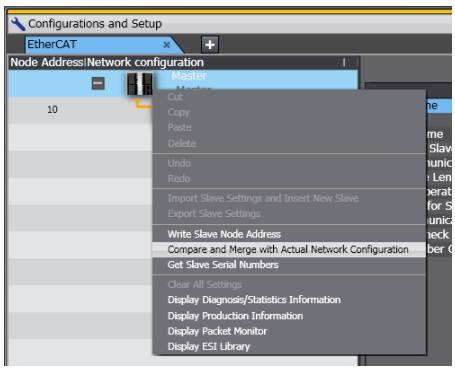
2 If the current value for the node address for an slave is 0 or if the same address is assigned to more than one slave (as indicated by “!”), set or correct the node address and click the **Write** Button.

(If the correct node addresses are set for all of the slaves, click the **Cancel** Button.)

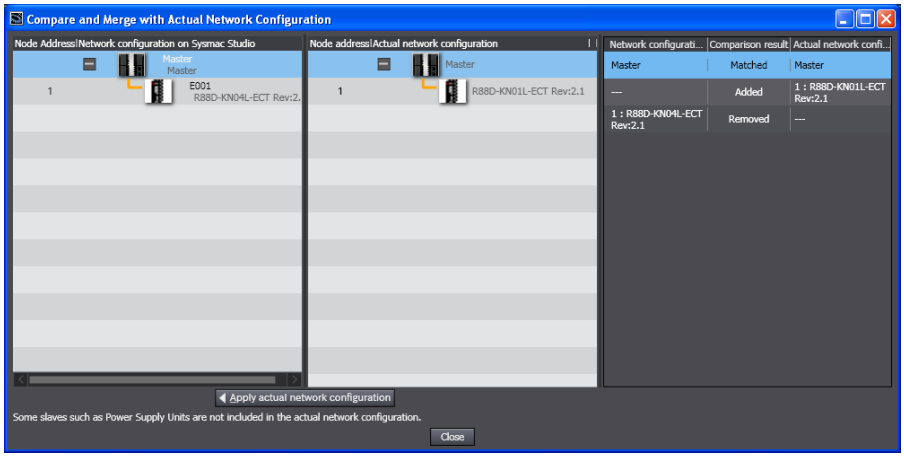


The node address is written to the physical slave.

3 Right-click the master in the EtherCAT Tab Page and select ***Compare and Merge with Actual Network Configuration***.



The actual network configuration is read and compared with the network configuration on the Sysmac Studio. The results are displayed in the Compare and Merge with Actual Network Configuration Window.



4 Click ***Apply actual network configuration*** Button.

5 The actual network configuration is duplicated in the Sysmac Studio network configuration, and the *Comparison results* Column shows that everything in the configurations agree. (The network configuration on the Sysmac Studio is created based on the actual network configuration.)

The network configuration on the Sysmac Studio will be the same as the actual network configuration.

6 Click the **Close** Button.

The Edit Network Configuration Tab Page is displayed.

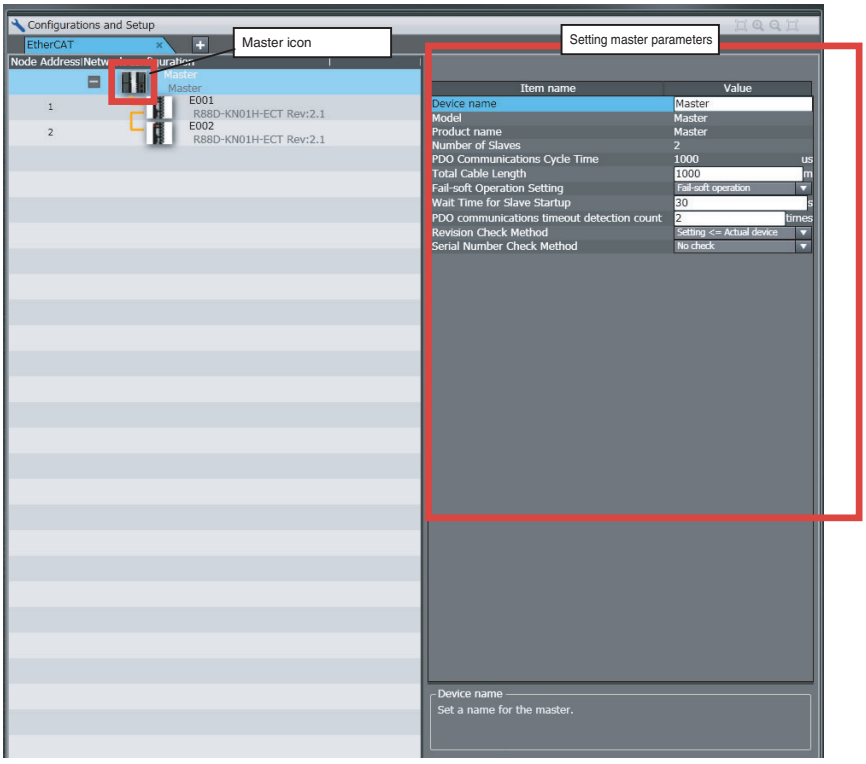
Precautions for Correct Use

- Make sure that the communications cables between the master and slaves are connected correctly before you perform this operation. The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if the connections are not correct. Refer to the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for information on the correct connection methods.
- The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if there is a slave in the actual network configuration for which the node address is not set or if the same address is set for more than one slave in the actual network configuration. Make sure that node addresses are set correctly for the slaves in the actual network configuration before you perform this operation.
- Even if you have previously set them on the Sysmac Studio, the following configuration and settings are discarded when you automatically create the network configuration on the Sysmac Studio based on the actual network configuration: network configuration, master settings, and any slave settings (including enable settings, PDO map settings, setting parameter settings, backup parameter settings, device variable assignments in the I/O map, slave assignments to Axes Variables registered in the axis settings, and master settings to control slaves that are registered in the task settings). To merge the actual network configuration information without losing the current settings in the Sysmac Studio, do not use the menu command to use the actual network configuration, and use the compare and merge operation to create the network configuration. Refer to *6-4-2 Performing Online Debugging* for information on the compare and merge operation.
- When the compare and merge operation is performed, the synchronization between the Sysmac Studio and the Controller is lost. Synchronize the Sysmac Studio and Controller before you perform any online operations for the slaves. Refer to *6-4-2 Performing Online Debugging* for information on the synchronization operation.

Setting Master Parameters

Setting Master Parameters

Select the master icon to view the parameter settings for the master.

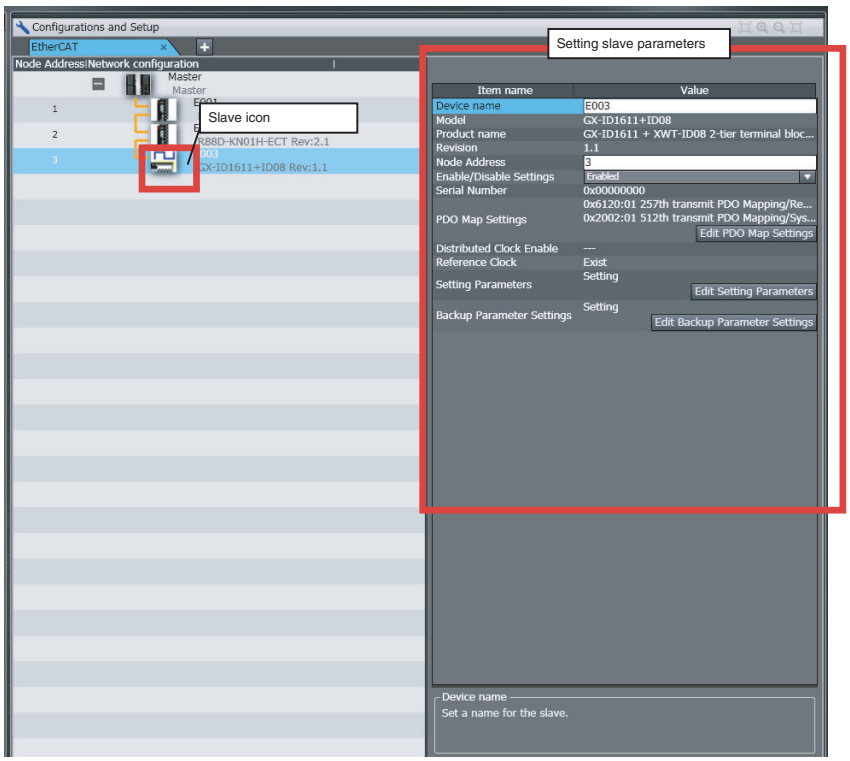


Refer to the *NJ-series CPU Unit Built-in EtherCAT User's Manual* (Cat. No. W505) for a list of the master parameters.

● Setting Slave Parameters

Setting Slave Parameters

Select a slave to view the parameter settings for that slave.



You can edit the parameters for the selected slave. Refer to the *NJ-series CPU Unit Built-in EtherCAT User's Manual* (Cat. No. W505) for information on slave parameters that are not described here.

Precautions for Correct Use

Make sure that the connections between the master and slaves are correct before you perform this operation.

Procedure to Set Serial Numbers

You can get the serial numbers of all of the slaves connected to a master and apply them as the serial numbers of the slaves in the settings on the Sysmac Studio.

Use the following procedure.

Go online, right-click the master in the EtherCAT Tab Page, and select ***Get Slave Serial Numbers***.
The serial numbers of the slaves are read and used as the serial numbers in the slave parameter settings.

Additional Information

A Network Configuration Verification Error occurs if the serial number on the Sysmac Studio and the serial number of the physical slave do not agree when the Serial Number Check Method in the master settings is set to *Setting = Actual device*.

PDO Map Settings

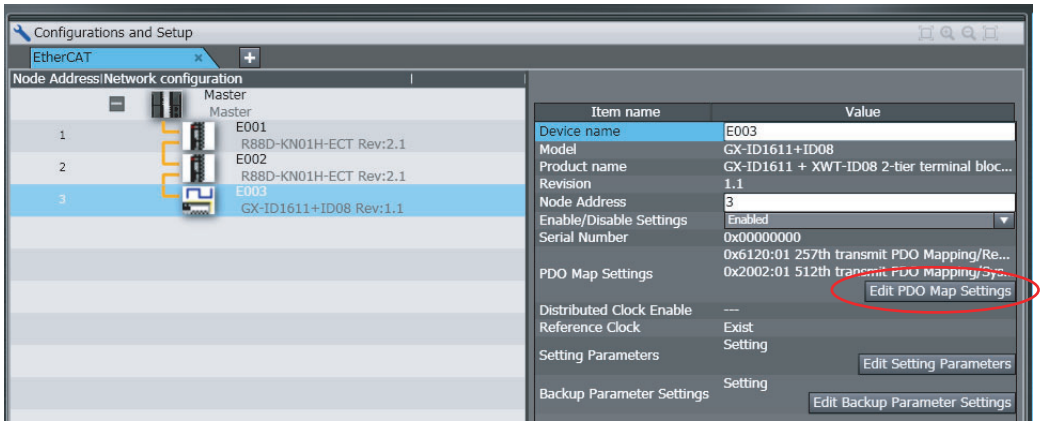
PDO Map Settings

Objects must be mapped for communications with process data objects (PDOs) to exchange information in realtime with a fixed period.

1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select ***Edit*** from the menu.

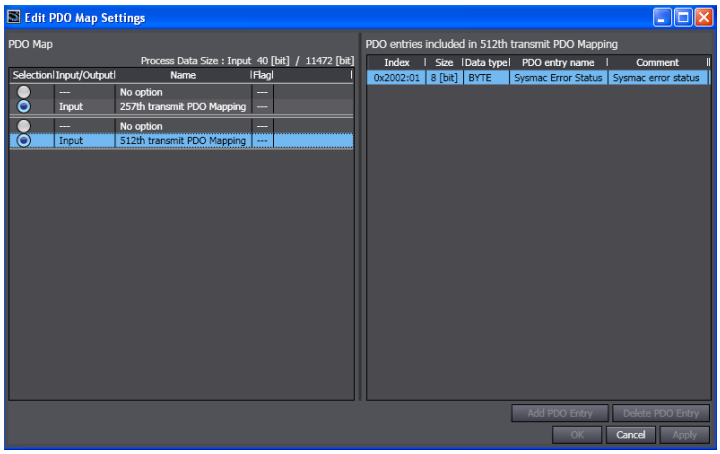
The EtherCAT Tab Page appears in the Configurations and Setup Layer.

2 Select the slave and then click the **Edit PDO Map Settings** Button in the Parameter Settings Area on the right side of the tab page.



The PDO Map Settings Window is displayed.

3 Select the PDO mappings that contain the entries to exchange information for in the PDO Map List Area, and then click the **OK** Button. You can add and delete PDO entries from PDO mappings for which “Editable” is displayed in the *Flag* Column.



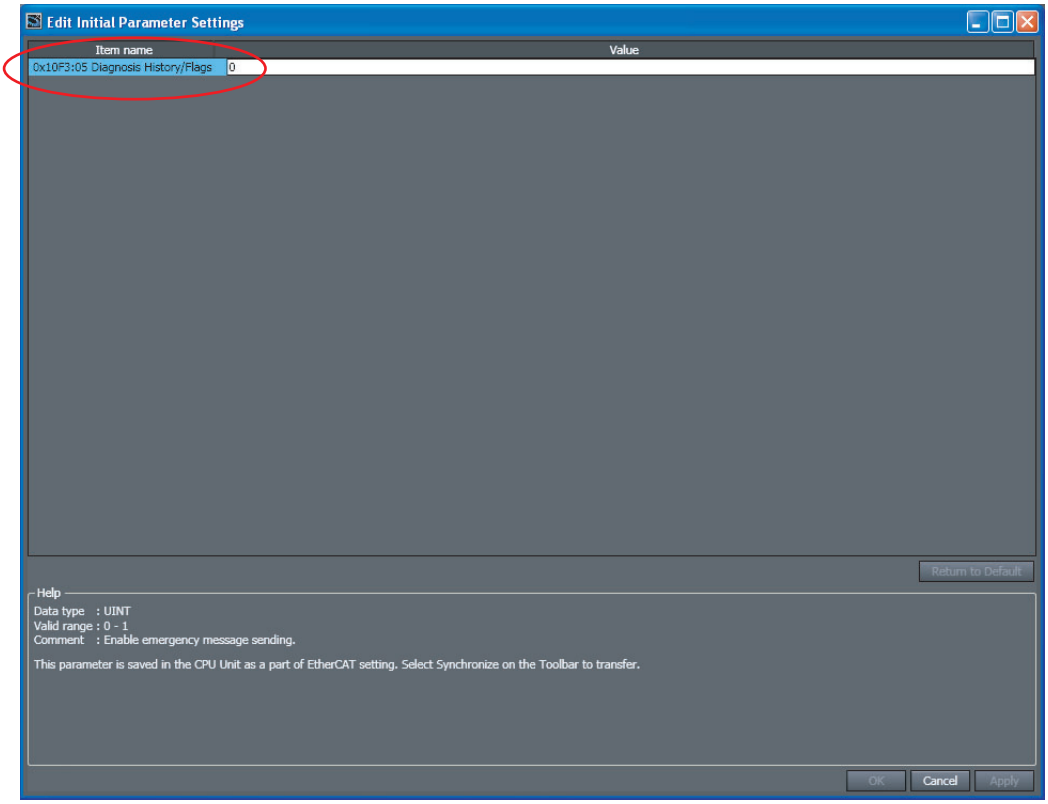
Additional Information

The default PDO mappings are selected for each slave. The display color is changed for any PDO mappings that are selected other than the default mappings and any PDO mappings for which the default PDO entries have been edited so that you can distinguish them from the default settings.

Setting Parameter Settings

Of the parameters that are set in the slaves, the parameters that are saved in the CPU Unit are called setting parameters.

1 Click the **Edit Setting Parameters** Button in the Parameter Settings Area for the slave. The Edit Setting Parameters Dialog Box for the selected slave is displayed.



2 Edit the parameters, and then click the **OK** Button.

Additional Information

The parameters that are displayed in the Edit Setting Parameters Dialog Box are saved in the CPU Unit as part of the overall EtherCAT settings. Default settings are defined for each slave. Items with set values that are different from the default values are displayed in a different color so that you can distinguish them. You can click the **Return to Default** Button to restore all set values that have changed on the Sysmac Studio to the default values.

Precautions for Correct Use

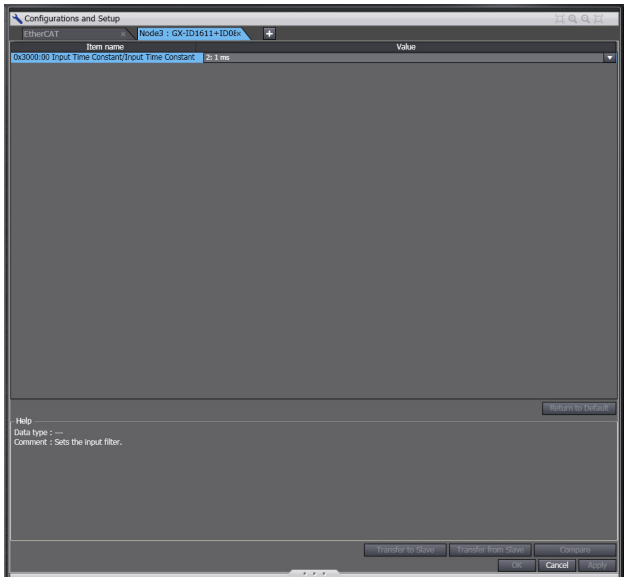
The settings in the CPU Unit are not restored to the default settings as soon as you click the **Return to Default** Button.

Backup Parameter Settings

Parameters that set for a slave and that are backed up in the slave are called backup parameters.

1 Click the **Edit Backup Parameter Settings** Button in the Parameter Settings Area for the slave.

The Edit Backup Parameter Settings Tab Page for the selected slave is displayed.



If the slave is an EtherCAT Drive, the EtherCAT Drive Tab Page is displayed. Refer to *4-2-2 Setting EtherCAT Servo Drives* for information on the slaves and EtherCAT Drive Tab Page.

2 Edit the parameters, and then click the **OK** Button.

Additional Information

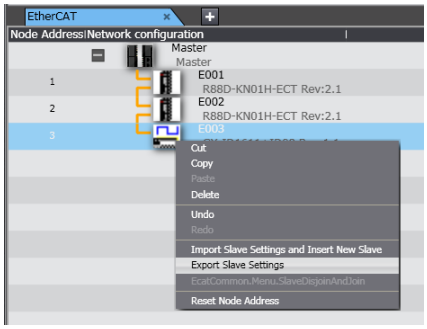
The settings that are displayed in the Edit Backup Parameter Settings Tab Page are saved in non-volatile memory in the slaves. Refer to the manuals for the slaves for information on when these settings are actually applied to slave operation. Default settings are defined for each slave. Items with set values that are different from the default values are displayed in a different color so that you can distinguish them. You can click the **Return to Default** Button to restore all set values that have changed to the default values.

Precautions for Correct Use

The settings that are saved in the slaves are not restored to the default settings as soon as you click the **Return to Default** Button.

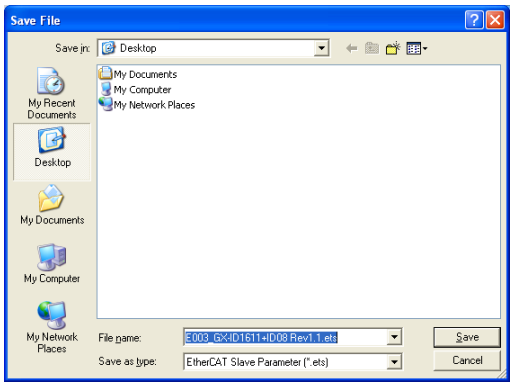
Exporting Slave Settings

1 Right-click the slave to export settings for and select ***Export Slave Settings*** from the menu.



The Save File Dialog Box is displayed.

2 Enter a file name, and then click the **Save** Button.



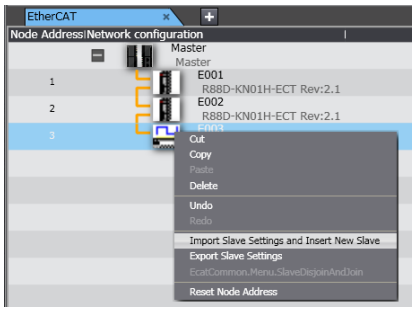
An EtherCAT slave parameter file with an .ets extension is saved.

Additional Information

All settings except for the device name and node address are saved in the EtherCAT slave parameter file. (That includes the settings that are made in the EtherCAT Drive Tab Page.)

Importing Slave Settings

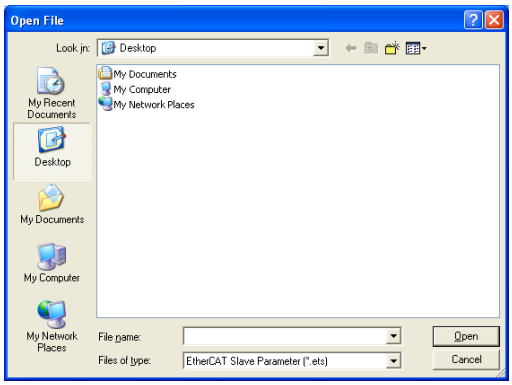
1 Right-click the master or slave and select ***Import Slave Settings and Insert New Slave*** from the menu.



The Open File Dialog Box is displayed.

2 Select the EtherCAT slave parameter file, and then click the **Open** Button.

The slave is added to the selected master or slave according to the settings in the parameter file.

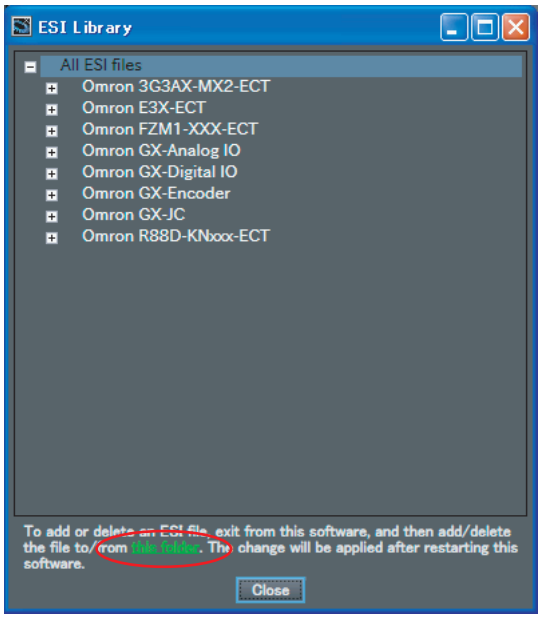


● Installing ESI Files

ESI Library (Slave Definition File and Version Checking)

1 Right-click the master in the Topology Display and select ***Display ESI Library*** from the menu.

2 To connect to an EtherCAT slave from another manufacturer, obtain the ESI file that conforms to the most recent ETG ESI standards and add it to *This Folder*.



3 Restart the Sysmac Studio.

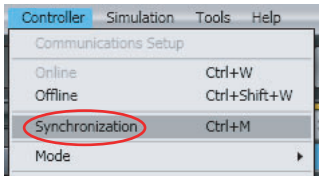
4 Right-click the master in the Topology Display and select ***Display ESI Library*** from the menu again.

5 Make sure that there is no exclamation mark (!) displayed to the left of the ESI file name that was added. If an ESI file for a slave cannot be used in the Sysmac Studio, an exclamation mark is displayed to the left of the file name. The cause of the problem is displayed below the file list.

● Transferring the Network Configuration Information

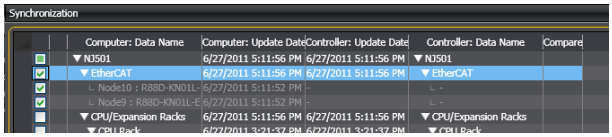
Use the synchronize operation to transfer the network configuration information. Refer to *Synchronizing* on page 6-80 for more information on synchronizing.

1 Go online and select ***Synchronization*** from the Controller Menu.



The Synchronize Dialog Box is displayed.

2 Select the *EtherCAT* Check Box in the Synchronization Dialog Box and then click the **Transfer To Controller** Button.



The network configuration information is downloaded from the Sysmac Studio to the Controller.

4-2-2 Setting EtherCAT Servo Drives

● Setting EtherCAT Servo Drives

You can set and monitor OMRON Servo Drives. Select the Servo Drive from the EtherCAT Configuration Edit Pane to set or monitor it.

⚠ Caution

Confirm the axis number carefully before you perform an axis operation from the Sysmac Studio.

If you perform FFT analysis, the motor velocity may change drastically. Be particularly careful to ensure safety. Provide a means so that you can at any time turn OFF the Servo power supply in an emergency. Do not use FFT analysis if a wide range of motor operation presents a risk of machine failure. Keep the gain as low as possible when you make measurements.

Precautions for Safe Use

- Do not turn OFF the power supply to the Servo Drive while flash memory is being written. In the worst case, the Servo Drive may be damaged.
- If the absolute encoder setting function is executed, the multiturn counter and encoder alarm are reset in the absolute serial encoder. When the multiturn counter in the absolute encoder is reset to 0, the previously defined machine system changes to a different coordinate system. After the encoder is set normally, reset the zero point of the mechanical system.
- Gain adjustment is automatically performed by the Servo Drive. The motor operates during the adjustment, so be sufficiently careful of the following points.
  1. Provide a means to perform an emergency stop (i.e., to turn OFF the power supply). The response may greatly change during the adjustment.
  2. Confirm safety around all moving parts. Always confirm that there are no obstacles in the movement range and directions of the motor and that the motor can operate safely. Provide protective measures for unexpected motion.
  3. Before you start the adjustment, make sure that the device that is being adjusted is not out of place. Before you start normal operation, make sure to perform homing to reset the position. If home is not reset before the adjustment is performed, the motor may run away, creating a very hazardous condition. Confirm the safety of the system if you use a vertical axis. Make sure that the object that is being adjusted does not fall when the Servo is turned OFF.
  4. If vibration or oscillation occurs when advanced adjustment is performed, manual reduce the gain until the system is stable.
- The motor operates and the workpiece moves during autotuning. Provide a means so that you can turn OFF the Servo immediately when you perform autotuning.
- Damping control is automatically performed by the Servo Drive. The motor operates during the adjustment, so be sufficiently careful of the following points.
  1. Provide a means to perform an emergency stop (i.e., to turn OFF the power supply). The response may greatly change during the adjustment.
  2. Confirm safety around all moving parts. Always confirm that there are no obstacles in the movement range and directions of the motor and that the motor can operate safely. Provide protective measures for unexpected motion.
  3. Before you start the adjustment, make sure that the device that is being adjusted is not out of place. Before you start normal operation, make sure to perform homing to reset the position. If home is not reset before the adjustment is performed, the motor may run away, creating a very hazardous condition. Confirm the safety of the system if you use a vertical axis. Make sure that the object that is being adjusted does not fall when the Servo is turned OFF.

Additional Information

The backup parameters of EtherCAT slaves are not subject to synchronization and are not downloaded to the slaves for the default settings. To transfer the backup parameters, clear the selection of the *Do not transfer Special Unit parameters and EtherCAT slave backup parameters (not synchronized)* Check Box in the Synchronization Pane before you click the **Transfer To Controller** Button.

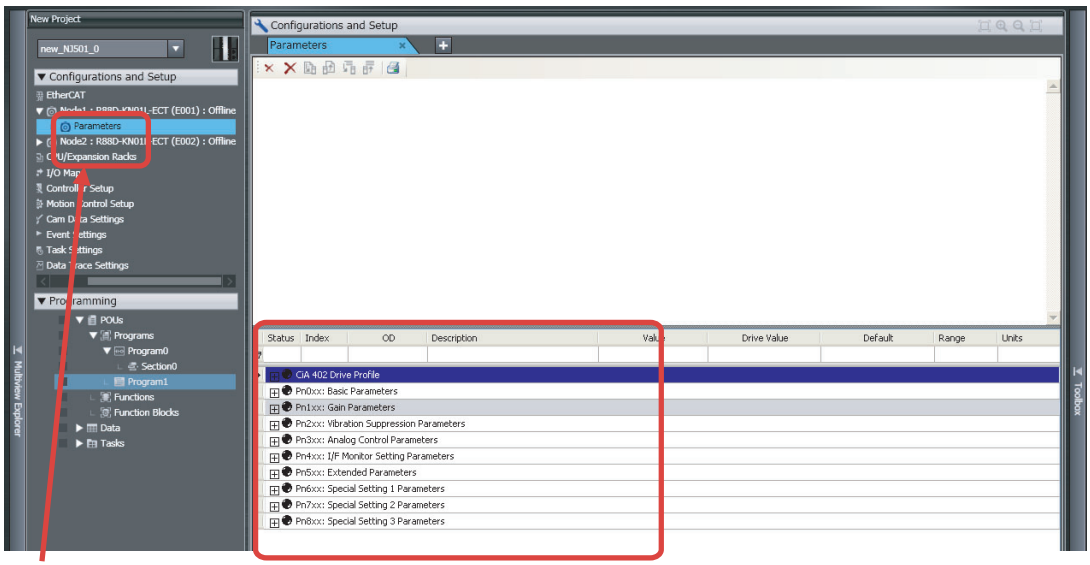
Applicable EtherCAT Servo Drives

You can set and monitor the following Servo Drives.

Servo Drive series	EtherCAT display	Slave models
G5 Series	R88D-KN□-ECT	R88D-KN□-ECT (version 1.0 or higher)
3G3MX2 Series	3G3AX-MX2-ECT	3G3MX2-□ (version 1.0 or higher)

Overview of the Structure of the EtherCAT Drive Tab Page

Register the EtherCAT Servo Drive in the EtherCAT Configuration Edit Pane and then right-click the Servo Drive in the Multiview Explorer to set or monitor the Servo Drive. The online/offline status of the Servo Drive is displayed in the Multiview Explorer.



Display in the Multiview Explorer

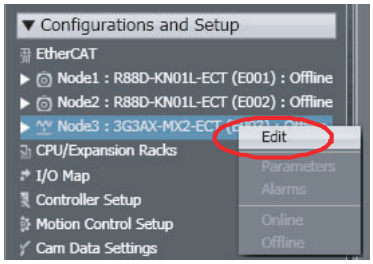
Function Display Tab Page in the Configuration Layer

Setting EtherCAT Drives

● Setting the Model (Applicable Series: 3G3MX2)

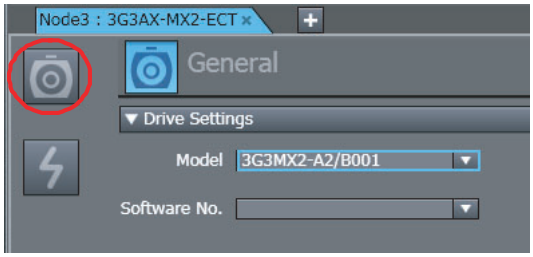
Set the Drive model and software number.

1 Double-click the Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer or right-click the Drive and select ***Edit*** from the menu.



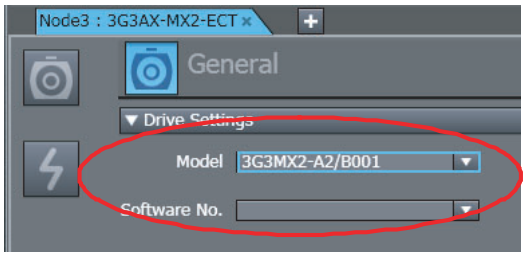
The Drive Settings Tab Page is displayed.

2 Click the **Edit** Button ( ) in the Drive Settings Tab Page.



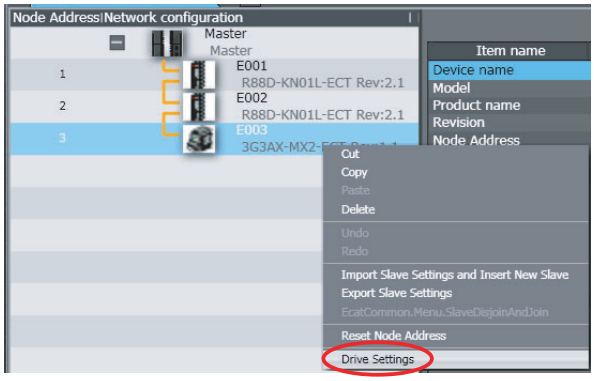
The EtherCAT Editor Tab Page appears in the Configuration Layer.

3 Set the model and software number.



Additional Information

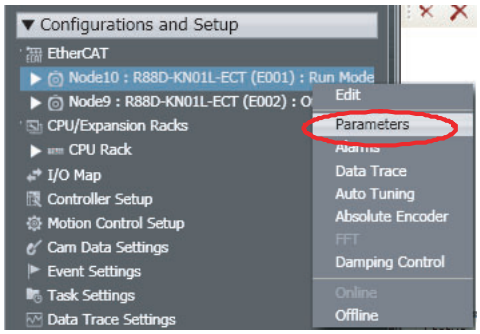
You can also display the Drive Settings Tab Page if you right-click the slave (3G3MX2-A2/8001) in the Topology Tab Page and select Drive Settings from the menu.



Setting the Parameters

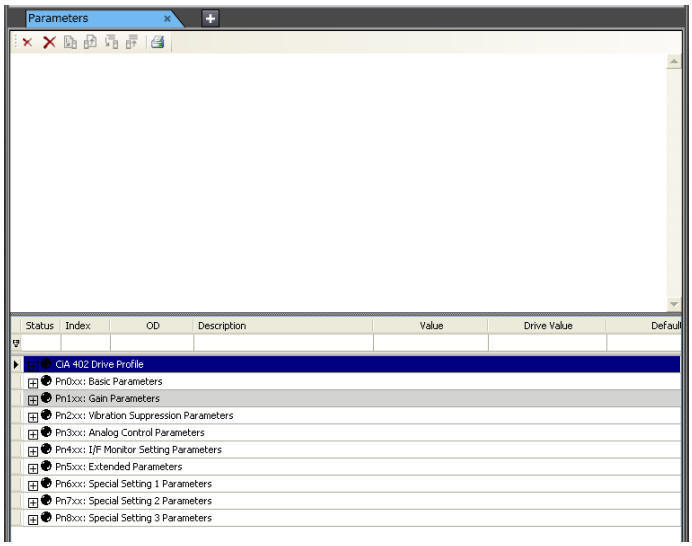
Use the following procedure to set the Drive parameters.

1 Right-click the Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Parameters*** from the menu.



The Parameters Tab Page is displayed in the Configuration Layer.

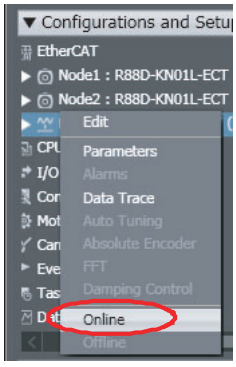
2 Set the axis parameters.



Going Online with a Drive

Use the following procedure to go online with a Drive. You can use this procedure only when the Sysmac Studio is online.

Right-click the Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Online*** from the menu.

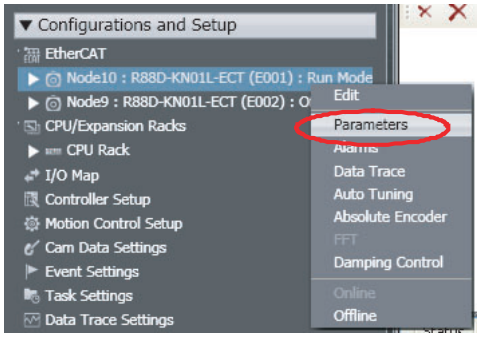


An online connection is made with the Drive.

Downloading the Parameters to the Drive

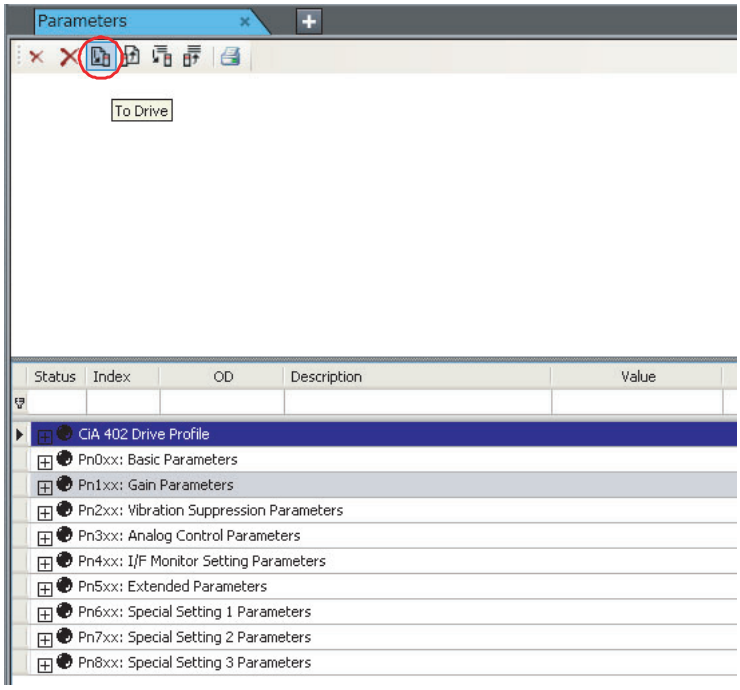
Use the following procedure to download the parameters to the Drive. You can use this procedure only when the Sysmac Studio and Drive are online.

1 Right-click the Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Parameters*** from the menu.



The Parameters Tab Page is displayed in the Configuration Layer.

2 Click the Icon in the toolbar.



All parameters are downloaded to the Drive.

Toolbar in the Parameters Tab Page

You can perform the following operations with the buttons in the toolbar.

Button	Function
	Returns the selected parameter to the default setting.
	Returns all parameters to the default settings.
	Downloads all parameters to the Drive.
	Uploads all parameters from the Drive.

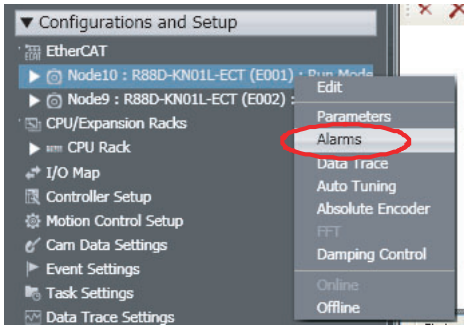
Button	Function
	Downloads the selected parameters to the Drive.
	Uploads the selected parameters from the Drive.
	Prints the axis parameters.

Monitoring EtherCAT Drives

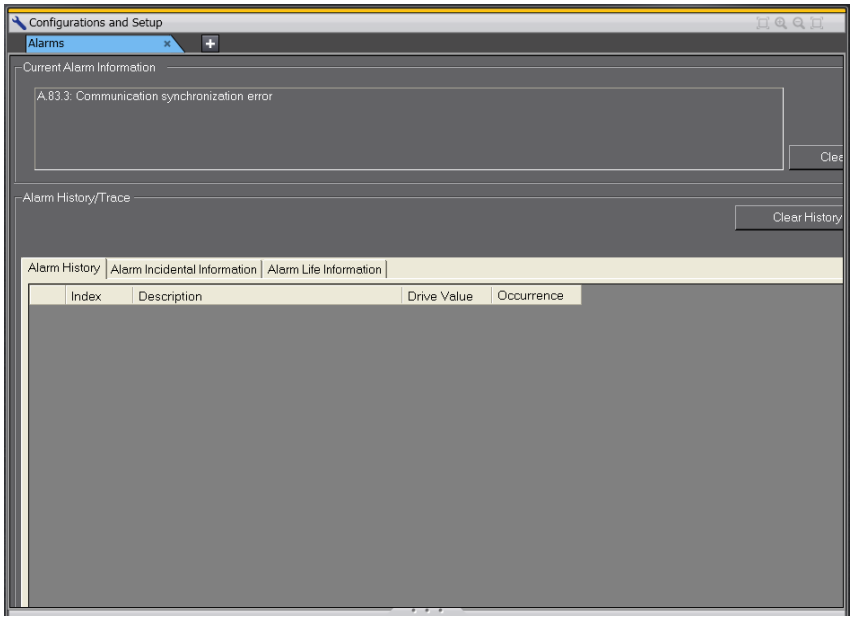
Displaying Alarms

You can display a list of alarms that have occurred in the Drive. You can use this procedure only when the Sysmac Studio and Drive are online.

Right-click the Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Alarms*** from the menu.



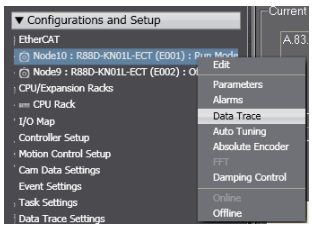
The Alarm Tab Page appears in the Configuration Layer.



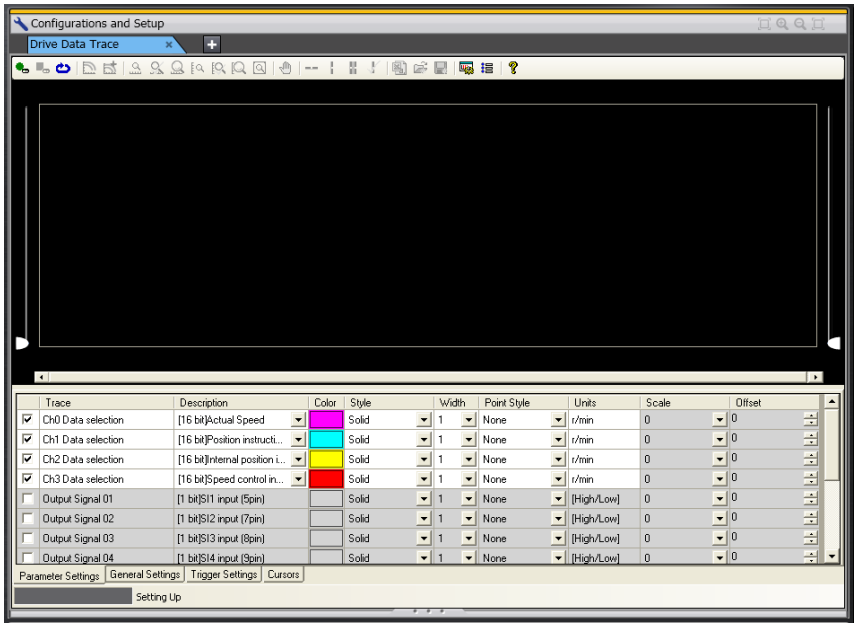
Executing Data Traces (Applicable Series: G5)

Use the following procedure to display and execute a data trace. You can use this procedure only when the Sysmac Studio and Servo Drive are online.

Right-click the Servo Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Data Trace*** from the menu.



The Drive Data Trace Tab Page appears in the Configuration Layer and a data trace is executed.

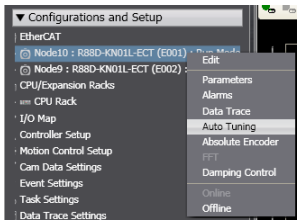


Adjusting EtherCAT Servo Drives

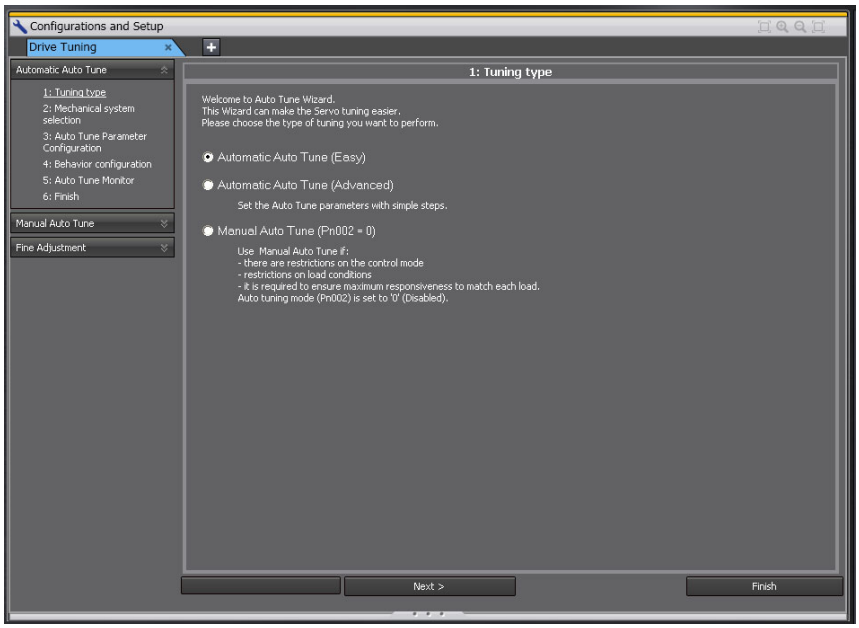
Executing Autotuning (Applicable Series: G5)

Use the following procedure to execute autotuning. You can use this procedure only when the Sysmac Studio and Servo Drive are online.

Right-click the Servo Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Auto Tuning*** from the menu.



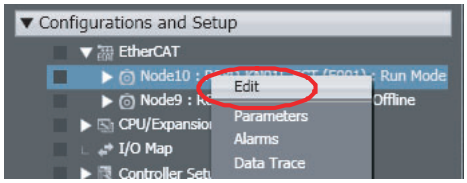
The Auto Tuning Tab Page appears in the Configurations and Setup Layer and autotuning is executed.



Changing to Commissioning Mode (Applicable Series: G5)

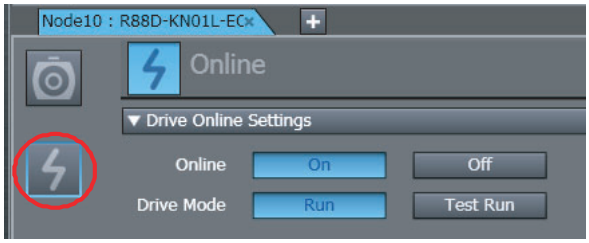
You must change the Servo Drive to Commissioning Mode to execute the FFT function. You can use this procedure only when the Sysmac Studio and Servo Drive are online.

1 Double-click the Servo Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer or right-click the Servo Drive and select ***Edit*** from the menu.



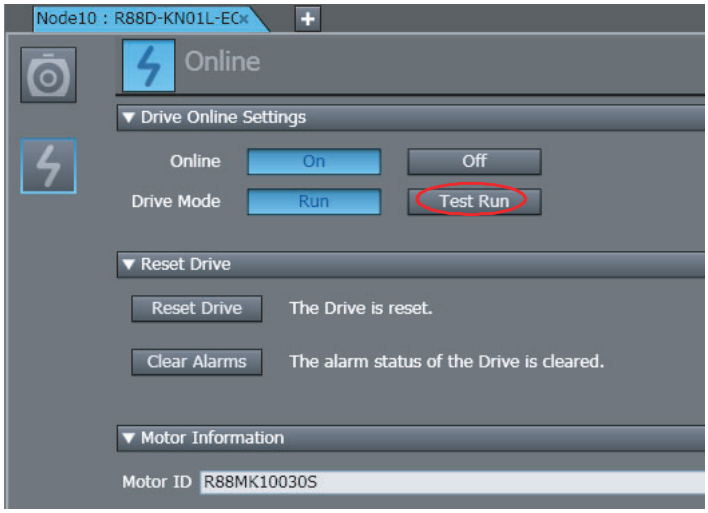
The Servo Drive Settings Tab Page is displayed.

2 Click the **Online** Button ( ) in the Drive Settings Tab Page.



The Online Tab Page appears in the Configurations and Setup Layer.

3 Click the **Test Run** Button for the Drive Mode.

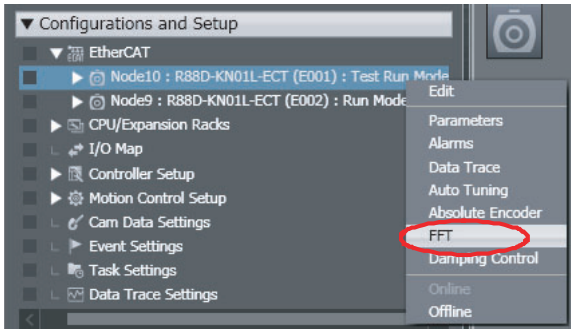


The mode of the Servo Drive is changed to Commissioning Mode.

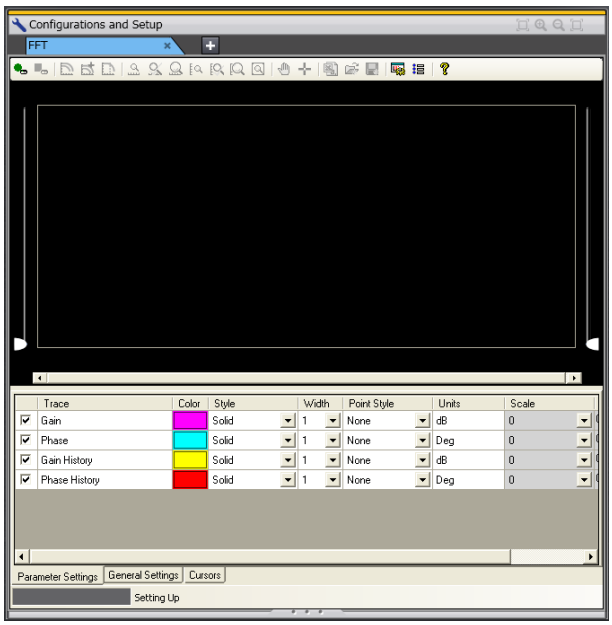
● Executing FFT (Fast Fourier Transform) (Applicable Series: G5)

Use the following procedure to execute FFT. You can use this procedure only when the Sysmac Studio and Servo Drive are online and the Servo Drive is in Commissioning Mode.

1 Right-click the Servo Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***FFT*** from the menu.



The FFT Tab Page appears in the Configuration Layer and FFT is executed.

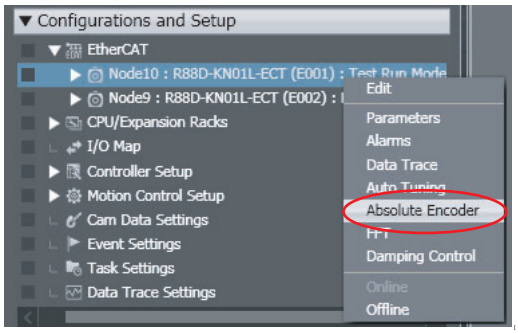


● Setting an Absolute Encoder (Applicable Series: G5)

Use the following procedure to set an absolute encoder.

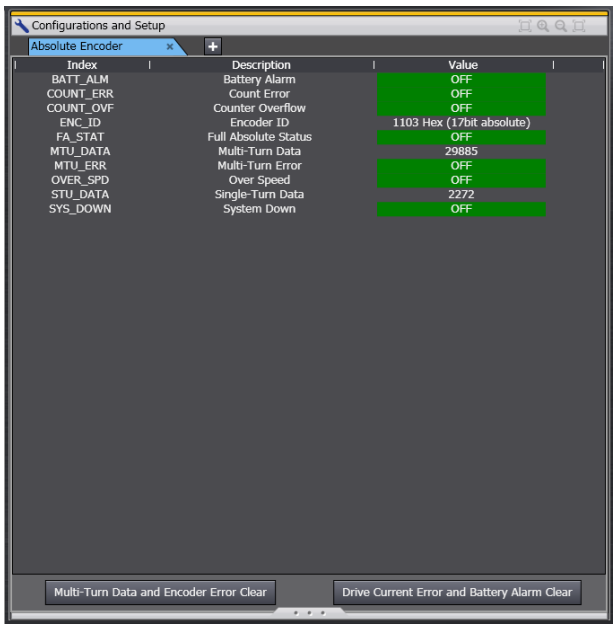
You can use this procedure only when the Sysmac Studio and Servo Drive are online.

1 Right-click the Servo Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Absolute Encoder*** from the menu.



The Absolute Encoder Tab Page is displayed.

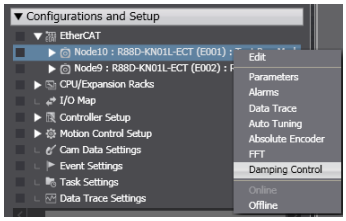
2 Set the absolute encoder.



● Setting Damping Control (Applicable Series: 3G3MX2)

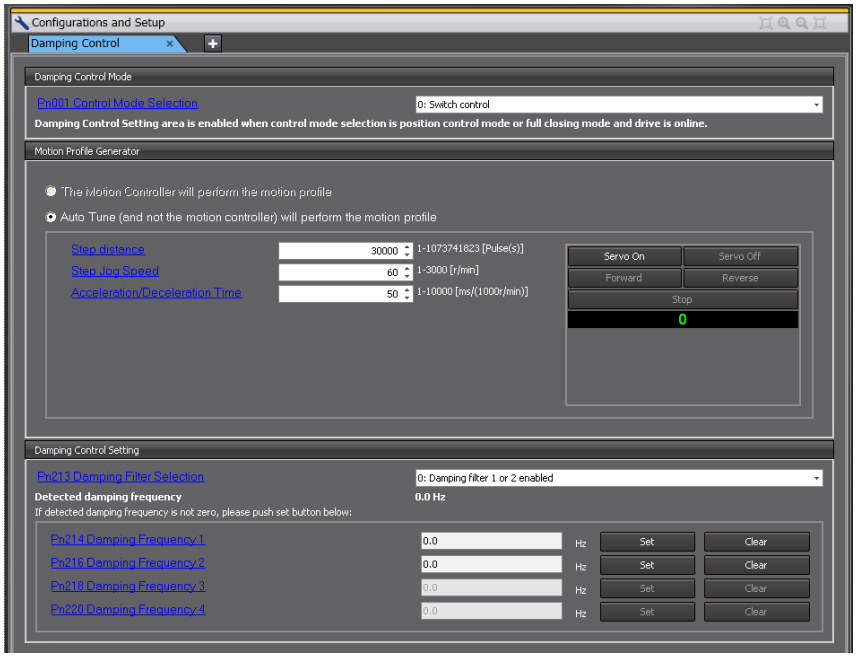
Use the following procedure to execute damping control. You can use this procedure only when the Sysmac Studio and Servo Drive are online.

1 Right-click the Servo Drive under **Configurations and Setup - EtherCAT** in the Multiview Explorer and select ***Damping Control*** from the menu.



The Damping Control Tab Page is displayed.

2 Set damping control.



4-2-3 CPU/Expansion Rack Configuration and Setup

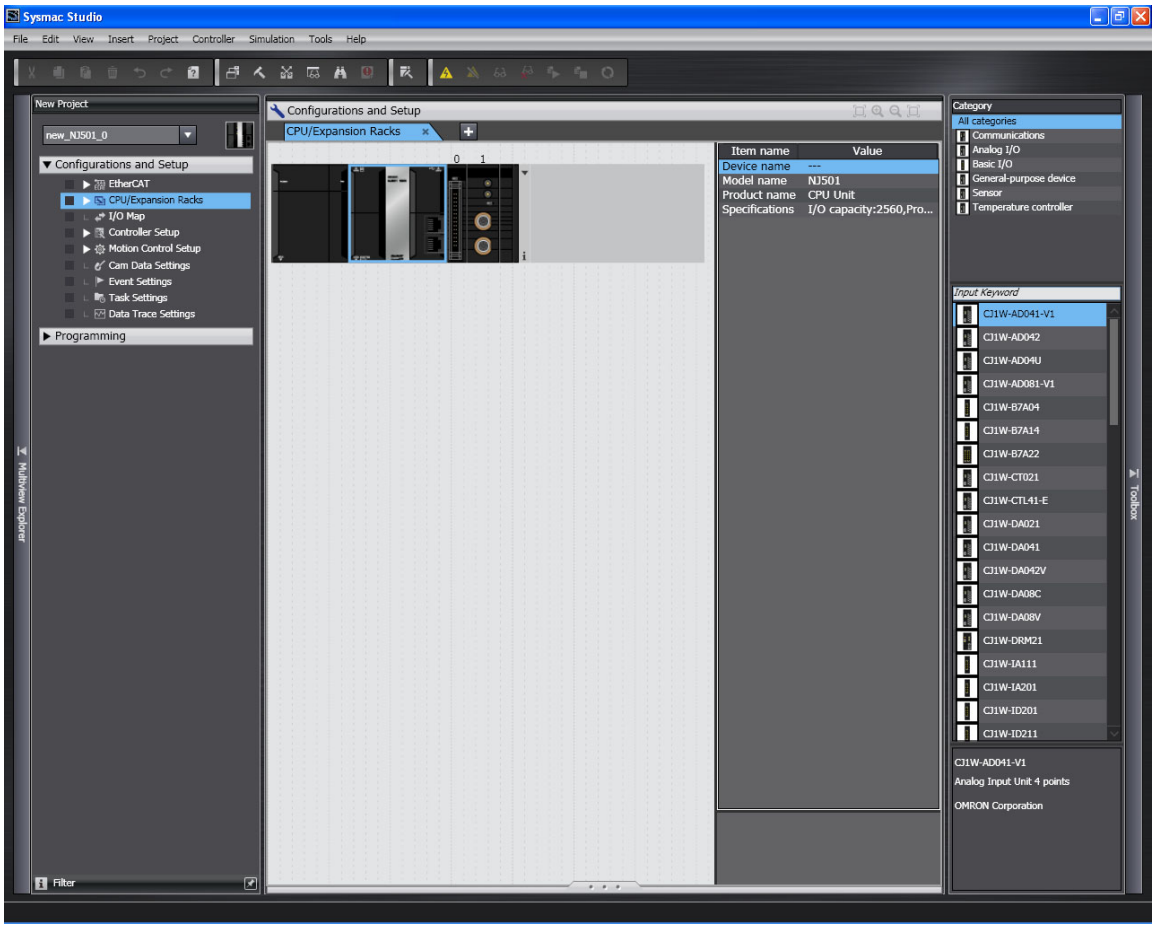
- CPU/Expansion Rack Configuration and Setup
  This is the configuration in the Sysmac Studio of the Units mounted in the NJ-series CPU Rack and Expansion Racks, and the Special Unit Setup.
  In the Sysmac Studio, you can construct a CPU/Expansion Rack Configuration just like you would put together with the actual physical Units.
  Select **Configurations and Setup** – **CPU/Expansion Racks** in the Multiview Explorer to open the Edit Pane to create CPU/Expansion Racks Configuration. You can build a Rack by dragging Units from the device list displayed in the Toolbox Pane to the locations where you want to mount them.

Precautions for Safe Use

- Check the parameters for proper execution before you use them for actual operation.
- Always confirm safety before you reset components.

Opening and Using the Unit Editor

Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **CPU/Expansion Racks** under **Configurations and Setup** and select ***Edit*** from the menu. The Unit Editor appears on the Configurations and Setup Layer.



Unit Information	Displays device information for the selected Unit, such as the device name, model number, rack number, slot number, unit number, number of unit numbers assigned, response time, and error information.
Rack Information	Click the tab to the right of a Rack to view its power consumption and size.

Registering Units Offline to Create the Unit Configuration

Procedure to Add Units

1. Drag the Unit selected in the Model Selection Pane to the Unit Editor.
   The Unit is added.
2. If you add a Special Unit, set the unit number.

Procedure to Delete Units

Right-click the Unit to delete and select ***Delete*** from the menu.
The Unit is deleted.

Procedure to Cut and Paste Units

1. Right-click the Unit to move and select ***Cut*** from the menu.
2. Right-click at the location where you want to insert the Unit and select ***Paste*** from the menu.
   The result is that the Unit is moved.

Procedure to Copy and Paste Units

1. Right-click the Unit to copy and select Copy from the menu.
2. Right-click at the location where you want to insert the Unit and select ***Paste*** from the menu.
   The Unit is pasted.

Additional Information

When you copy a Unit, all settings except for the device name and unit number (for a Special Unit) are copied with it. The device name and unit number (for a Special Unit) are automatically set to values that are not used by other Units. Each Rack can contain a maximum of 10 Units.

Procedure to Change the Unit

1. Right-click the Unit and select ***Change Model*** from the menu.
   The Change Model Dialog Box is displayed.
2. Select the Unit and then click the **OK** Button.
   The Unit is changed to the selected model.

Procedure to Change the Power Supply Unit Model

1. Right-click the Power Supply Unit and select ***Change Model*** from the menu.
   The Change Model Dialog Box is displayed.
2. Select the Power Supply Unit, and then click the **OK** Button.

Creating Racks

Procedure to Add Racks

Right-click at any location where there are no Units and select ***Add Rack*** from the menu. The Rack is added.

Procedure to Delete Racks

1. Select a Unit of the Rack to delete.
2. Right-click at any location where there are no Units and select ***Delete Rack*** from the menu.

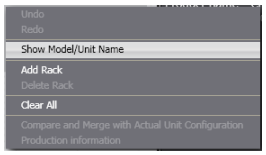
   The Rack is deleted.

Procedure to Delete All Racks and Units

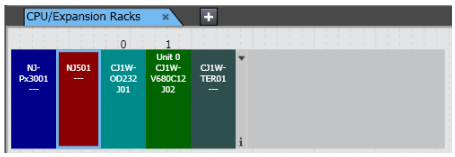
Right-click at any location where there are no Units and select ***Clear All*** from the menu. All Racks and Units are deleted.

● Changing How Units Are Displayed

Right-click at any location where there are no Units and select ***Show Model/Unit Name*** from the menu.

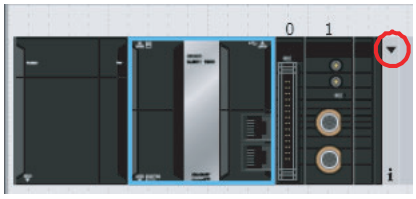


The unit numbers, model names, and device names are displayed.

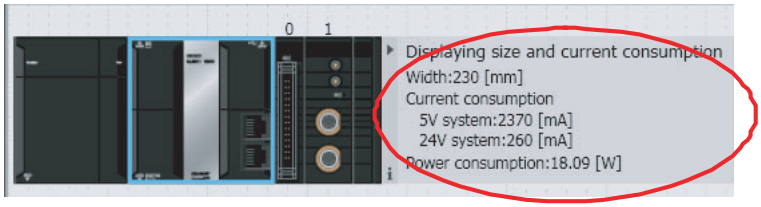


● Displaying Rack Widths, Current Consumptions, and Power Consumptions

Click ▼ Button at the right end of a Rack.



The rack width, current consumption, and power consumption are displayed.



● Setting Basic Input Units

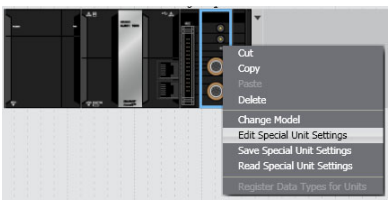
Editing the Settings of Basic Input Units

You can set the input response time of a Basic Input Unit in the Unit Information in the Unit Editor.

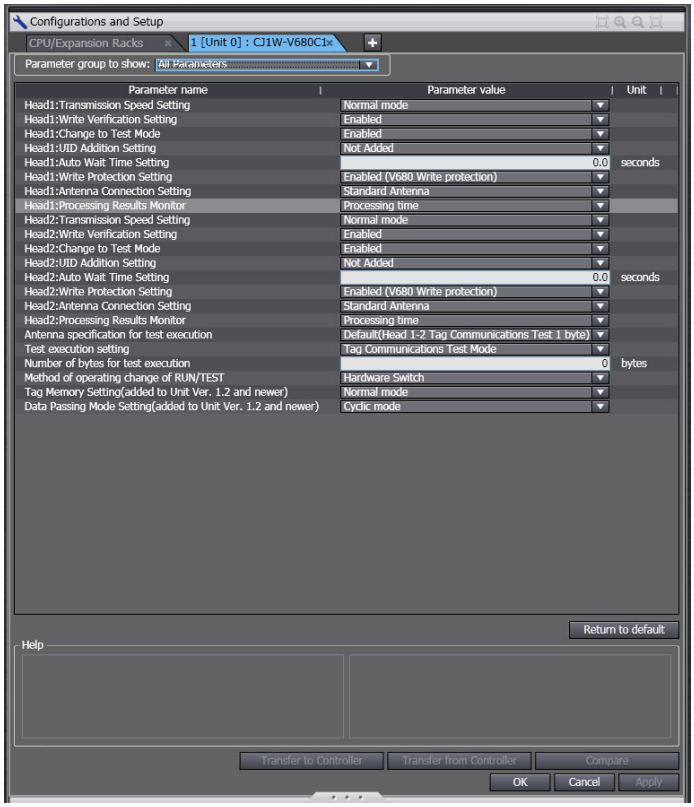
● Setting Special Units

Procedure to Edit the Special Unit Setup

1. Double-click a Unit. Or, right-click the Unit and select ***Edit Special Unit Settings*** from the menu.



The Edit Special Unit Settings Tab Page for the selected Unit is displayed.



2 Edit the parameters, and then click the **OK** Button.

Additional Information

Default settings are defined for each Special Unit. Items with set values that are different from the default values are displayed in a different color so that you can distinguish them. You can click the **Return to default** Button to restore all set values that have changed on the Sysmac Studio to the default values.

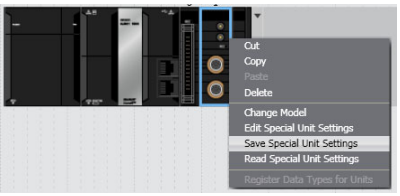
Precautions for Correct Use

No checks are made to verify the logical consistency between data items in the Special Unit Setup. Therefore, always check the logical consistency between all settings before transferring the Special Unit Setup to the Controller and starting operation, especially when you perform tasks such as enabling or disabling a setting from another setting. Depending on the settings, logical inconsistencies could result in unintended operation. For example, assume that setting item 1 specifies either defaults or user settings and that the user settings start from setting item 2. Here, even if you set the user settings from item 2 onward, the setting of setting item 1 will not be automatically changed to specify using the user settings. In this case, if you do not also change the setting of setting item 1 to specify using the user settings, the settings from items 2 onward will be ignored.

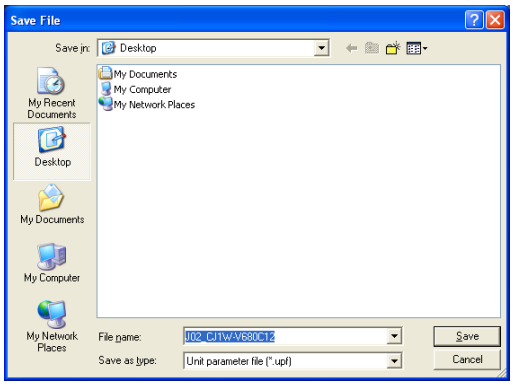
The settings for the Special Units in the CPU Unit are not restored to the default settings as soon as you click the **Return to default** Button.

Procedure to Save the Special Unit Settings

1 Right-click a Unit and select ***Save Special Unit Settings*** from the menu.



A Save File Dialog Box is displayed.



2 Enter a file name, and then click the **Save** Button.

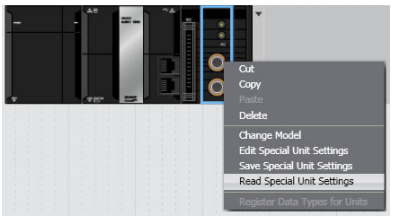
A Unit parameter file with a .upf extension is saved.

Additional Information

All settings except for the device name and unit number are saved in the Unit parameter file.

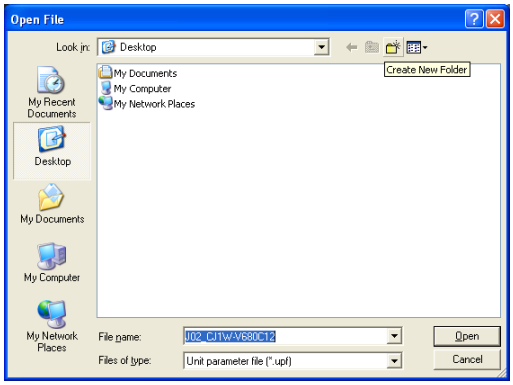
Procedure to Read Special Unit Setting File

1 Right-click a Unit and select ***Read Special Unit Settings*** from the menu.



A Open File Dialog Box is displayed.

2 Select a Unit parameter file, and then click the **Open** Button.



The parameters are read from the file.

Additional Information

All settings except for the device name and unit number are saved in the Unit parameter file.

Registering Units Online to Configure the CPU Rack and Expansion Racks

Procedure to Automatically Create the Configuration on the Sysmac Studio from the Actual Unit Configuration

1 Go online, right-click anywhere in the Unit Editor where there is no Unit and select ***Compare and Merge with Actual Unit Configuration***.

The actual Unit configuration is read and compared with the Unit configuration on the Sysmac Studio. The results are displayed in the Compare and Merge with Actual Unit Configuration Dialog Box.

2 Click the ***Apply actual Unit configuration*** Button to synchronize with the actual Unit configuration.

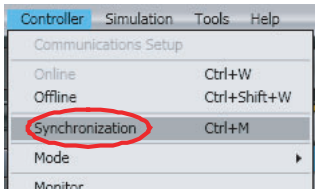
3 Click the **OK** Button.

This returns you to the Unit Editor.

Transferring the CPU/Expansion Rack Configuration Information

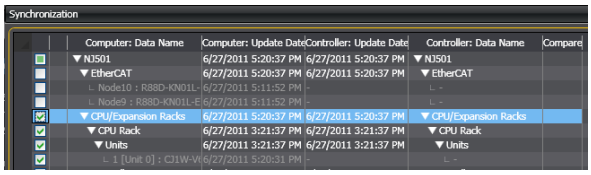
Use the synchronize operation to transfer the CPU/Expansion Rack configuration information. Refer to *Synchronizing* on page 6-80 for more information on synchronizing.

1 Go online and select ***Synchronization*** from the Controller Menu.



The Synchronize Dialog Box is displayed.

2 Select the *CPU/Expansion Racks* Check Box in the Synchronize Dialog Box and then click the **Transfer To Controller** Button.



The CPU/Expansion Racks configuration information is downloaded from the Sysmac Studio to the Controller.

Precautions for Correct Use

The parameters of the Special Units in the configuration information for the CPU/Expansion Racks are not subject to synchronization and are not downloaded to the slaves for the default settings. To transfer the parameters of the Special Units in the configuration information for the CPU/Expansion Racks, clear the selection of the *Do not transfer Special Unit parameters and backup parameters of EtherCAT slaves (out of synchronization scope.)* Check Box in the Synchronization Pane before you click the **Transfer To Controller** Button.

4-2-4 Controller Setup

- Use the Controller Setup to change settings related to the operation of the Controller.

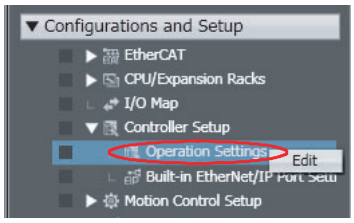
The Controller Setup contains PLC Function Module operation settings and built-in EtherNet/IP Function Module port settings.

Operation Settings

- Operation Settings
  These settings are related to the operation of the PLC Function Module, such as the Startup Mode, and to the routing tables. There are basic settings and FINS settings.

● Procedure to Open the Operation Settings Tab Page

1 Double-click **Operation Settings** under **Configurations and Setup - Controller Setup** in the Multiview Explorer. Or, right-click **Operation Settings** and select ***Edit*** from the menu.



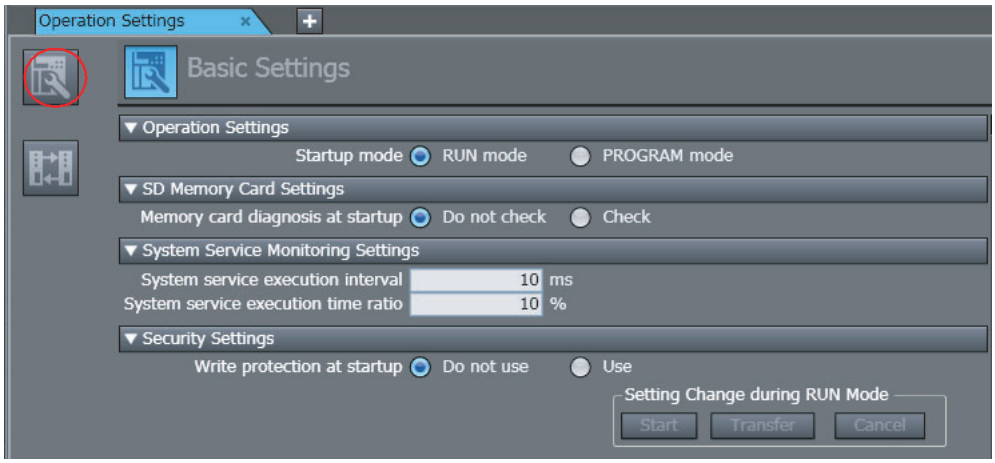
The Operation Setting Tab Page is displayed in the Edit Pane.

● Procedure to Open the Basic Settings Display

1 Double-click **Operation Settings** under **Configurations and Setup - Controller Setup** in the Multiview Explorer. Or right-click **Operation Settings** and select ***Edit*** from the menu.

The Basic Settings Display is displayed on the Operation Settings Tab Page in the Edit Pane.

2 If the Basic Settings Display does not appear, click the **Basic Settings** Button ( ).



The basic settings are listed below.

Basic Settings

Category	Setting	Description
Operation Setting	Startup Mode	Select the operating mode to enter when the power is turned ON.
SD Memory Card Setting	SD Memory Card Diagnosis at Startup	Sets whether to execute self-diagnosis (file system check and restoration) on the inserted SD Memory Card when the power is turned ON.
System Service Monitoring Settings	System Service Execution Interval [ms]	Sets the interval to monitor system service execution.
	System Service Execution Time Ratio [%]	Sets the ratio to monitor execution of system services in relation to overall processing of the CPU Unit.
Security Settings	Write Protection at Startup	Sets whether to write-protect the CPU Unit when the power supply is turned ON.
Setting Change during RUN Mode	• Start • Transfer • Cancel	As long as the parameters match between the project and the Controller, you can write the setting for Write Protection at Startup parameter during RUN mode. Refer to *7-3-3 Controller Write Protection* for details.
---	Reset all to default.	Returns all of the basic settings and FINS settings to their default settings.

Precautions for Correct Use

You cannot undo or redo operations in the Basic Settings Display.

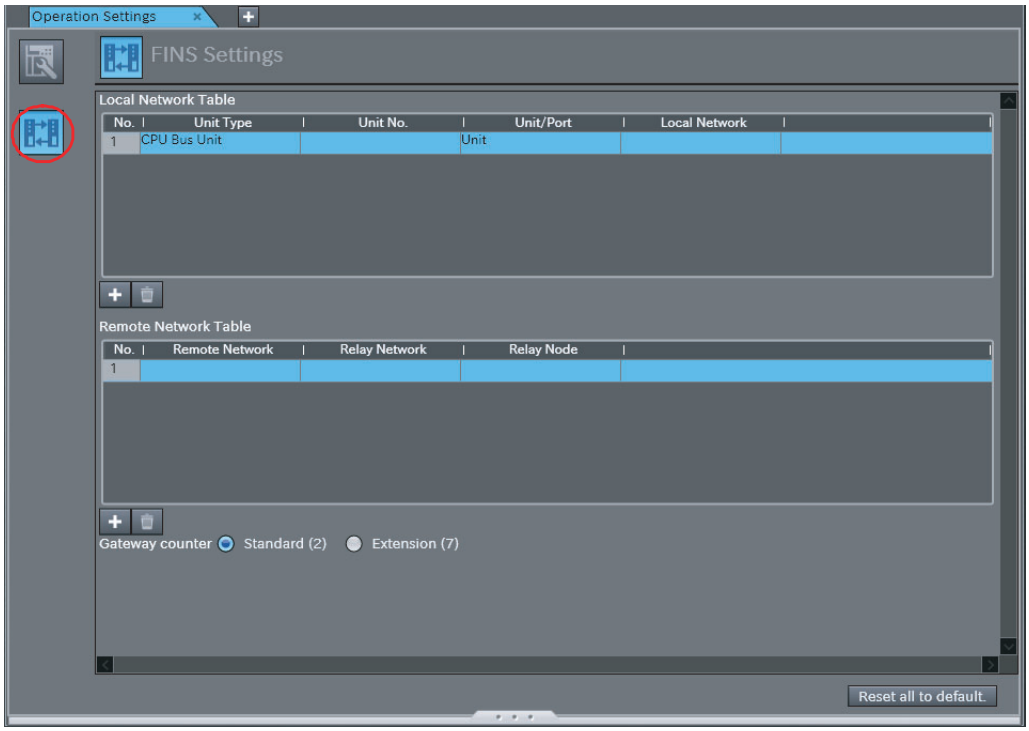
Additional Information

If there is a mistake in any set value, it is highlighted in red. Move your mouse over any location for which an error is displayed to view the error message as a tooltip. You can change certain parameters in RUN mode. Refer to *7-3-3 Controller Write Protection* for details.

● Procedure to Open the FINS Settings Display

1 Double-click **Operation Settings** under **Configurations and Setup - Controller Setup** in the Multiview Explorer. Or right-click **Operation Settings** and select ***Edit*** from the menu.

2 Click the **FINS Settings** Button ( ) displayed on the Operation Settings Tab Page in the Edit Pane.



The FINS Settings Display is displayed.

Additional Information

You can use FINS networks and FINS communications with NJ-series Controllers. Ask your OMRON representative for details.

FINS Settings

Setting		Item or set value	Default	Description
Local Network Table	Unit type	• CPU Bus Unit • Special I/O Unit • Built-in EtherNet/IP port	CPU Bus Unit	Select the Unit type.
	Unit number	• CPU Bus Unit: 0 to 15 • Special I/O Unit: 0 to 95 • Built-in EtherNet/IP port: 250	---*1	If the Unit is a CPU Bus Unit or Special I/O Unit, set the unit number.
	Unit/Port	• Unit • Port 1 • Port 2	Unit*2	If the Unit is a CPU Bus Unit, specify the Unit or port that connects to the network.
	Local network	1 to 127	---	Set the local network number.

Setting		Item or set value	Default	Description
Relay Network Table	Destination network	1 to 127	---	Set the number of the network to connect to.
	Relay network	1 to 127	---	Set the number of the relay network closest to the local network.
	Relay network node	1 to 254	---	Set the node number that is connected to the relay network from the local network.
Gateway counter		Standard (2) or extended (7)	Standard (2)	Set the GCT (gateway counter), which determines how many levels of the network to go through when a FINS command or FINS response is sent. Standard: Up to 3 levels (GCT = 02 hex) Extended: 4 to 8 levels (GCT = 07 hex)

The **Reset all to default** Button resets all the settings to their default values.

*1 If the Unit is the built-in EtherNet/IP port, this value is always 250.

*2 If the Unit is a Special I/O Unit or built-in EtherNet/IP port, this value is always *Unit*.

Additional Information

If there is a mistake in any set value, it is highlighted in red. Move your mouse over any location for which an error is displayed to view the error message as a tooltip.

Transferring Operation Settings

Use the synchronize operation to transfer the operation settings to the Controller. Refer to *Synchronizing* on page 6-80 for more information on synchronizing.

1. Go online with the Controller.
2. Select ***Synchronization*** from the Controller Menu.

   The Synchronize Dialog Box is displayed.
3. Select *Operation Settings* under the Controller Setup in the Synchronize Dialog Box and then click the **Transfer To Controller** Button.

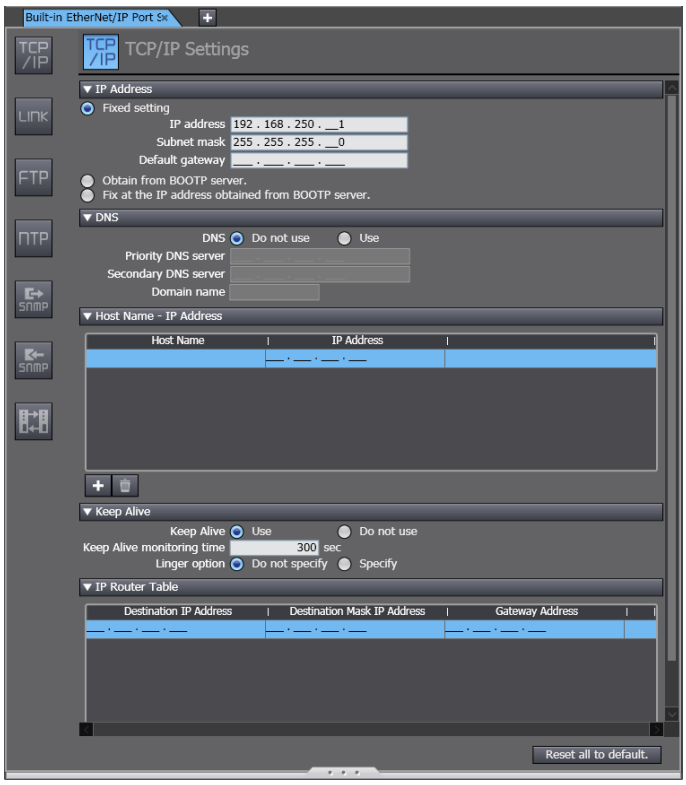
   The settings are transferred.

Built-in EtherNet/IP Port Settings

- Built-in EtherNet/IP Port Settings
  These settings are made to perform communications using the built-in EtherNet/IP port of the Controller.

Procedure to Open the Built-in EtherNet/IP Port Settings Tab Page

Double-click **Built-in EtherNet/IP Port Settings** under **Configurations and Setup - Controller Setup** in the Multiview Explorer. Or, right-click **Built-in EtherNet/IP Port Settings** and select ***Edit*** from the menu. The Built-in EtherNet/IP Port Settings Tab Page is displayed.



Built-in EtherNet/IP Port Settings

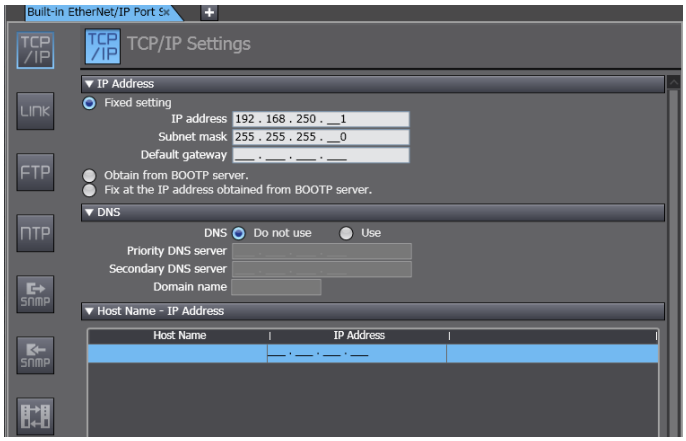
Setting	Button	Description
TCP/IP Settings		Set the EtherNet/IP port TCP/IP settings.
Link Settings		Set the baud rate for the EtherNet/IP port.
FTP Settings		Select whether to use the FTP server, and set up the FTP server if it is required.
NTP Settings		Select whether to use NTP (automatic time setting), and set up NTP if it is required.
SNMP Settings		Select whether to use SNMP (Simple Network Management Protocol), and set up SNMP if it is required.
SNMP Trap Settings		Select whether to use SNMP traps (to detect network problems), and set up SNMP traps if they are required.
FINS Settings		Make the FINS communications settings for the built-in EtherNet/IP port. Refer to *FINS Settings* on page 4-119 for details.

Refer to the *NJ-series CPU Unit Built-in EtherNet/IP User's Manual* (Cat. No. W506) for a list of the settings.

Procedure to Open the Settings Displays

The TCP/IP settings, Link settings, FTP settings, NTP settings, SNMP settings, SNMP trap settings, and FINS settings are set on the Built-in EtherNet/IP Port Settings Tab Page. The TCP/IP Settings Display is used as an example in the following procedure.

1 Click the **TCP/IP Settings** Button (TCP/IP) on the Built-in EtherNet/IP Port Settings Tab Page. The TCP/IP Settings Display is displayed.



Use the same procedure to display the other settings displays.

Procedure to Download Built-in EtherNet/IP Port Settings

Use the synchronize operation to transfer the Built-in EtherNet/IP Port Settings to the Controller. Refer to *Synchronizing* on page 6-80 for more information on synchronizing.

1 Go online with the Controller.

2 Select ***Synchronization*** from the Controller Menu.

The Synchronize Dialog Box is displayed.

3 Select *Built-in EtherNet/IP Port Settings* under the Controller Setup in the Synchronize Dialog Box and then click the **Transfer To Controller** Button.

The settings are transferred.

Precautions for Correct Use

You cannot undo and redo operations in the Built-in EtherNet/IP Port Settings Tab Page.

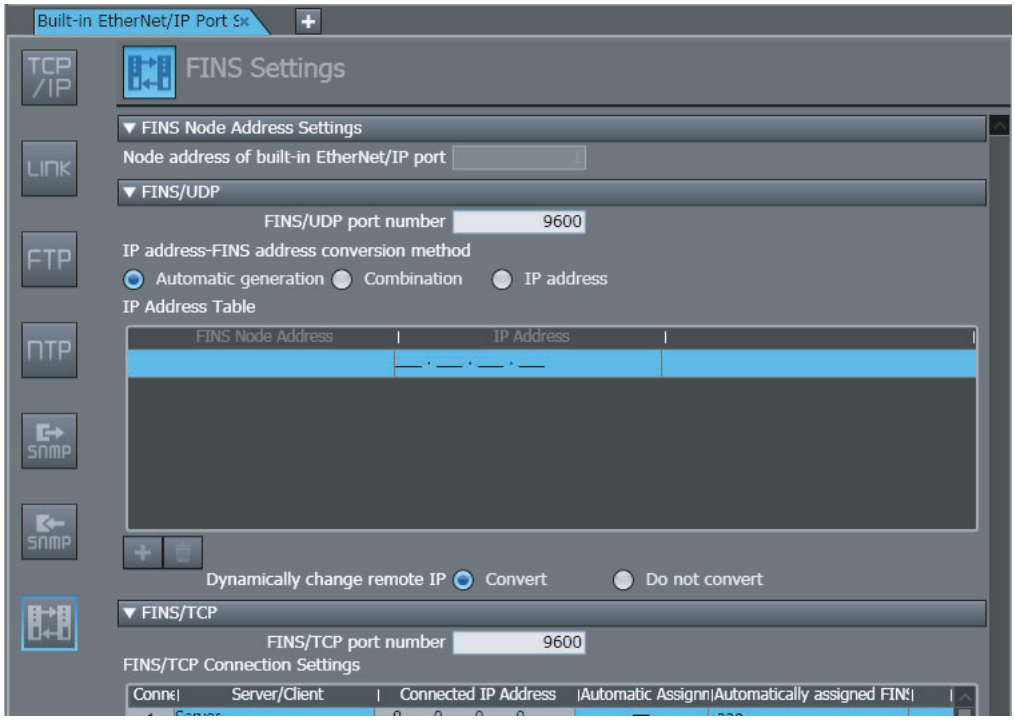
Additional Information

- If there is a mistake in any set value, it is highlighted in red. Move your mouse over any location for which an error is displayed to view the error message as a tooltip.
- If you select *Obtain from BOOTP Server* as the IP address acquisition method in the TCP/IP Settings, you can display the acquired IP address in the Status Monitor Pane. Refer to the *Controller Status Monitor* on page 6-31 for the procedure to open the Status Monitor Pane.

- FINS Settings
  FINS settings are used to perform FINS network communications from the Controller's built-in EtherNet/IP port.

Procedure to Open the FINS Settings Display

1 Click the **FINS Settings** Button ( ) on the Built-in EtherNet/IP Port Settings Tab Page. The FINS Settings Display is displayed.



Category	Description
FINS Node Address Setting	Set the FINS node address.
FINS/UDP	Set FINS/UDP communications.
FINS/TCP	Set FINS/TCP communications.

The settings are listed below for each setting category.

FINS Node Address Setting

Setting	Description	Set value	Default	Condition
Address of built-in EtherNet/IP port	Set the FINS node address. The FINS node address is determined by the IP Address/FINS Node Address Conversion Method setting in the FINS/UDP settings.	1 to 254	1	The IP Address-FINS Address Conversion Method must be set to *Combine or IP Address*.

FINS/UDP

<table>
<tr><th>Setting</th><th>Description</th><th>Set value</th><th>Default</th><th>Condition</th></tr>
<tr><td>FINS/UDP Port Number</td><td>Set the FINS/UDP port number.</td><td>1 to 65535*</td><td>9600</td><td>---</td></tr>
<tr><td>IP Address-FINS Address Conversion Method</td><td>Select the conversion method to use when determining the FINS address from the IP address.
• Automatic Generation
The FINS node address is determined from the lower eight bits of the IP address as shown below.
• Lower 8 bits of subnet address are 0:
The lower 8 bits of the IP address are set as the FINS node address.
Example:
<table>
<tr><th>IP address</th><th>Subnet mask</th><th>FINS node address</th></tr>
<tr><td>192.168.250.129</td><td>255.255.255.0</td><td>129</td></tr>
<tr><td>192.168.250.129</td><td>255.255.128.0</td><td>129</td></tr>
<tr><td>192.168.250.129</td><td>255.255.0.0</td><td>129</td></tr>
</table>
• Lower 8 bits of subnet address are not 0:
The host address that is created from the IP address and the subnet mask is set as the FINS node address.
Example:
<table>
<tr><th>IP address</th><th>Subnet mask</th><th>FINS node address</th></tr>
<tr><td>192.168.250.129</td><td>255.255.255.128</td><td>1</td></tr>
<tr><td>192.168.250.129</td><td>255.255.255.192</td><td>1</td></tr>
</table>
• Combination
The address specified in the FINS node address setting or in the IP address table is used.
• IP Address
The address set in the IP address table is used.</td><td>Automatic Generation, Combination, or IP Address</td><td>Automatic Generation</td><td>---</td></tr>
<tr><td>IP Address Table</td><td>Set the table of corresponding IP addresses and FINS addresses to determine the FINS addresses.</td><td>FINS node address: 1 to 254</td><td>Blank</td><td>The IP Address-FINS Address Conversion Method must be set to Combination or IP Address.</td></tr>
<tr><td>Dynamically Change Remote IP Address</td><td>Set whether to dynamically change the IP address of the remote node.</td><td>Change or Do Not Change</td><td>Change</td><td>---</td></tr>
</table>

* Port numbers that are reserved by the system cannot be set. Refer to the *NJ-series CPU Unit Built-in EtherNet/IP User's Manual* (Cat. No. W506) for details.

FINS/TCP

Setting		Description	Set value	Default	Condition
FINS/TCP Port Number		Set the FINS/TCP port number.	1 to 65535*1	9600	---
FINS/TCP Connection Settings	Connection No.	Displays the connection number.	Cannot be changed	No. 1 to No. 16	---
	Server/Client	Set if this is a server or a client.	Server/Client	Server	---
	Connected IP address	Set the IP address to connect to.	*2	0.0.0.0	The *Protect with IP Address* Option must be selected or *Server/Client* must be set to *Client*.
	Automatic Assignment	Set whether to use automatic assignment.	Selected or not selected	Selected.	*Server/Client* must be set to *Server*.
	Automatically assigned FINS node address	Set the FINS address that corresponds to the IP address.	1 to 254	239 to 254 (line 1 to line 16)	*Server/Client* must be set to *Server* and *Automatic Assignment* must be selected.

*1 Port numbers that are reserved by the system cannot be set. Refer to the *NJ-series CPU Unit Built-in EtherNet/IP User's Manual* (Cat. No. W506) for details.

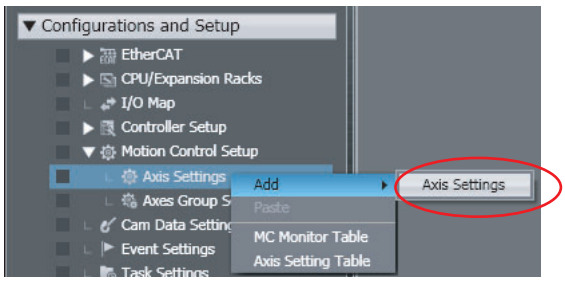
*2 Refer to the *NJ-series CPU Unit Built-in EtherNet/IP User's Manual* (Cat. No. W506) for details on the setting ranges of IP addresses.

4-2-5 Motion Control Setup

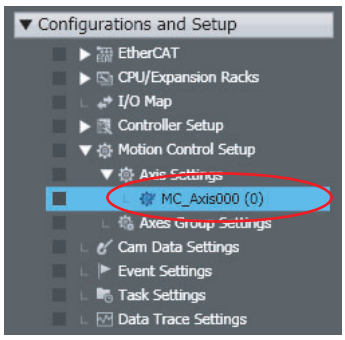
- Motion Control Setup
  The Motion Control Setup is used to create the axes to use in motion control instructions, assign those axes to Servo Drives and encoders, and set axis parameters.

Setting Axes

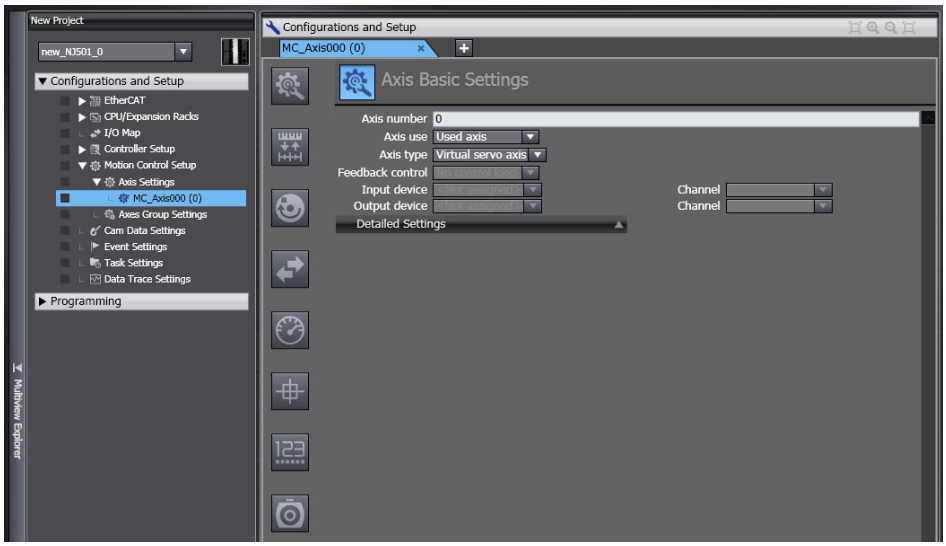
1 Right-click **Axis Settings** under **Configurations and Setup - Motion Control Setup** in the Multiview Explorer and select ***Add - Axis Settings*** from the menu.



The axis *MC_Axis000(0)* is added under **Axis Settings**.



2 Double-click **MC_Axis000(0)**.

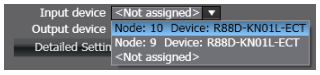


The Axis Basic Settings Tab Page is displayed in the Configuration Layer of the Edit Pane. The basic parameters are displayed on the initial display.

3 Select the following settings to use a servo axis.

- Axis Use: Used Axis
- Axis Type: Servo Axis

4 Select a servo axis for the input device.



* Refer to *4-2-1 EtherCAT Configuration and Settings* for the procedure to set slaves.

5 Click the buttons on the left side of the Axis Basic Settings Tab Page to complete different settings. The parameters you can set for each button are given below.

Settings Buttons and Axis Parameters

Button	Name	Description
	Axis Basic Settings	Set whether to use the axis, the axis type, the axis number, and the channel.
	Unit Conversion Settings	Set the gear ratio of the electronic gear. Set the pulses per motor rotation and the travel distance.
	Operation Settings	Set the velocity, acceleration rate, deceleration rate, torque warning values, and other monitor parameters.
	Other Operation Settings	Set the I/O for the Servo Drive.

Button	Name	Description
	Limits Settings	Set software limits and following error limits.
	Homing Settings	Set the homing operation.
	Position Count Settings	Set Count Mode of the Controller.
	Servo Drive Settings	Set the Servo Drive parameters.

Refer to the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for details on each setting.

Additional Information

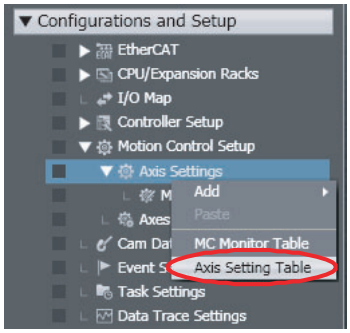
Parameters that you change in the Axis Parameter Settings Tab Page are automatically updated in the Axis Setting Table.

● Axis Setting Table

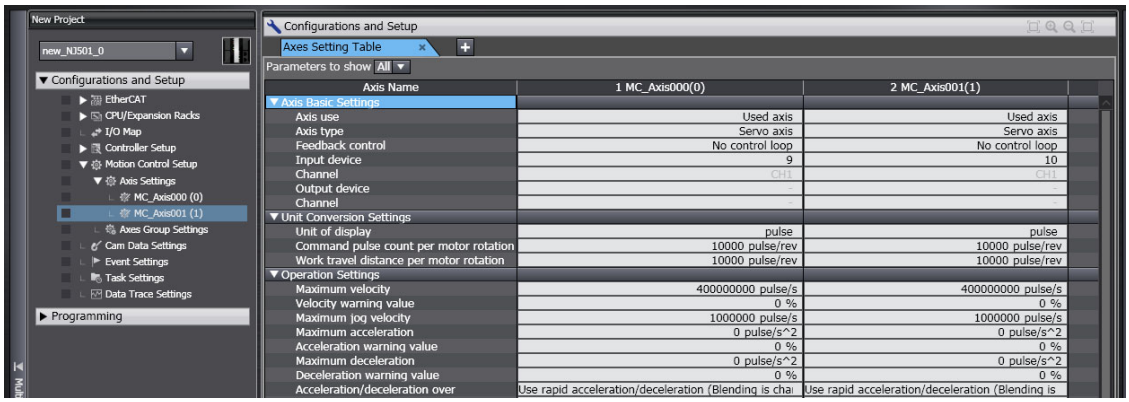
- Axis Setting Table
  The Axis Setting Table is a table of all registered axis parameters. You can edit any axis parameters here just as you can on the Axis Settings Tab Page.

Opening the Axis Setting Table

1 Double-click **Axis Setting Table** under **Configurations and Setups - Motion Control Setup - Axis Settings** on the Multiview Explorer.



The Axis Setting Table is displayed.



Note Each line represents an axis parameter, and each column is for one axis number. All registered axes are displayed. You can collapse the table by axis parameter category.

Changing Axis Parameters

1. Click the parameter to change.
2. Enter the new setting for the parameter.

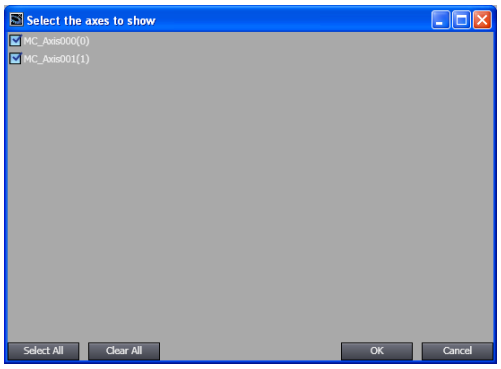
Copying Axis Parameters

1. Right-click the cell to copy and select ***Copy Selected Cells*** from the menu.
2. Right-click the cell to paste in and select ***Paste*** from the menu.

Selectively Displaying Axis Parameters

You can select the axis parameters to display.

1. Open the Axis Setting Table.
2. Right-click anywhere in the Axis Setting Table and select ***Select Axes to show*** from the menu.
   The following Select the axis to show Columns Dialog Box is displayed.



3. The names of the axes in the Axis Setting Table are displayed. Select the axes to view.
4. Click the **OK** Button. Only the axes you selected are displayed in the Axes Setting Table.

Filtering Axis Parameters

You can switch between displaying all axis parameters and only those that are used the most often.

1. Open the Axes Setting Table.
2. Select either *All* or *Basic Settings* under *Parameters to show* at the top of the Axes Setting Table.

Additional Information

Any changes made in the Axes Setting Table are automatically updated in the Axis Parameter Settings Tab Page.

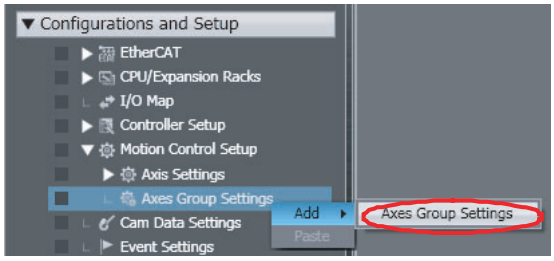
Setting Axes Groups

- Setting Axes Groups
  You can set axes to perform interpolated motions as an axes group.

● Procedure to Set Axes Groups

- Opening the Axes Group Settings Tab Page

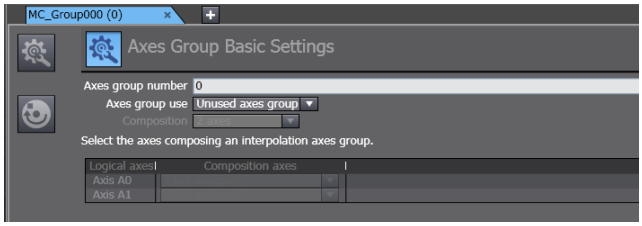
1 Right-click **Axes Group Settings** under **Configurations and Setup - Motion Control Setup** in the Multiview Explorer and select ***Add - Axes Group Settings*** from the menu.



The axes group **MC_Group000(0)** is added under **Axes Group Settings**.

2 Double-click **MC_Group000(0)**.

The Edit Pane for Axes Group Basic Settings is displayed.



3 Click the buttons on the left side of the Axes Group Basic Settings Tab Page to change between different settings.

The parameters you can set for each button are given below.

Settings Buttons and Axes Group Parameters

Button	Name	Description
	Axes Group Basic Settings	Set the axes group number, whether to use the axes group, or the axis composition.
	Axes Group Operation Settings	Set the interpolated velocity, the maximum interpolated acceleration and deceleration, and the interpolated operation settings.

Refer to the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for details on each setting.

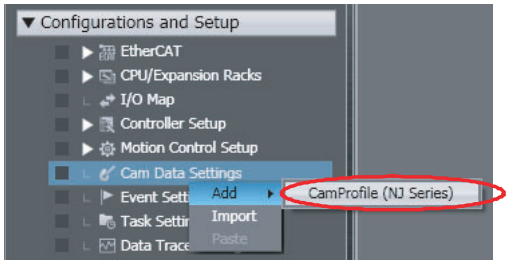
4-2-6 Cam Data Settings

Cam data is curve data that defines the motion of an electronic cam. The curve that defines the relationship between the phases and displacements of the cam data is called the cam profile curve. You can create cam profile curves with the Cam Editor.

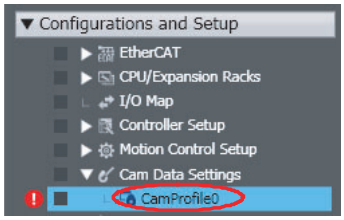
Procedures

● Registering Cam Data

1 Right-click **Cam Data Settings** under **Configurations and Setup** in the Multiview Explorer and select ***Add - CamProfile (NJ Series)*** from the menu.



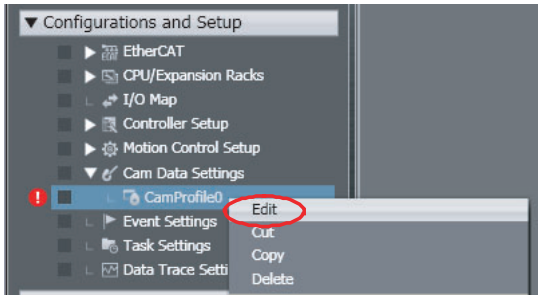
CamProfile0 is added under the Cam Editor.



● Editing Cam Data

1 Starting the Cam Editor

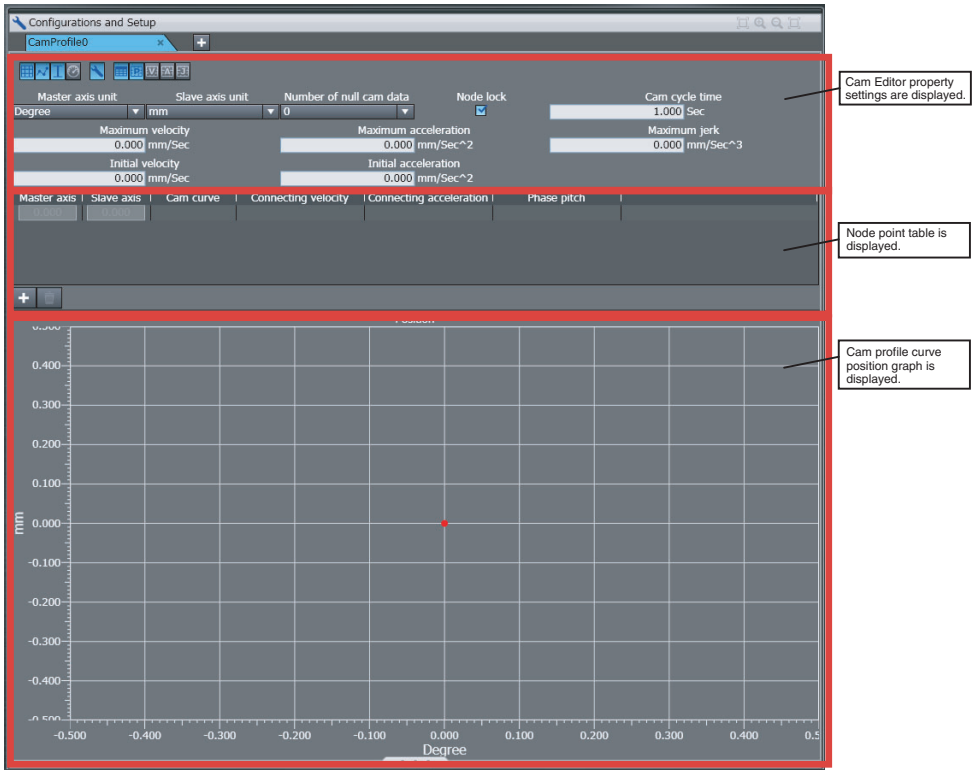
Right-click CamProfile0 and select ***Edit*** from the menu.



The Cam Editor starts.

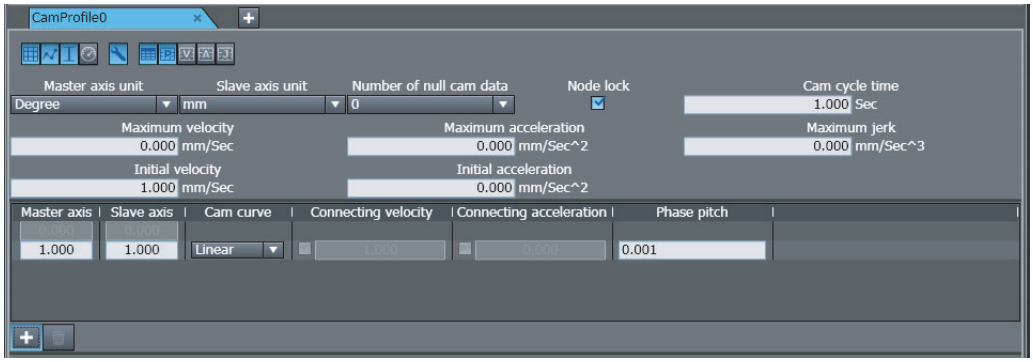
2 Setting Properties

Set the master and slave axis profile data. Cam data properties are displayed at the top of the Cam Editor.

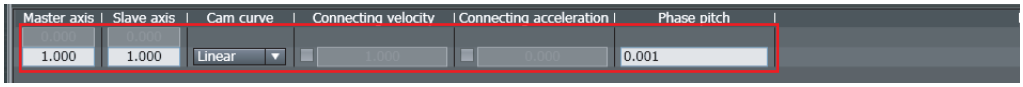


3 Registering Node Points (Defining Curves)

- Click the **Add** Button ( ).

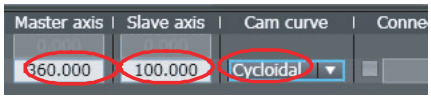


- A node point is added.

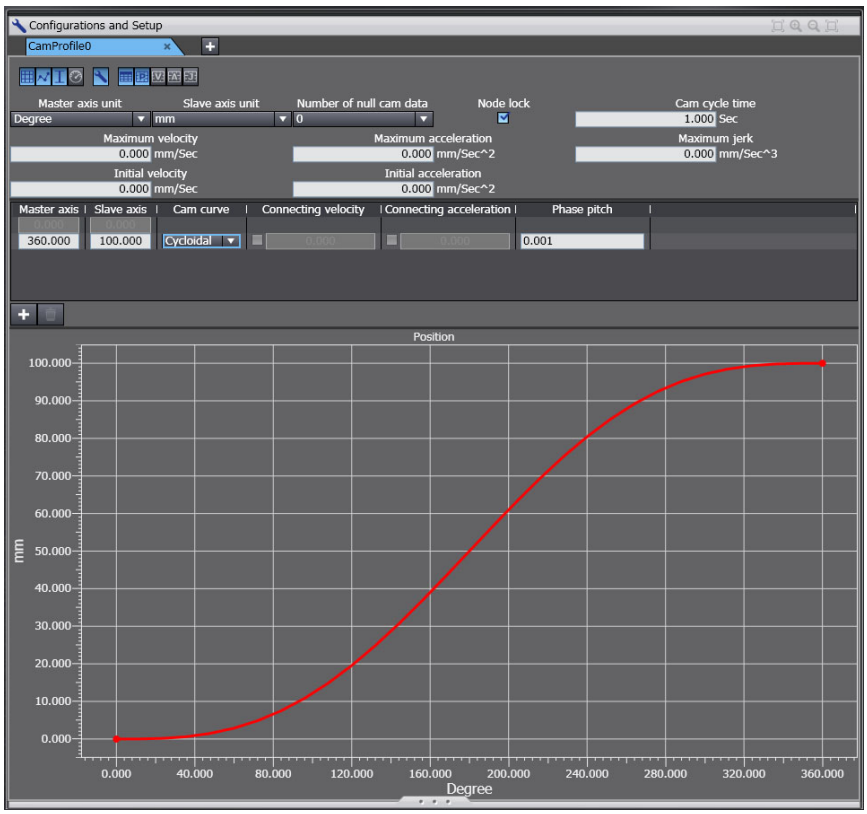


- Enter the phase of the master axis and the displacement of the slave axis and then specify the shape of the curve.

Note Enter the phase of the master axis and the displacement of the slave axis before you add the next node point.



The cam profile curve is drawn on the graph.



4 Editing Node Points

You can use the following two methods to edit node points.

A) Entering the Phase and Displacement Directly

- Enter the phase, displacement, curve, and phase pitch for the node.

B) Moving the Points on the Graph with the Mouse

- Enable the position graph display on the toolbar ( ) to display the graph.
- Click the pointers that represent the start and end points of the curve ( ) and drag them to the positions you want.

Note 1 If you drag a point to a location where it cannot be moved, the curve is not changed and only the pointer moves.

2 You can perform this same operation for the velocity graph, acceleration graph, and jerk graph.

Additional Information

Enter the phases of the master axis in ascending order.

Procedure to Transfer Cam Data

Use the synchronization operation to transfer the cam data to the Controller. Refer to *Synchronizing* on page 6-80 for more information on synchronizing.

Use the following procedure.

1 Go online with the Controller.

2 Select ***Synchronization*** from the Controller Menu.

The Synchronize Dialog Box is displayed.

3 Select the cam data to transfer under Cam Data Settings in the Synchronization Dialog Box and then click the **Transfer To Controller** Button.

The transfer starts.

Properties

Parameter	Range/unit	Description
Master axis unit	deg, inch, mm, pulse, µm, or nm	Set the unit to use for the master axis.
Slave axis unit	deg, inch, mm, pulse, µm, or nm	Set the unit to use for the slave axis.
Number of null cam data	0, 10, 50, 100, 500, 1000, 5000, or 10000	Set a value to insert data with the phase of the master axis and the displacement of the slave axis set to zero after the end point of the cam.
Cam cycle time	---	Set the time for one cam cycle.
Maximum velocity	---	Set the maximum velocity for the slave axis. The set value is displayed on the velocity graph as a blue dotted line.
Maximum acceleration	---	Set the maximum acceleration for the slave axis. The set value is displayed on the position graph as a blue dotted line.
Maximum jerk	---	Set the maximum jerk for the slave axis. The set value is displayed on the jerk graph as a blue dotted line.
Initial velocity	---	Set the velocity when the phase of the slave axis is 0. If a phase of 0 is followed by a polynominal 3, polynominal 5, or free curve, you can specify the initial velocity.
Initial acceleration	---	Displays the acceleration rate when the phase of the master axis is 0. You can specify the initial acceleration rate when a polynomial 5 curve is connected after a phase of 0.

Curve List

Curve shape	Connection condition specification	Main applications
Constant	Not possible.	Used to create a dwell range between a block start point and block end point.
Straight Line	Not possible.	Used to move at a constant velocity.
Parabolic	Not possible.	Used to suppress residual vibration even for a high-velocity, high-load equipment.
Modified Constant Velocity	Not possible.	Used to suppress residual vibration even for a high acceleration rate.
Modified Trapezoid	Not possible.	Used for high-velocity, medium-load equipment. Used to reduce the effect on the motor for load variations.
Modified Sine	Not possible.	Used for high-velocity, low-load equipment.
Cycloidal	Not possible.	Used to accelerate/deceleration at a constant rate or to restrict the maximum acceleration/deceleration rate.
Trapecloid	Not possible.	Use this setting to decelerate relatively smoothly.
Reverse-Trapecloid	Not possible.	Use this setting to accelerate smoothly.
Simple Harmonic	Not possible.	Use this setting to accelerate relatively smoothly or for one-dwell motion.
Double Harmonic	Not possible.	Used for low-velocity motion or non-stopping operation.
Reverse-Double Harmonic	Not possible.	Used to reduce the effect on the motor for load variations. Use this setting to suppress residual vibration.
NC2 Curve	Not possible.	Used for medium-velocity, high-load equipment.

Curve shape	Connection condition specification	Main applications
Polynomial 3	Possible (Connecting Velocity).	Used to specify the velocity between a block start point and block end point.
Polynomial 5	Possible (Connecting Velocity and Connecting Acceleration).	Used to specify the velocity and acceleration rate between a block start point and block end point.
Free Curve	Possible (Connecting Velocity).	Used to accelerate/decelerate smoothly. Used to specify the velocity between a block start point and block end point.

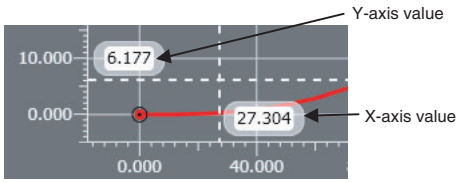
Node Point Table

Item	Description
Connecting Velocity	You can specify the velocity for a polynomial 3, polynomial 5, or free curve and the connecting section to the next curve. Use this setting for smooth connections between curves.
Connecting Acceleration	You can specify the acceleration rate for a polynomial 5 curve and the connecting section to the next curve. Use this setting for smooth connections between curves.
Phase Pitch	The phases of the cam profile curve are divided by the specified pitch to create the cam data. There must be no more than 65,535 nodes in the cam data. Division is performed when the project is built.

Additional Information

- You can use only a free curve, straight line, or constant curve before and after a free curve.
- If free curves are connected to each other, you can specify a connection condition only for the last point.

Graph View List

Icon	Description
	Shows or hides the grid on the graph.
	Shows or hides the marker at the end of the graph.
	Shows or hides the cursors and value-at-cursor display. 
	Shows or hides the maximum values for the velocity, acceleration/deceleration rate, and jerk on the graph. These values are indicated by dotted blue lines.
	Shows or hides the properties.
	Shows or hides node points.
	Shows or hides the position graph.

Icon	Description
	Shows or hides the velocity graph.
	Shows or hides the acceleration rate (deceleration rate) graph.
	Shows or hides the jerk graph.

Graph Operations

Rotate the mouse wheel to increase or decrease the scale.

- Rotate the mouse wheel in the center of the graph to zoom in or zoom out of the entire graph.
- Move your mouse over the X or Y axis and rotate the mouse wheel to increase or decrease the scale of only the X or Y axis.

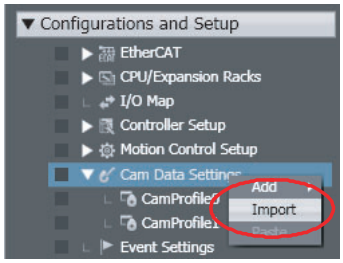
Restrictions

You can use a straight line or straight line with constant displacement only before and after a free form curve.

Importing Cam Data Settings

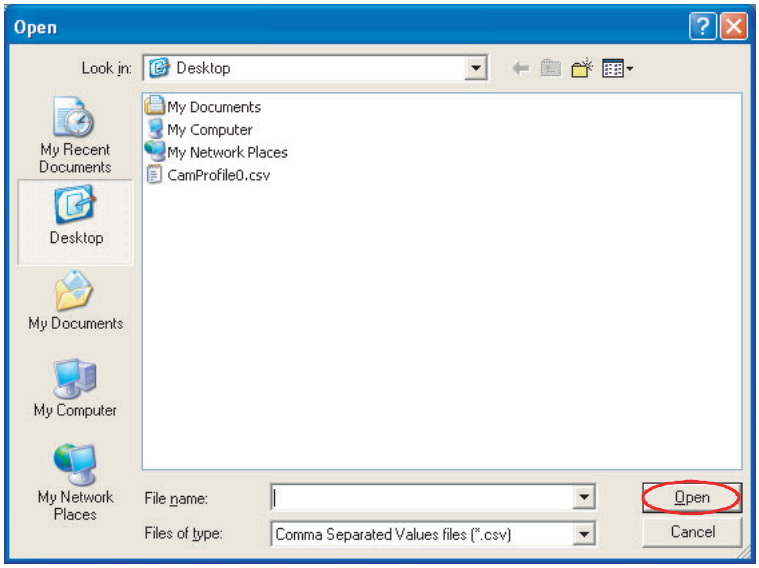
You can import cam data settings from a CSV file.

1 Right-click **Cam Data Settings** under **Configurations and Setup** in the Multiview Explorer and select ***Import*** from the menu.

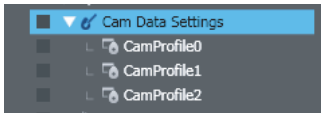


The Open Dialog Box is displayed.

2 Select the CSV file to import, and then click the **Open** Button.



The imported cam data is registered under **Cam Data Settings** with a serial number added.



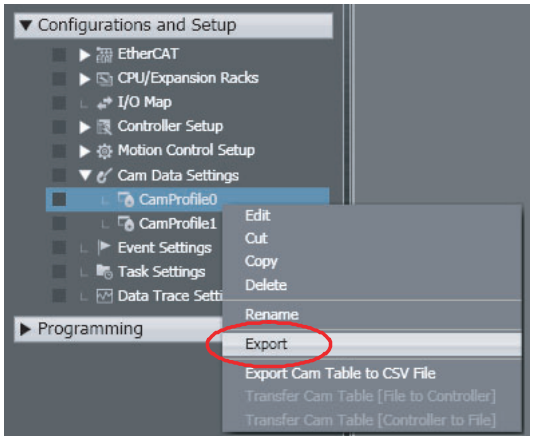
Precautions for Correct Use

To import cam data settings, use a CSV file encoded with UTF-8 character codes.

Exporting Cam Data Settings

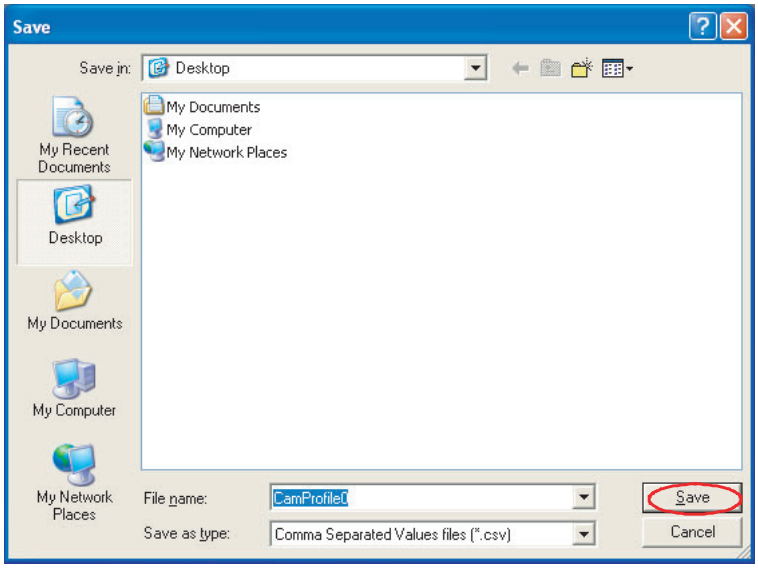
You can export cam data to a CSV file.

1 Right-click the cam data to export and select ***Export*** from the menu.



The Save Dialog Box is displayed.

2 Specify the file location and name, and then click the **Save** Button.



The cam data is saved in CSV format.

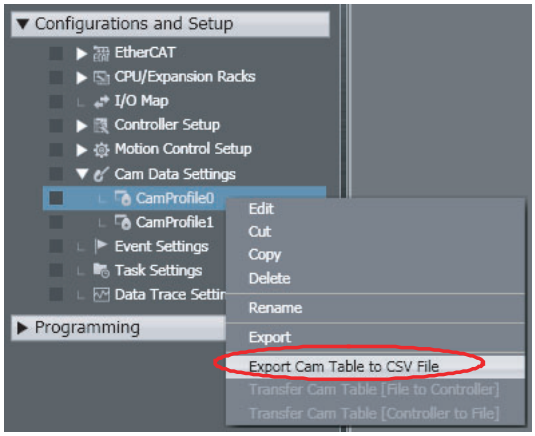
Precautions for Correct Use

The exported CSV file of cam data settings is encoded in UTF-8 character codes.

Exporting Cam Tables

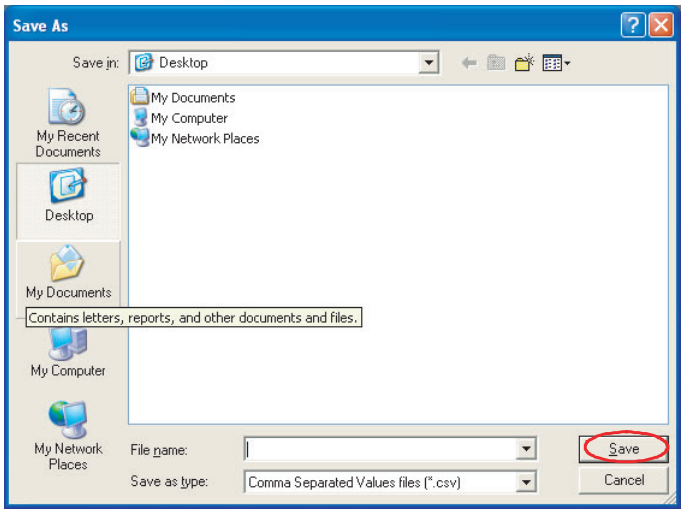
You can export cam data in the data format of the master and slave axes that is used by the Controller.

1 Right-click the cam table to export and select ***Export Cam Table to CSV File*** from the menu.



The Save Dialog Box is displayed.

2 Specify the file location and name, and then click the **Save** Button.



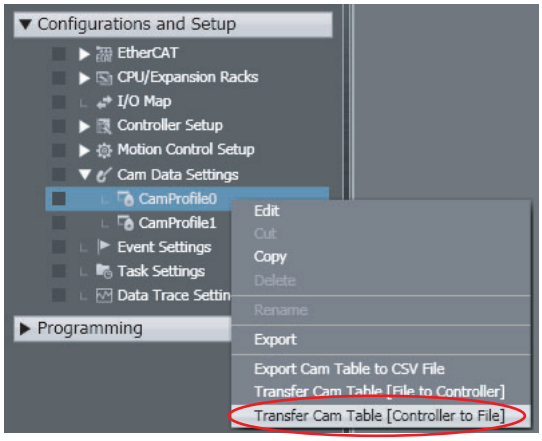
Precautions for Correct Use

To export a cam table, you must first build the project.

● Transferring Cam Data from the Controller to Files

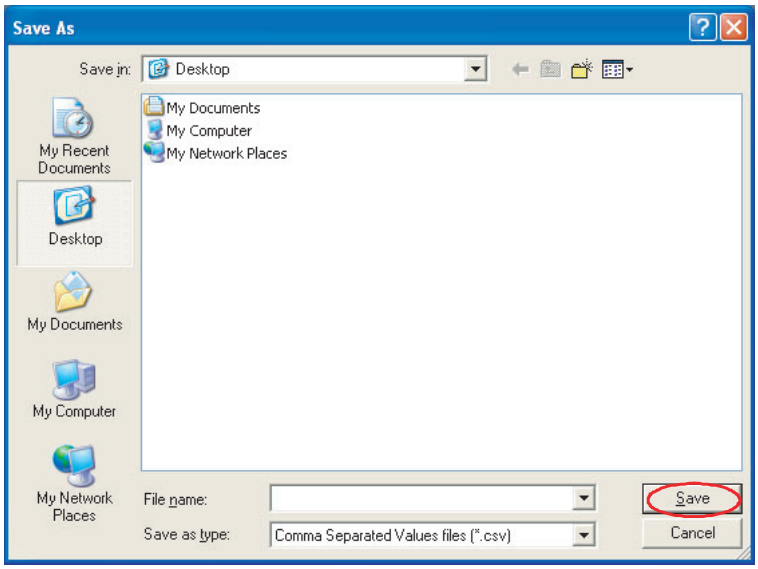
You can save a cam table in the Controller in a file in the data format of the master and slave axes.

1 Right-click the cam table to export and select ***Transfer Cam Table [Controller to File]*** from the menu.



The Save Dialog Box is displayed.

2 Specify the file location and name, and then click the **Save** Button.



The cam data is saved in a CSV format file.

● Transferring Cam Data from Files to the Controller

You can transfer the data from a cam data file in the data format of the master and slave axes to update the contents of the cam data that is already in the Controller.

1 Right-click the cam table to export and select ***Transfer Cam Table [File to Controller]*** from the menu.

The Open File Dialog Box is displayed.

2 Specify the name of the file to transfer, and then click the **OK** Button.

3 To enable the cam table that was transferred, reset the Controller or cycle the power supply to the Controller after you transfer the cam table.

Restrictions

- You must synchronize with the Controller before you can transfer a cam table from a file to the Controller. Refer to *Synchronizing* on page 6-80 for more information on synchronizing.
- The number of cam data nodes in the cam table that is transferred from a file to the Controller must be the same as the number of cam data nodes in the cam table in the Controller.
- The cam table that is transferred from a file to the Controller is not saved in the project on the Sysmac Studio.
- You cannot use the Controller synchronization function to transfer to the project on the Sysmac Studio, a cam table that was transferred from a file to the Controller. To save a cam table in the Controller to a file, select ***Transfer Cam Table [Controller to File]*** from the menu.
- If you perform verification after transferring a cam table from a file to the Controller, an inconsistency is not detected even if the contents of the cam table differs from the cam data settings.
- If you synchronize the Controller data after you transfer a cam table from a file to the Controller, you will need to transfer the cam table again.

4-2-7 Task Settings

- Task Settings
  Programs are executed in tasks in an NJ-series CPU Unit. Task settings define the execution period, the execution timing, the programs executed by the task, the I/O refreshing performed by the task, and which variables to share between tasks.

● Registering Tasks

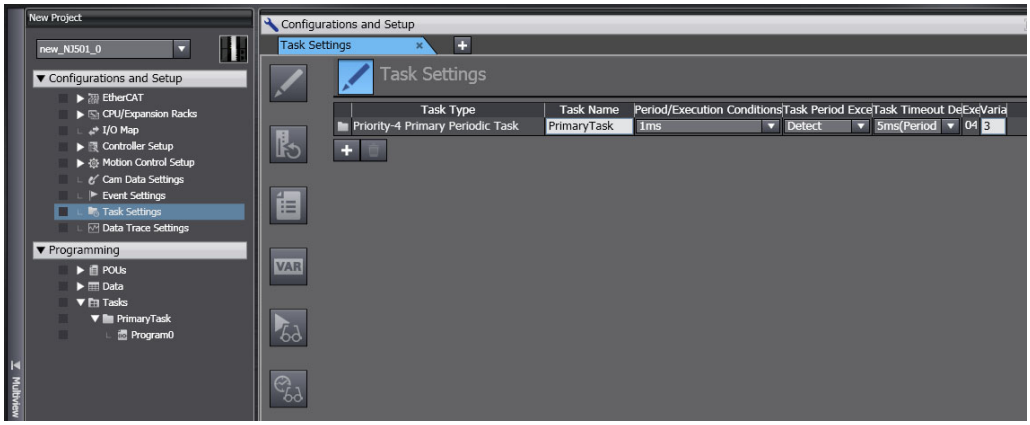
Use the following procedure to register a task to execute programs.

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

2 Click the **Task Settings** Button ( ) in the Edit Pane.

3 Click the Button to add a task and enter the task type.

The primary periodic task (execution priority 4) is registered by default and cannot be deleted. You can create one period task each with execution priorities of 16, 17, and 18.



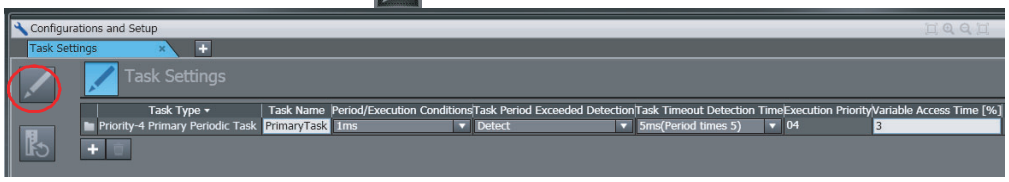
In the task design, you define the period and execution conditions, task period exceeded error detection, and timeout detection time for registered tasks.

● Procedure to Set Tasks

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

The Task Settings Tab Page is displayed in the Edit Pane.

2 If the Task Settings Display does not appear on the Task Settings Tab Page in the Edit Pane, click the Task Settings Button ( ).



3 Select the task name, period/execution conditions, task period exceeded detection, task execution timeout detection time, and variable access time [%] from the lists for the registered task.

For information on the items in the Task Settings, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

Additional Information

- Task Execution Order
  The execution order of tasks is determined by the task types (execution priorities). Tasks are not necessarily executed in the order that they are registered. Programs are executed based on which task has the highest execution priority (which is represented by the lowest number) of all tasks that meet the execution conditions. For example, even if periodic task A (which has an execution priority of 16) meets its execution condition, periodic task A is paused if primary periodic task B (which has an execution priority of 4) is currently being executed.

Task I/O Settings

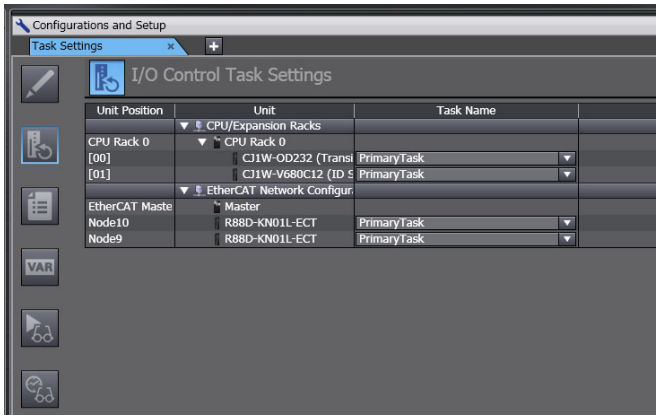
- Task I/O Settings
  The task I/O settings define what Units the task should perform I/O refreshing for.

Procedure to Set Task I/O Settings

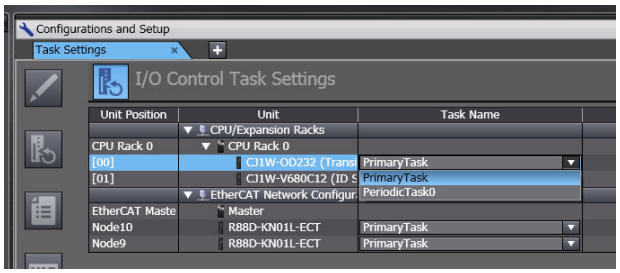
1 Double-click **Task Settings** under **Configurations and Setup** in the Multiview Explorer.

2 Click the **I/O Control Task Settings** Button ( ) on the Task Settings Tab Page in the Edit Pane.

The I/O Control Task Settings is displayed.



3 Select the task that should perform I/O refreshing for the registered Unit from the list.



Task I/O settings can be defined only for the primary periodic task (priority 4) and the priority-16 periodic task. You cannot define task I/O settings for priority-17 and priority-18 periodic tasks. Units specified in task I/O settings must already be registered under **Configurations and Setup** – **CPU/Expansion Racks** and **Configurations and Setup** – **EtherCAT**.

Program Assignments

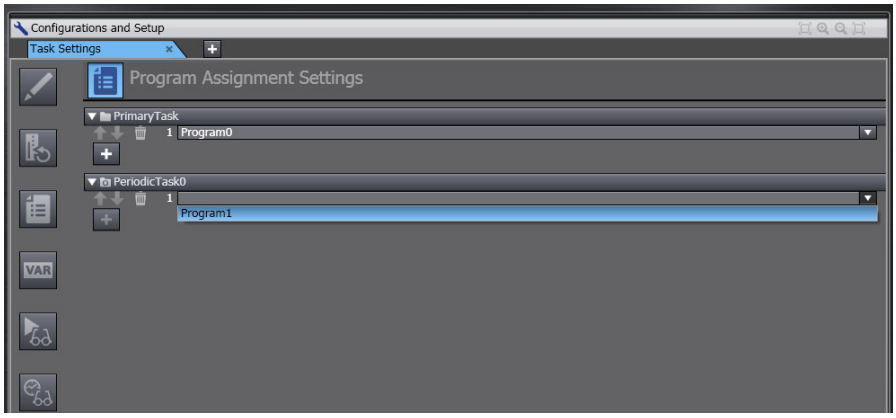
- Program Assignments
  The programs that are assigned to a task are executed in the order that they are assigned.

Procedure to Assign Programs

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

2 Click the **Program Assignment Settings** Button ( ) in Task Settings Tab Page in the Edit Pane.

3 Select the programs to assign to the task from the list.



Any program you assign must already be registered under **Programming - POUs**.

Settings for Exclusive Control of Variables in Tasks

- Settings for Control of Variables in Tasks
  You can specify a task that can write a global variable (called a refreshing task) and a task that can only read the global variable (called an accessing task) for global variables. This ensures concurrency for global variable values from all tasks that reference them.

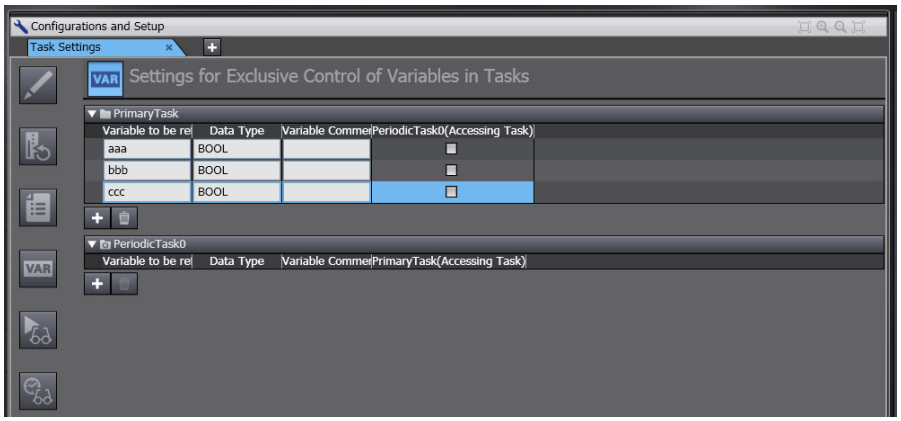
Procedure

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

2 Click the **Settings for Exclusive Control of Variable in Tasks** Button ( ) on the Task Settings Tab Page in the Edit Pane.

3 Define the variables to share between tasks.

Select the global variables to specify for a refreshing task. Then select the accessing task for the global variables.



5

Online Connections to a Controller

This section describes how to go online with a Controller.

5-1 Overview 5-2

5-2 Going Online with a Controller 5-3

5-2-1 Overview 5-3
5-2-2 Setting the Connection Method 5-4
5-2-3 Going Online 5-5
5-2-4 Going Online after Checking the Connection Method 5-6
5-2-5 Going Offline 5-6
5-2-6 Confirming Serial IDs 5-6
5-2-7 Checking for Forced Refreshing 5-7

5-1 Overview

Online Connections to a Controller

You must go online with the Controller or connect to the Simulator to communicate with them from the Sysmac Studio.

The Sysmac Studio supports the following online connections for different applications.

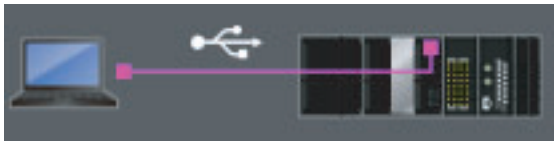
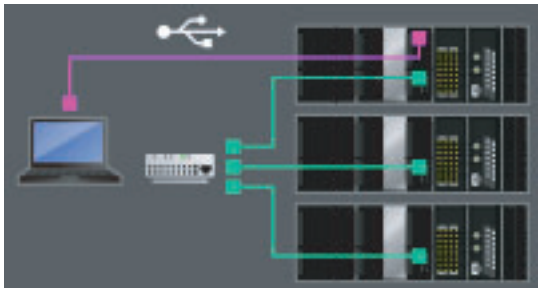
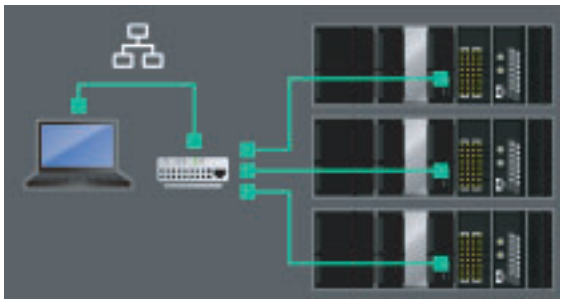
Online connection	Connection made to	Application
Online connection	Controller	To perform debugging, startup, or normal maintenance, the same project file as in the Controller is opened on the Sysmac Studio and then an online connection is made. An online connection is made based on the Communications Setup in the project file.
Simulator connection	Simulator	The Simulator is used to debug the user program offline. The Communications Setup in the project file is not used.

Note Refer to *6-3 Offline Debugging* for information on connecting to the Simulator and debugging operations.

5-2 Going Online with a Controller

5-2-1 Overview

To go online with a Controller, there are four types of hardware connections that can be used. These are described in the following table.

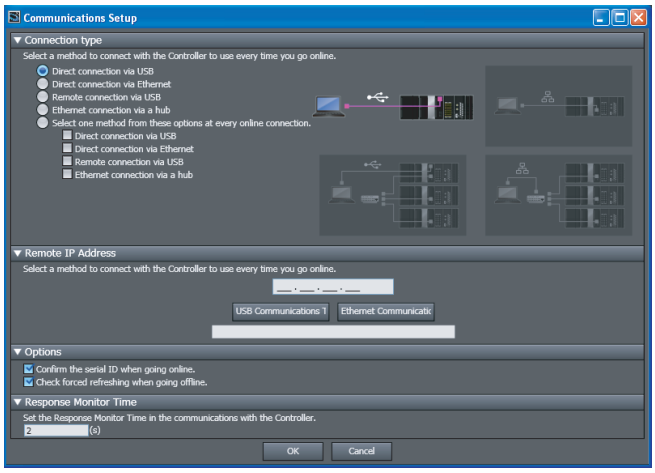
Connection method	Connection diagram	Description
Direct connection via USB		The USB port on the computer is connected directly to the peripheral USB port on the Controller. **Note** This is the default connection configuration.
Direct connection via Ethernet		The Ethernet port on the computer is connected directly to the EIP port on the Controller with a cross cable.
Remote connection via USB		The USB port on the computer is connected directly to the peripheral USB port on a Controller and then the Sysmac Studio is placed online with another Controller on the Ethernet network.
Ethernet connection via a hub		The Ethernet port on the computer is connected to a hub and then the Sysmac Studio is placed online with a Controller through the Ethernet network.

5-2-2 Setting the Connection Method

You must set the connection method, IP address to connect to, and other parameters for communications between the computer and Controller.

1 Select ***Communications Setup*** from the Controller Menu.

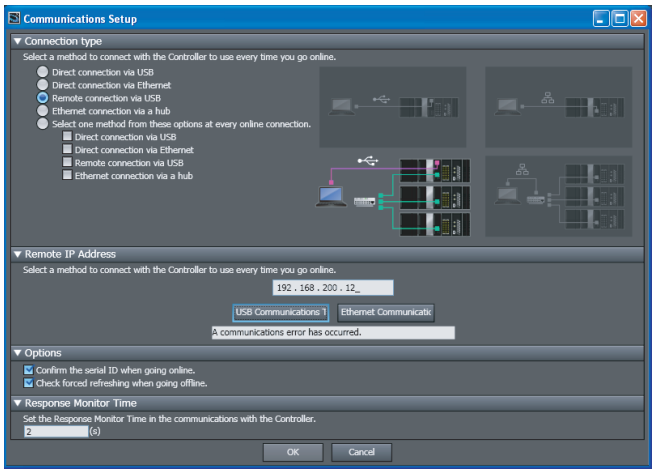
The Communications Setup Dialog Box is displayed.



2 Select the connection method in the *Connection Type* Field. For a remote USB connection or Ethernet hub connection, enter the IP address of the Controller to which you need to connect in the *Remote IP Address* Field.

Select any required options and enter the response timeout time if required.

* Refer to *Communications Setup Dialog Box Settings* on the next page for information on the settings.



3 Click the **OK** Button.

This completes the settings.

● Communications Setup Dialog Box Settings

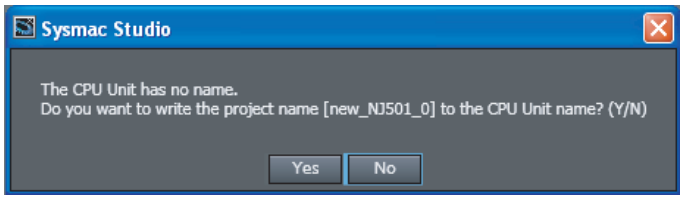
Item	Description	
Connection Type	Select the connection port to use to go online. The selected method is normally used to go online.	
Remote IP Address	If you specify a USB remote or Ethernet hub connection, set the IP address of the Controller that you normally will connect to.	
	USB Communications Test Button Ethernet Communications Test Button	These buttons perform a communications test with the Controller at the specified remote IP address. The result is displayed as follows: • Normal: *Communications test successful.* • Error: *The Controller was not found, There is more than one Controller with the specified IP address, or a communications error occurred.*
Options	*Confirm serial ID when going online.*	If you select this option, the names and serial IDs are compared between the project and the Controller when you go online to make sure that a connection is made to the intended Controller.
	Check for forced refreshing before going offline.	When this option is selected, a check is made when breaking the connection for inputs or outputs that have forced refreshing.
Response Monitor Time	You can set the response monitoring time for communications with the Controller. An error is displayed if a response is not received before this time expires. **Note** The time can be set to between 1 and 3,600 s.	

5-2-3 Going Online

Use the following procedure to place the Sysmac Studio online with the Controller.

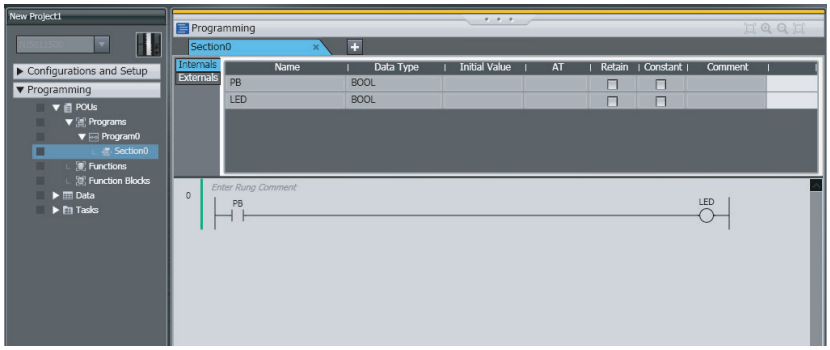
1 Select ***Online*** from the Controller Menu. Or, click the **Go Online** Button ( ) in the toolbar.

The following message is displayed the first time you go online. After you write the project name, this message is not displayed.



2 Click the **Yes** Button.

The Sysmac Studio goes online and the color of the bar at the top of the Edit Pane changes to yellow.

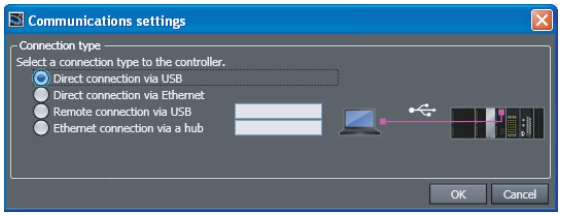


5-2-4 Going Online after Checking the Connection Method

Use the following procedure to go online if you selected the option to select the connection method whenever you connect the computer with the Controller in the Communications Setup Dialog Box.

1 Select ***Online*** from the Controller Menu. Or, click the **Go Online** Button ( ) in the toolbar.

The Communication Settings Dialog Box is displayed.



The IP address that is set in the Communications Setup Dialog Box is displayed to the right of the remote connection methods.

2 Select the connection method and then click the **OK** Button.

The Sysmac Studio goes online.

5-2-5 Going Offline

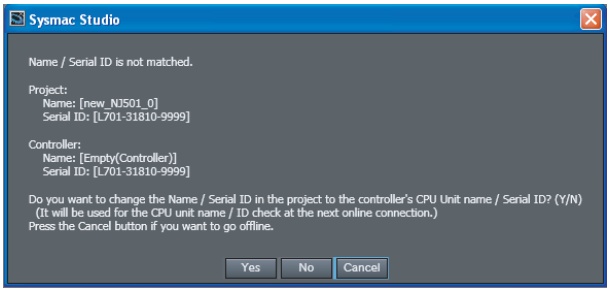
Use the following procedure to go offline.

1 Select ***Offline*** from the Controller Menu. Or, click the **Go Offline** Button ( ) in the toolbar.

The Sysmac Studio goes offline.

5-2-6 Confirming Serial IDs

The serial ID is verified when going online if the option to do so was selected in the Communications Setup Dialog Box. If the serial ID of the project on the Sysmac Studio is different from that of the Controller, the following confirmation dialog box is displayed when you attempt to go online.

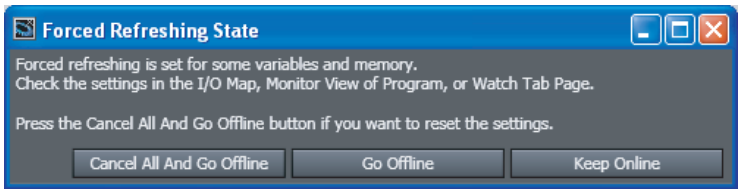


1 Click the **Yes** Button.

The serial ID of the project on the Sysmac Studio is rewritten to the same value as that of the Controller.

5-2-7 Checking for Forced Refreshing

Forced refreshing is checked when going offline if the option to do so was selected in the Communications Setup Dialog Box. If there are any variables that have been forced refreshed, the following confirmation dialog box is displayed after you go online.



1 Click the **Cancel All And Go Offline** Button.

All of the forced refreshing is released.

2 Click the **Go Offline** Button.

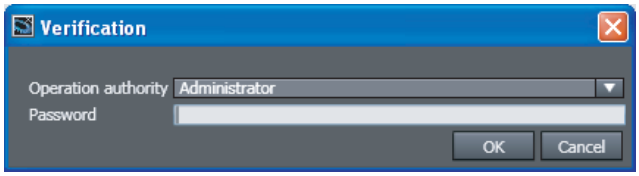
All of the forced refreshing is retained, and the Sysmac Studio goes offline.

Precautions for Correct Use

- If a direct or remote USB connection is used, an Ethernet IP address of 192.168.255.xxx is used internally. When using a USB connection, do not use an IP address of 192.168.255.xxx for the Ethernet interface card in the computer, or do not remotely connect to a Controller with an IP address of 192.168.255.xxx.
- Socket ports 9600 and 2224 are used for Ethernet UDP/IP communications. When using Ethernet UDP/IP communications, do not use these ports for any other application.
- When using a direct Ethernet connection and there is more than one Ethernet interface card mounted in the computer, you must select the Ethernet interface card to use. Refer to *A-2 Specifying One of Multiple Ethernet Interface Cards* for the selection procedure.

Additional Information

- Refer to *10-1 Error Messages for Ladder Program Checks* for corrections for errors that occur when you go online.
- If operation authority is set in the Controller, a Verification Dialog Box is displayed when you go online. Refer to *7-3-1 Operation Authority Verification* for details.



6

Debugging

This section describes how to debug the programs online on the Controller or debug it offline with the Simulator.

6-1 Debugging Operations on the Simulator and Controller 6-2

6-2 Operations Used for Both Online and Offline Debugging 6-4

6-2-1 Monitoring 6-4
6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing 6-14
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6-1 Debugging Operations on the Simulator and Controller

The operations that can be used to debug the programs on the Sysmac Studio are listed below. Debugging can be performed online on the Controller or offline with the Simulator.

Operations for Debugging	Controller	Simulator	Reference
Monitoring	Supported.	Supported.	*6-2-1 Monitoring*
Monitoring in a Watch Tab Page	Supported.	Supported.	*6-2-1 Monitoring*
Monitoring in the I/O Map	Supported.	Supported.	*6-2-1 Monitoring*
Controlling BOOL variables	Supported.	Supported.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Forced Refreshing (TRUE/FALSE/Cancel)	Supported.	Supported.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Changing present values of data	Supported.	Supported.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Changing the set values of timers/counters	Supported.	Supported.	*6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing*
Memory All Clear operation	Supported.	Not supported.	*7-6 Clearing Memory*
Cross-reference pop-ups	Supported.	Supported.	*6-2-3 Cross References*
Online editing	Supported.	Supported.	*6-2-4 Online Editing*
Monitoring Controller information	Supported.	Not supported.	*6-2-5 Monitoring Controller Status*
Monitoring task execution status	Supported.	Supported.	*6-2-6 Task Execution Status Monitor*
Monitoring axis status	Supported.	Supported.	*6-2-8 Axis Status Monitor (MC Monitor Table)*
Changing the operating mode	Supported.	Not supported.	*6-4-2 Performing Online Debugging*
Resetting the Controller	Supported.	Not supported.	*6-4-2 Performing Online Debugging*
Data tracing	Supported.	Supported.	*6-2-9 Data Tracing*
Setting triggers	Supported.	Supported.	*6-2-9 Data Tracing*
Setting variables to sample	Supported.	Supported.	*6-2-9 Data Tracing*

Operations for Debugging	Controller	Simulator	Reference
Starting and stopping tracing	Supported.	Supported.	*6-2-9 Data Tracing*
Displaying trace results	Supported.	Supported.	*6-2-9 Data Tracing*
Saving trace results	Supported.	Supported.	*6-2-9 Data Tracing*
Setting the virtual composition	Supported.	Supported.	*6-2-9 Data Tracing*
Displaying timing charts	Supported.	Supported.	*6-2-9 Data Tracing*
Displaying 3D axis paths	Supported.	Supported.	*6-2-9 Data Tracing*
Monitoring task execution times	Supported.	Supported.	*6-2-7 Task Execution Time Monitor*
Estimating execution processing times	Not supported.	Supported.	*6-3-1 Debugging with Program Simulation*
Debugging with program simulations	Not supported.	Supported.	*6-3-1 Debugging with Program Simulation*
Setting what to simulate	Not supported.	Supported.	*6-3-1 Debugging with Program Simulation*
Changing the simulation speed	Not supported.	Supported.	*6-3-1 Debugging with Program Simulation*
Setting breakpoints	Not supported.	Supported.	*6-3-1 Debugging with Program Simulation*
Step execution	Not supported.	Supported.	*6-3-1 Debugging with Program Simulation*
Troubleshooting	Supported.	Not supported.	*7-11 Troubleshooting*
Monitoring error information	Supported.	Supported.	*7-11 Troubleshooting*
Displaying error logs	Supported.	Supported.	*7-11 Troubleshooting*
Event Setting Table	Supported.	Supported.	*7-11 Troubleshooting*
User Memory Usage Monitor	Supported.	Supported.	*7-4 User Memory Usage Monitor*
Clock Information Settings	Supported.	Not supported.	*7-2 Clock Information Settings*
Releasing access rights	Supported.	Not supported.	*7-7 Releasing Access Rights*

Note For the functional differences between the Controller and Simulator, refer to *A-3 Differences between the Simulator and the Physical Controller*.

6-2 Operations Used for Both Online and Offline Debugging

6-2-1 Monitoring

● Overview

You can monitor the TRUE/FALSE status of program inputs and outputs and the present values of variables in the Controller. You can monitor operation on the Ladder Editor, ST Editor, Watch Tab Page, or I/O Map.

Monitoring on the Ladder Editor

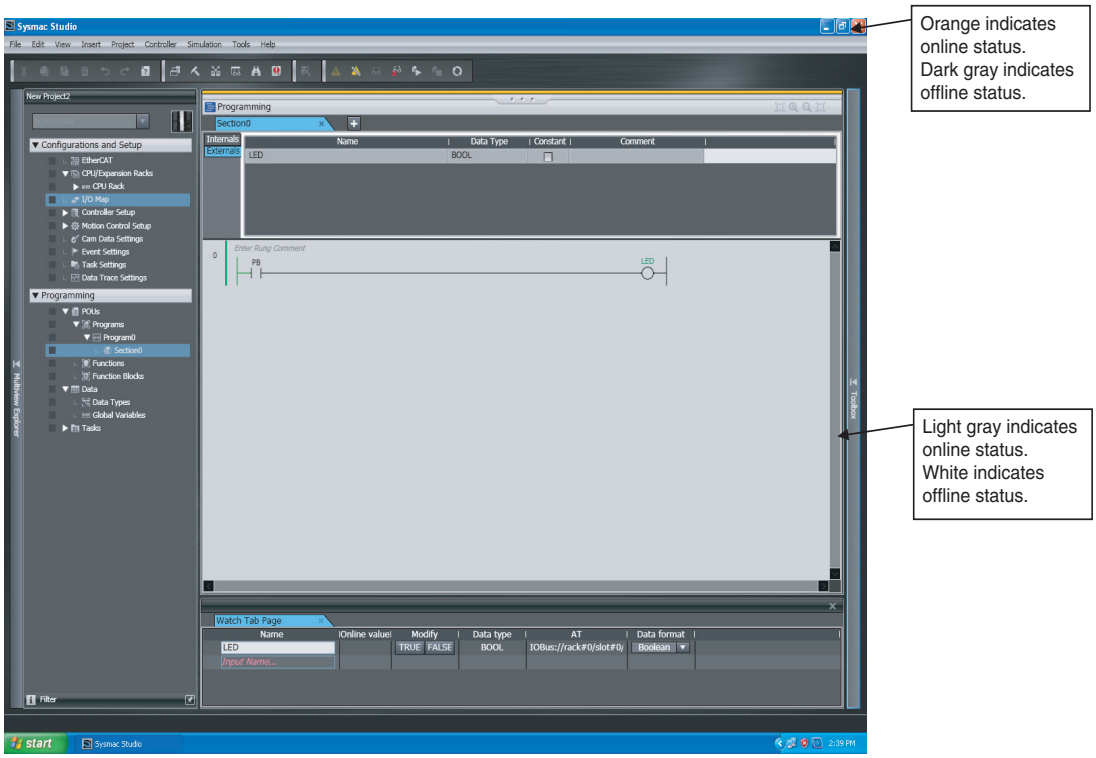
● Monitoring on the Ladder Editor

You can check the execution status of a ladder diagram on the Ladder Editor.

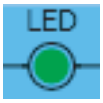
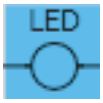
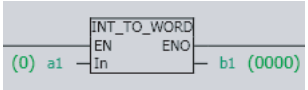
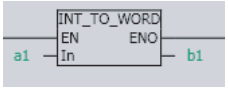
● Procedure to Monitor on the Ladder Editor

1 Double-click the ladder program or ladder function block under **Programming** in the Multiview Explorer.

The rungs are displayed on the Ladder Editor in monitor status.



The monitor displays are described in the following table.

Circuit part	TRUE or being executed	FALSE or not being executed
Program input		
Program output		
Functions and function blocks (See note 1.)	 (See note 2.)	
Connecting lines		

Note 1 Program inputs, program outputs, and connecting lines on the right side of functions remain gray even online.

2 The present values are displayed in parentheses in decimal to the left of input variables and to the right of output variables. The present values are displayed in parentheses in decimal to the left and right of in-out variables.

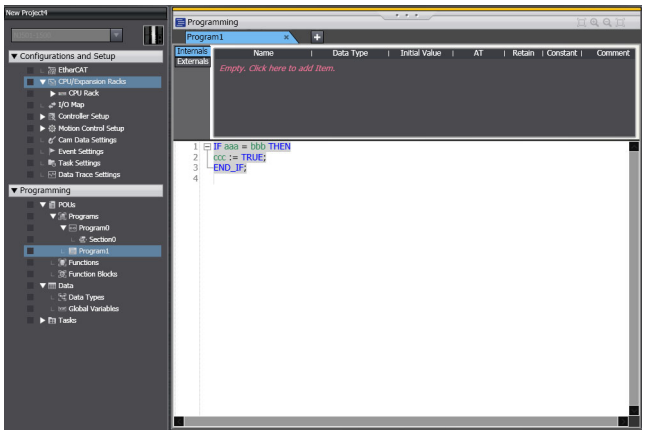
Monitoring on the ST Editor

● Monitoring on the ST Editor

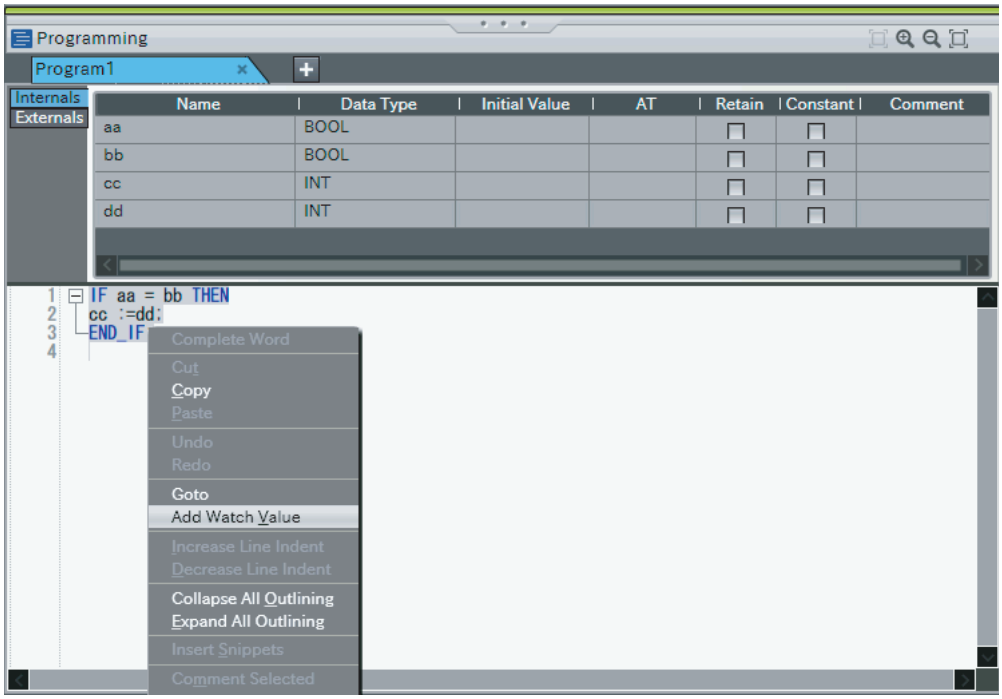
You can confirm the present values of variables in standard text in the ST Editor. Use the following procedure to monitor present values.

1 Double-click the ST program or ST function block under **Programming** in the Multiview Explorer.

The ST Editor is displayed.



2 Right-click the variable for which to monitor the present value and select ***Add Watch Value*** from the menu.



The present value is display in a Watch Tab Page.

Monitoring in a Watch Tab Page

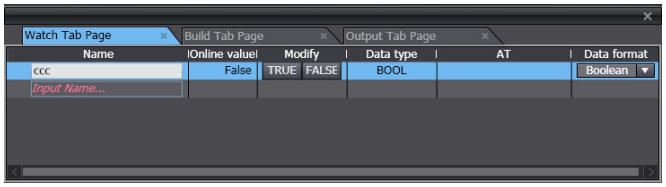
Monitoring in a Watch Pane

You can check the present value of one or more variables in the Watch Tab Page.

Displaying a Watch Tab Page

1 Select ***Watch Tab Page*** from the View Menu.

A Watch Tab Page is displayed.



Contents of the Watch Tab Page

Item	Meaning	Editing	Remarks
Name	The variable name is displayed.	Supported.	
Online value	The present value in the Controller is displayed in Monitor Mode.	---	
Modify	The new value is displayed.	Supported.	
Data type	The data type is displayed.	---	Refer to page 6-8 for the data types that you can register.
AT	The address of an AT specification in memory for CJ-series Units or an I/O port is displayed.	---	
Data format	The display format (decimal, hexadecimal, etc.) of the present value and modify value is displayed.	Supported.	Refer to page 6-9 for the data formats that you can select.

Registering Variables in the Watch Tab Page

There are two ways to register variables.

Method (1) Enter the variable name in the name cell in the Watch Tab Page.

Method (2) Drag the variable to the Watch Tab Page from an editor or variable table.

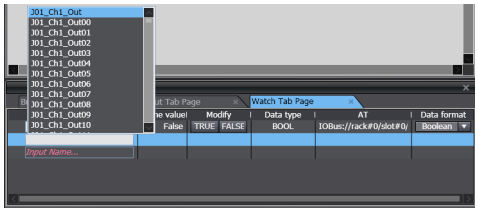
Method (1) Entering the Variable Name in the Name Cell in the Watch Tab Page

1 Click the cell that says *Input Name* at the bottom of the Watch Tab Page.

2 Enter the variable name to display the present value.

3 As you enter characters, a list of candidate variable names is displayed. Select the variable name from the list.

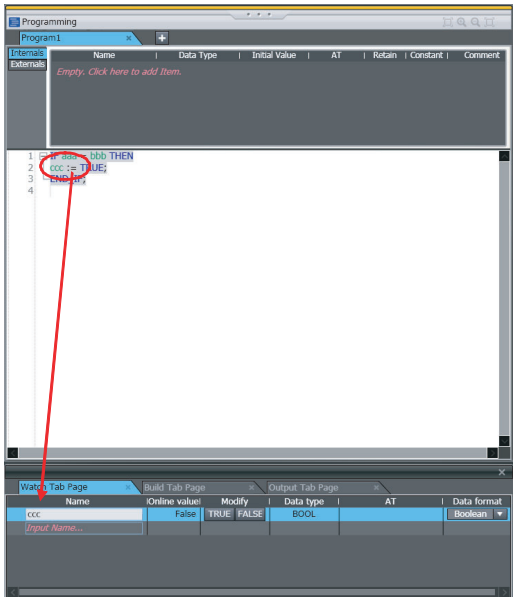
The variable name is registered.



Method (2) Dragging Variables to the Watch Tab Page from an Editor or Variable Table

The procedure to register variables from the ST Editor is given below. Go offline to perform this procedure.

1 Select the required variable in the ST Editor and drag it to the cell that says *Input Name* at the bottom of the Watch Tab Page.



The variable name is registered.

Dragging Variables to the Watch Tab Page

Source	Item	Operation
Ladder Editor	Program input or output	The variable name that is assigned to the input or output is registered.
	Function or function block	The function block instance variable and the input, output, and in-out variables that are assigned in the function or function block are registered.
ST Editor	Variable name	The specified variable name is registered.
Global variable table or local variable table	Variable or function block instance name in the variable table	The specified variable name or function block instance name is registered.

Format to Register Variables

The formats that you use to enter variable names are given below.

(1) Formats for Global and Local Variables

Variable	Format to enter	Example
Global variables	Variable name	Start_SW1
Local variable for *program*	*Program_name.variable_name*	Program1.Start_SW1

(2) Formats for Different Data Types

Variable data type	Format to enter	Display
Basic data types	Variable name	The specified variable is displayed.
Arrays	*array_variable_name*	If an array variable name is registered, the array elements are compressed on the display.
	array_variable_name[number]	The specified element is displayed.
	array_variable_name[number..number] (range specification)	The elements in the specified range are compressed on the display.
Structures	*structure_variable_name*	The structure members are compressed on the display.
	structure_variable_name.member_name	The specified member is displayed.
Unions	*union_variable_name*	The unit members are compressed on the display.
	union_variable_name.member_name	The specified member is displayed.
POU instance of function or function block	*POU_instance_variable_name*	The variables in the POU are compressed on the display.
	POU_instance_variable_name.variable_name_in_POU	The specified variable is displayed.
Enumerations	*variable_name*	The specified variable is displayed.

● Changing the Display Format of a Present Value in the Watch Tab Page

If the Sysmac Studio is online with a Controller in Monitor Mode, the present value of a variable is displayed when the variable name is registered. You can use the *Data Format* Column to change the display format of the present value. The data formats that can be selected depend on the data type.

Data Formats and Display Formats

Data format	Display format
Boolean	TRUE or FALSE
Binary	Groups of four digits are displayed. The groups are separated by single-byte spaces.
Decimal	For signed decimal, “+x_xxx_xxx” is displayed. (“x_xxx_xxx” is the present value. If the value is negative, “-” is displayed instead of “+”.) For unsigned decimal, “x_xxx_xxx” is displayed. (“x_xxx_xxx” is the present value. There is no sign.)
Hexadecimal	The value is displayed in hexadecimal.
Real (floating-point)	Zero: 0.0 Subnormal Number: The conversion results based on display specifications for normalized numbers is displayed. Normalized Number: (sign) decimal_mantissa e decimal_exponent (with no spaces) (The mantissa is 17 digits for a LREAL number and 9 digits for a REAL number.) Example: +1.2345678901234567e-17 Infinity: The conversion results based on display specifications for normalized numbers is displayed.
String	The text string for the UTF-8 text is displayed.
Duration	(- negative value) *xxx* d *yy* h *zz* m *uu* s *vvv.vvvv* ms (with no spaces) *xxx* is the number of days, *yy* is the number of hours, *zz* is the number of minutes, *uu* is the number of seconds, and *vvv.vvv* is the number of milliseconds. Leading zeros are not displayed. If a number for one of the units is 0, 0 is displayed with the unit. However, if there are no numbers on the left of a 0 number that are not 0, then 0 and the unit are not displayed. Example for 5 minutes, 0 seconds, and 23 milliseconds 5m0s23ms
Date	yyyy-mm-dd Leading zeros are displayed. Example for August 17, 2010 2010-08-17-13:00:05.00
Time of day	hh:nn:ss:ss Leading zeros are displayed.
Date and time	yyyy-mm-dd-hh:nn:ss:ss Leading zeros are displayed.

Data Types and Supported Data Formats

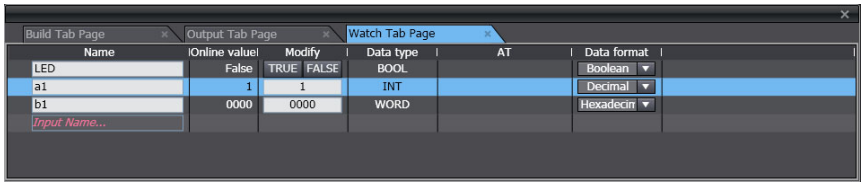
Data type	Data format (The default formats are set in bold text.)
BOOL	**Boolean** or Binary
SINT	**Decimal**, Hexadecimal, or Binary
USINT	**Decimal**, Hexadecimal, or Binary
INT	**Decimal**, Hexadecimal, or Binary
UINT	**Decimal**, Hexadecimal, or Binary
DINT	**Decimal**, Hexadecimal, or Binary
UDINT	**Decimal**, Hexadecimal, or Binary
LINT	**Decimal**, Hexadecimal, or Binary
ULINT	**Decimal**, Hexadecimal, or Binary
BYTE	**Hexadecimal,** Decimal, or Binary

Data type	Data format (The default formats are set in bold text.)
WORD	**Hexadecimal**, Decimal, or Binary
DWORD	**Hexadecimal**, Decimal, or Binary
LWORD	**Hexadecimal**, Decimal, or Binary
REAL	**Real**, Octal, or Hexadecimal
LREAL	**Real**, Octal, or Hexadecimal
TIME	**Time**
DATE	**Date**
TIME_OF_DATE	**Time of date**
DATE_AND_TIME	**Date of time**
STRUCT	Depends on the data type of the members.
UNION	Depends on the data type of the members.
STRING	**String**
ENUM	**Decimal**

Changing the Display Format

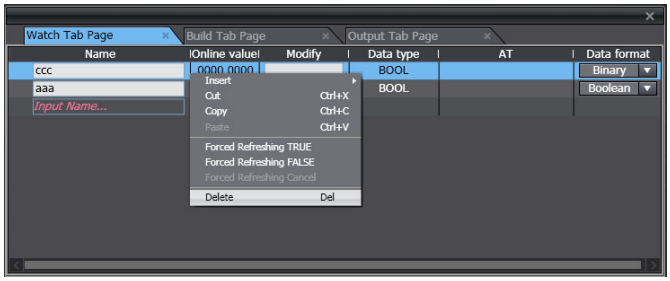
1 Select the display format from the *Data Format* Column on the Watch Tab Page.

The present value changes to the specified data format.

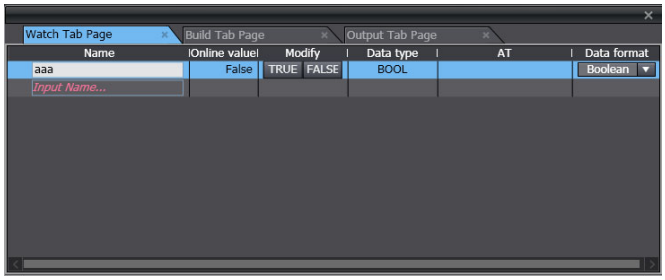


● Deleting Variable Names from the Watch Tab Page

1 Right-click the variable name to delete in the Watch Tab Page and select ***Delete*** from the menu Or, press the **Backspace** Key to delete the variable name directly.



The variable name and the row it was displayed on are deleted.

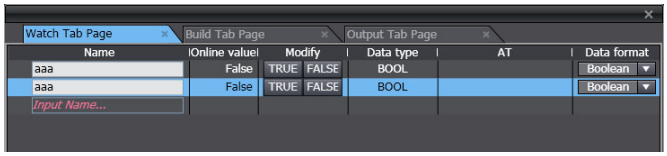


● Copying and Pasting Variable Names from the Watch Tab Page

1 Right-click the variable name to copy on the Watch Tab Page and select ***Copy*** (or press the **Ctrl + C** Keys).

2 Right-click the row at which to paste the variable on a Watch Tab Page and select ***Paste*** from the menu (or press the **Ctrl + V** Keys).

The copied variable name is registered.



Additional Information

You can copy variable names from a Watch Tab Page and paste them into a spreadsheet (e.g., Excel).

Monitoring in the I/O Map

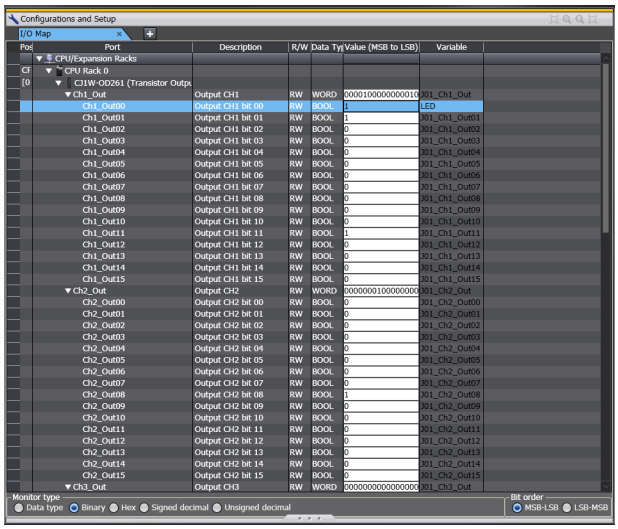
Monitoring in the I/O Map

You can monitor the present values of Unit I/O ports in the I/O Map when the Sysmac Studio is online with a Controller.

Monitor Displays in the I/O Map

1 Double-click **I/O Map** under **Configurations and Setup** on the Multiview Explorer. The I/O Map is displayed.

The present values of the registered Unit I/O ports are displayed in the *Variable* Column.



The data types that are given in the following table can be monitored in the I/O Map.

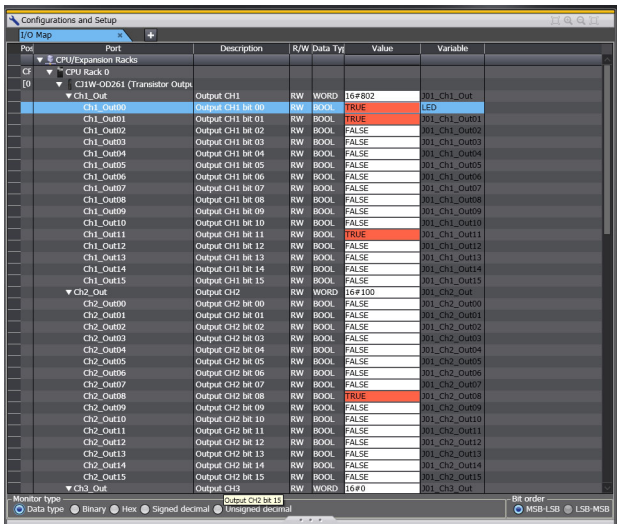
- Data Types and Present Value Displays in the I/O Map

Data type	Number of bytes	Range
BOOL	2	0 or 1
BYTE	1	16#0 to FF
WORD	2	16#0000 to FFFF
DWORD	4	16#00000000 to FFFFFFFF
LWORD	8	16#0000000000000000 to FFFFFFFFFFFFFFFF
SINT	1	-128 to +127
INT	2	-32768 to +32767
DINT	4	-2147483648 to +2147483647
LINT	8	-9223372036854775808 to +9223372036854775807
USINT	1	0 to +255
UINT	2	0 to +65535
UDINT	4	0 to +4294967295
ULINT	8	0 to +18446744073709551615
REAL	4	-3.40282347e+38 to 3.40282347e+38
LREAL	8	-1.7976931348623157e+308 to 1.7976931348623157e+308

Changing the Display Format in the I/O Map

1 Select the display format from the *Monitor Type* Area in the I/O Map.

The present value in the *Value* Column changes to the specified display format.



The display formats that you can select for each data type are given in the following table.

Display format	Description	Remarks
Data type	The present value is displayed in the format for the data type.	
Binary	The present value is displayed in binary.	The bit order can also be specified (MSB-LSB or LSM-MSB). (The default bit order is MSB-LSB.)
Hexadecimal	The present value is displayed in hexadecimal.	
Signed decimal	The present value is displayed in signed decimal.	
Unsigned decimal	The present value is displayed in unsigned decimal.	

Additional Information

- Structures and arrays cannot be monitored.
- REAL and LREAL data are displayed in the REAL and LREAL data formats even if the monitor type is changed.

6-2-2 Changing Present Values and Set/Reset Using Forced Refreshing

Changing Present Values and Set/Reset Using Forced Refreshing

You can change the values of variables that are used in the user program and settings to any desired value, and you can use the Set/Reset command to change program inputs and outputs to TRUE or FALSE. This allows you to check the operation of the user program and settings.

Caution

Always confirm the safety at the destination node before you transfer a user program to a node or perform an operation that changes device variables. Not doing so may result in injury.

Sufficiently confirm safety before you change the values of variables on a Watch Tab Page when the Sysmac Studio is online with the CPU Unit. Incorrect operation may cause the devices that are connected to Output Units to operate regardless of the operating mode of the Controller.

Sufficiently confirm safety before you change the values of I/O ports or variables on the I/O Map when the Sysmac Studio is online with the CPU Unit. Incorrect operation may cause the devices that are connected to Output Units to operate regardless of the operating mode of the Controller.

Precautions for Safe Use

Always confirm the safety of the system before you perform forced refreshing.

Controlling BOOL Variables

Controlling BOOL Variables

You can change the value of any BOOL variable to TRUE or FALSE. The specified value is then overwritten by the execution results of the user program. If the operating mode is changed or the power supply is cycled, the initial value is restored. You can control BOOL variables in the Ladder Editor, Watch Tab Page, or I/O Map.

Additional Information

Go online and select ***Monitor*** from the Controller Menu to enter monitor status before you perform the following procedure.

Controlling BOOL Variables in the Ladder Editor (Set/Reset)

You can use the ***Set*** and ***Reset*** menu commands to change program inputs and outputs in the Ladder Editor to TRUE or FALSE.

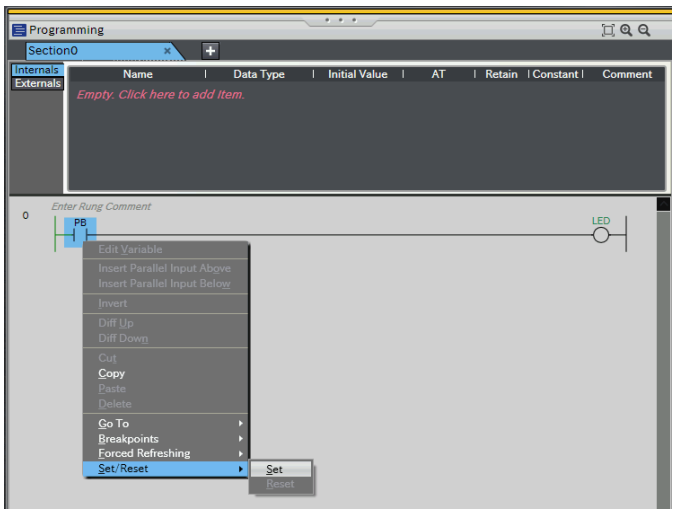
Procedure

1. Double-click the ladder program, ladder function, or ladder function block under **Programming** in the Multiview Explorer.

   The rungs are displayed on the Ladder Editor in monitor status.

2. Right-click the input or output and select ***Set/Reset*** – ***Set*** to change the input or output to TRUE. Or, right-click the input or output and select ***Set/Reset*** – ***Reset*** to change the input or output to FALSE.

   The input or output in the Ladder Editor changes to TRUE or FALSE and the execution condition changes accordingly.



Controlling BOOL Variables in the Watch Tab Page (Set/Reset)

You can change the status of BOOL variables that are registered in a Watch Tab Page to TRUE or FALSE. The monitor values in the Watch Tab Page change to TRUE or FALSE.

Procedure

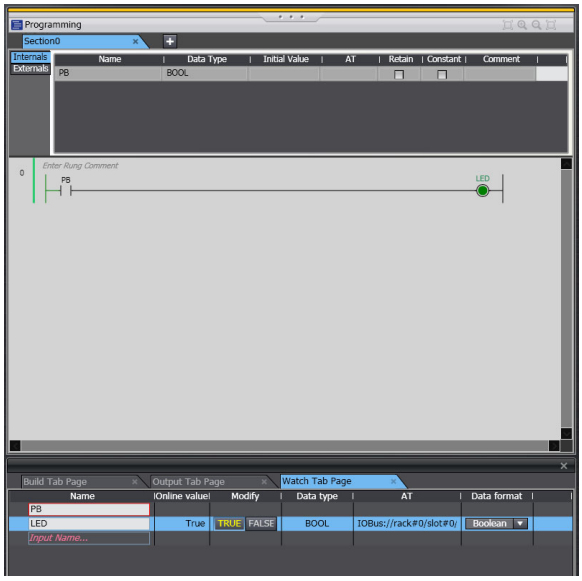
1 Select ***Watch Tab Page*** from the View Menu to display a Watch Tab Page.

The rungs are displayed on the Ladder Editor in monitor status.

2 Select a BOOL variable in the Watch Tab Page.

3 Select TRUE in the *Modify* Column to change the variable to TRUE. Select FALSE in the *Modify* Column to change the variable to FALSE.

Click the **FALSE** Button and press the **Enter** Key to change the variable to TRUE. The value in the *Online value* Column changes to TRUE or FALSE.



Additional Information

If the status of a BOOL variable that is used in a ladder diagram is changed, the execution status in the Ladder Editor changes accordingly.

● Controlling Boolean I/O Ports in the I/O Map

Controlling Boolean I/O Ports in the I/O Map

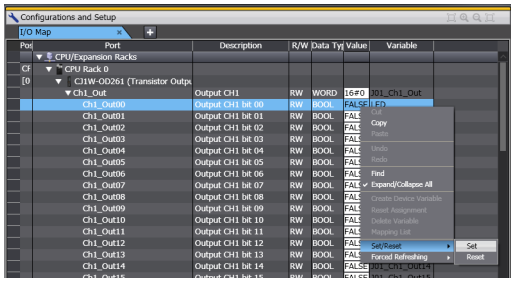
You can change the status of the BOOL I/O ports in the I/O Map.

Procedure

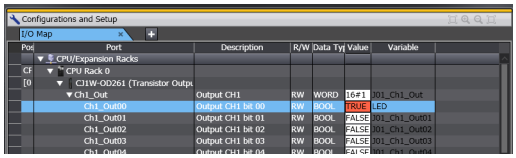
1 Double-click **I/O Map** under **Configurations and Setup** on the Multiview Explorer. The I/O Map is displayed.

2 Select the BOOL I/O port in the I/O Map.

3 Enter TRUE in the *Value* Column to change the variable to TRUE. Enter FALSE in the *Value* Column to change the variable to FALSE.



The status of the BOOL device variable changes to TRUE or FALSE and the value in the *Value* Column in the I/O Map changes to TRUE or FALSE.



Changing the Present Values of Variables

● Changing the Present Values of Variables

You can change the present values of user-defined variables, system-defined variables, and device variables as required. You can do this in the Watch Tab Page or I/O Map.

● Changing Present Values on a Watch Tab Page

Changing Present Values on a Watch Tab Page

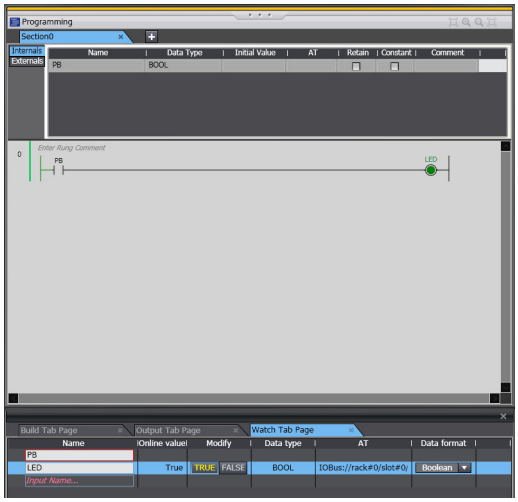
You can change the present value of variables that are registered in a Watch Tab Page.

Procedure

1 Select ***Watch Tab Page*** from the View Menu to display a Watch Tab Page.

2 Move the cursor to the cell in the *Modify* Column on the Watch Tab Page, enter a value that is compatible with the format that is given in the *Data format* Column, and then press **Enter** Key. Press the **Esc** Key to cancel entering a value.

The present value is changed.



The format for entering a value in the *Modify* Column depends on the data type that is given in the *Data Type* Column.
Refer to *Changing the Display Format of a Present Value in the Watch Tab Page* on page 6-8 for details. Press the **Esc** Key to cancel entering a value.

- Examples of Entries in the *Modify* Column:

Data format	Example
Boolean	TRUE or FALSE
Decimal	10, -100
Real (floating-point)	123.4 1.234e2, 1.234E2, -1.23e-3
Hexadecimal	1001, FFFF8000
Binary	11110000
String	abc, ABC

Additional Information

If you enter an illegal value in the *Modify* Column, an error is detected and the cell is highlighted in red.

● Changing Present Values in the I/O Map

Changing Present Values in the I/O Map

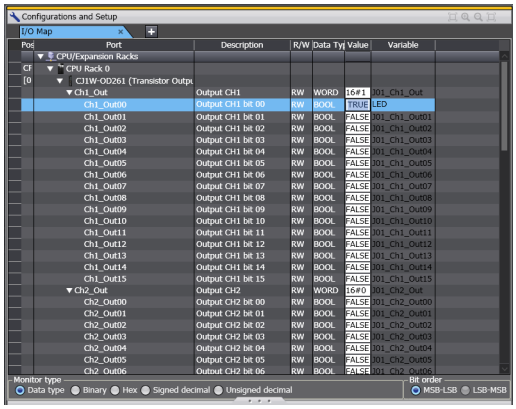
You can change the present value of I/O ports in the I/O Map.

Procedure

1 Double-click **I/O Map** under **Configurations and Setup** on the Multiview Explorer. The I/O Map is displayed.

2 Select the I/O ports in the I/O Map.

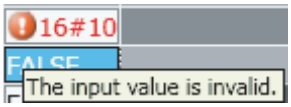
3 Enter a value in the *Variable* Column. The present value is changed.



Refer to *Monitoring in the I/O Map* on page 6-12 for the formats to enter.

Additional Information

If the value is entered in the wrong format, an error occurs. The illegal values are highlighted in red and an error icon is displayed. Place the mouse over the error icon to view the error details.



Changing the Set Values of Timers/Counters

● Changing the Set Values of Timers/Counters

You can change the set values of Timer Instructions and Counter Instructions. You can do this on a Watch Tab Page. You can also change them during online editing. Refer to *6-2-4 Online Editing* for information on online editing.

Caution

Always confirm the safety at the destination node before you transfer a user program to a node or perform an operation that changes device variables. Not doing so may result in injury.

Sufficiently confirm safety before you use a Watch Tab Page online. Incorrect operation may cause the devices that are connected to Output Units to operate regardless of the operating mode of the Controller.

Sufficiently confirm safety before you use the I/O Map online. Incorrect operation may cause the devices that are connected to Output Units to operate regardless of the operating mode of the Controller.

Precautions for Safe Use

- Always confirm the safety of the system before you change a present value.
- Always confirm the safety of the system before you change a set value.

● Changing the Set Values of Timers/Counters on a Watch Tab Page

Changing the Set Values of Timers/Counters on a Watch Tab Page

You can change the set time of a Timer Instruction registered to the Watch Tab Page or the present value of a variable assigned to the preset value of a Counter Instruction that is registered to the Watch Tab Page.

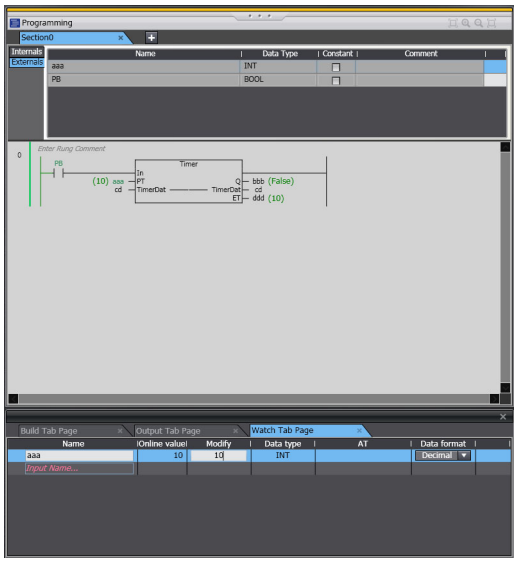
Procedure

The following example is for a Timer instruction.

1 Select ***Watch Tab Page*** from the View Menu to display a Watch Tab Page.

2 Click the *Modify* Column for the variable that is assigned to the *PT* variable (set time) of the Timer instruction on the Watch Tab Page, enter a value compatible with the data type that is given in the *Data Type* Column, and then press the **Enter** Key.

The set value of the Timer instruction is changed.



Additional Information

If you enter an illegal value in the *Modify* Column, an error is detected and the cell is highlighted in red.

Forced Refreshing

Forced Refreshing

Forced refreshing allows the user to refresh external inputs and outputs with user-specified values from the Sysmac Studio to debug the system. Forced refreshing is executed not for the specified device variables, but for the I/O ports that are assigned to the device variables. The state that is specified with forced refreshing is retained until forced refreshing is cleared from the Sysmac Studio. (Refer to descriptions of forced refreshing and canceling later in this manual for information how forced refreshing is retained or canceled according to changes in CPU Unit status. All forced refreshing is cancelled when a fatal error occurs, when a Clear All Memory operation is performed, when the operating mode is changed, when power is interrupted, or when the project is downloaded.

Caution

Sufficiently confirm safety at the connected slave or Unit before you change the value of an I/O port or device variable. Not doing so may result in injury.

Precautions for Safe Use

- Confirm that no adverse effect will occur in the system before you use forced refreshing.
- Forced refreshing ignores the results of user program execution and refreshes I/O with the specified values. If forced refreshing is used for program inputs for which it is not supported, the program inputs will first take the specified values, but they will then be overwritten by the user program.
- Discrepancies in the forced status may cause unexpected operation of the controlled system.

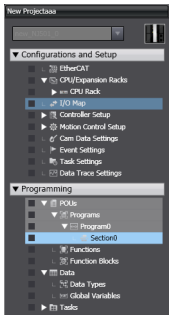
Forced Refreshing and Canceling Forced Refreshing in the Ladder Editor

Forced Refreshing and Canceling Forced Refreshing in the Ladder Editor

Forced refreshing forces a program input or output to TRUE or FALSE in the Ladder Editor. Canceling forced refreshing removes the forced TRUE/FALSE values of the inputs and outputs.

Procedure for Forced Refreshing in the Ladder Editor

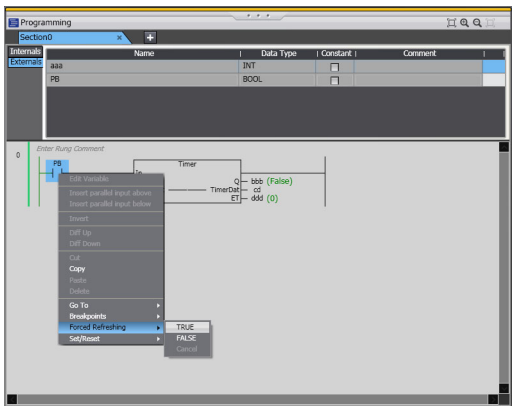
1 Double-click the ladder program or ladder function block under **Programming** in the Multiview Explorer.



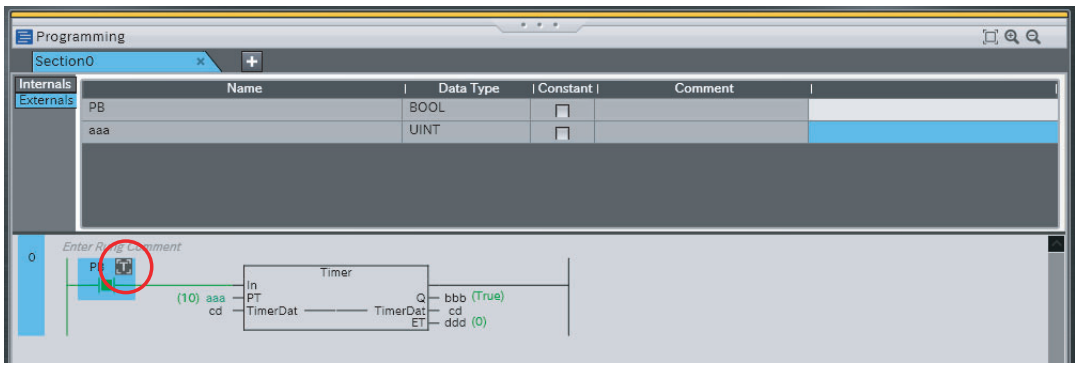
The rungs are displayed on the Ladder Editor.

2 Right-click the program input or output and select ***Forced Refreshing - TRUE***. The input or output is forced to TRUE.

Right-click the program input or output and select ***Forced Refreshing - FALSE***. The input or output is forced to FALSE.

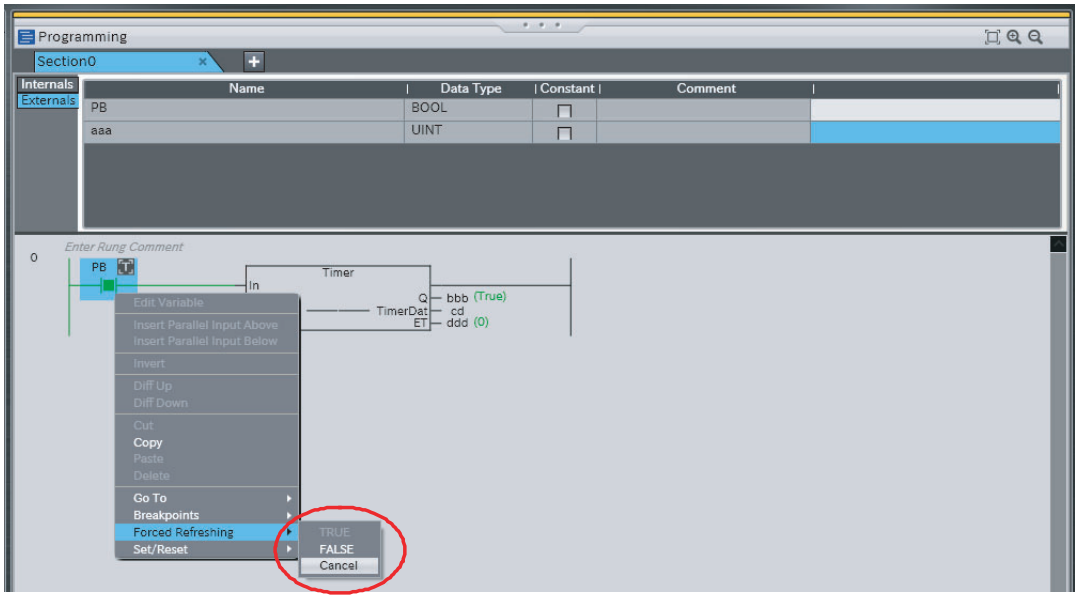


The input or output in the Ladder Editor changes to TRUE or FALSE and the execution condition changes accordingly. An icon also appears by the input or output that represents its current forced value.

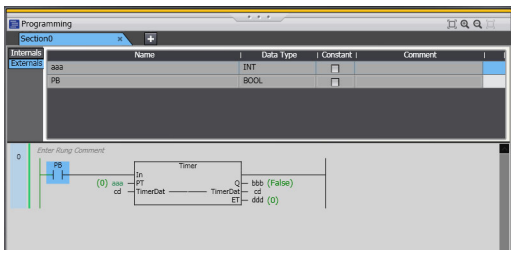


Procedure to Cancel Forced Refreshing from the Ladder Editor

1 Right-click the program input or output to clear in the Ladder Editor and select ***Forced Refreshing - Cancel***.



The forced value for the selected input or output is cleared and the forced value icon disappears. The TRUE/FALSE value does not change.

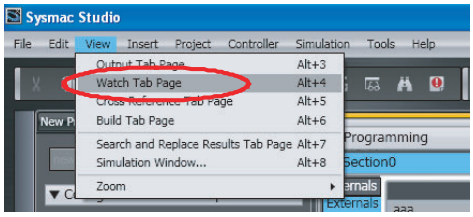


Forced Refreshing and Clearing Forced Refreshing on a Watch Tab Page

You can force the I/O ports or memory addresses for CJ-series Units that are assigned to BOOL variables that are registered on a Watch Tab Page to TRUE or FALSE and clear the forced values on the Watch Tab Page.

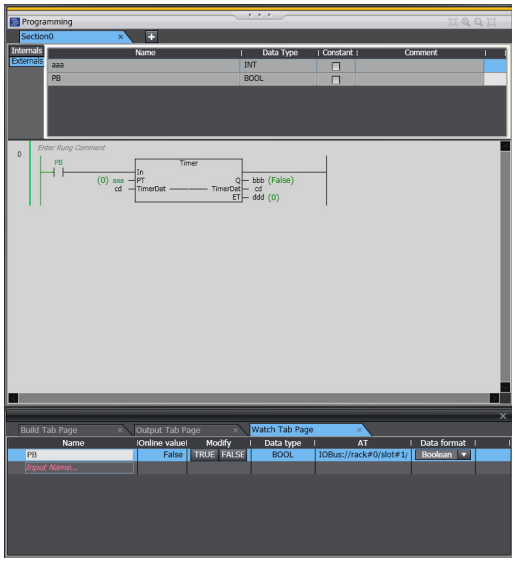
Procedure for Forced Refreshing on a Watch Tab Page

1 Select ***Watch Tab Page*** from the View Menu.

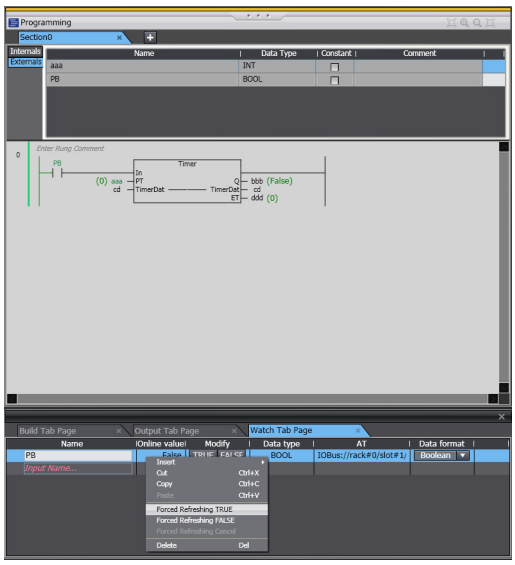


A Watch Tab Page is displayed.

2 Select a BOOL variable in the Watch Tab Page.



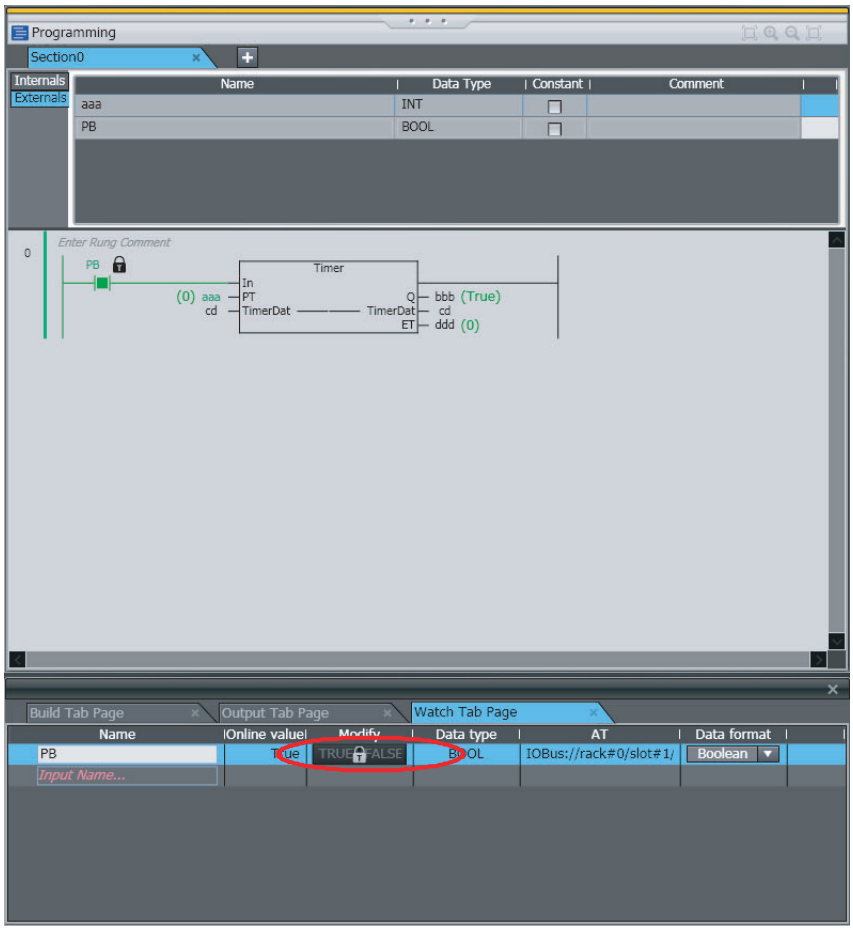
3 Right-click the BOOL variable and select ***Forced Refreshing TRUE*** from the menu. The I/O port or memory address is forced to TRUE. Or right-click the BOOL variable and select ***Forced Refreshing FALSE*** from the menu. The variable is forced to FALSE.



The present value is displayed in the Watch Tab Page as shown below.

- ***Forced Refreshing TRUE*** selected: TRUE
- ***Forced Refreshing FALSE*** selected: FALSE

An icon also appears by the BOOL variable that represents its current forced value.



Procedure for Canceling Forced Refreshing in a Watch Tab Page

1 Right-click the BOOL variable on the Watch Tab Page, and then select ***Force Refreshing Cancel***.

The forced value for the selected BOOL variable is canceled and the forced value icon disappears.
The TRUE/FALSE value does not change.

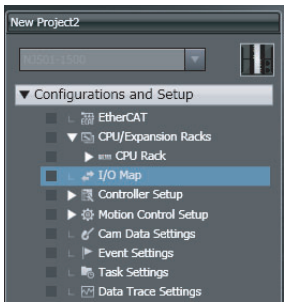
● Forced Refreshing and Canceling Forced Refreshing in the I/O Map

Forced Refreshing and Canceling Forced Refreshing in the I/O Map

You can force the I/O ports of BOOL device variables to TRUE or FALSE in the I/O Map.

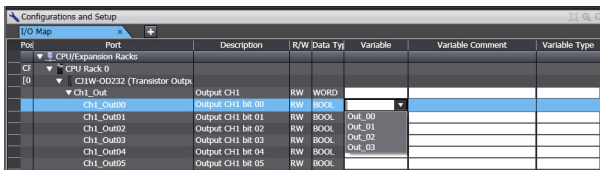
Procedure for Forced Refreshing in the I/O Map

1 Double-click **I/O Map** under **Configurations and Setup** in the Multiview Explorer or right-click **I/O Map** and select ***Edit*** from the menu.

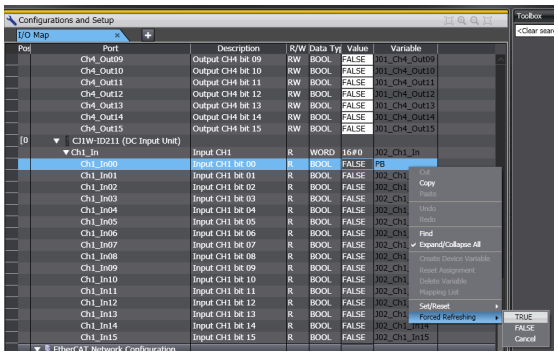


The I/O Map is displayed.

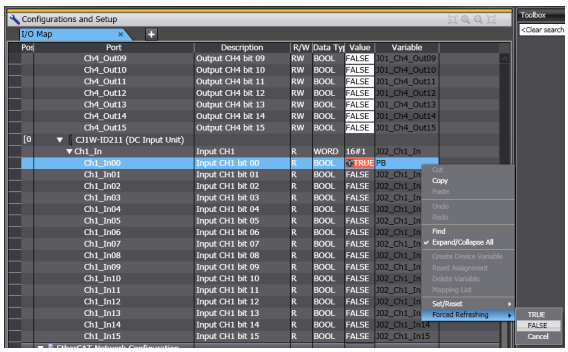
2 Select the BOOL device variable in the I/O Map.



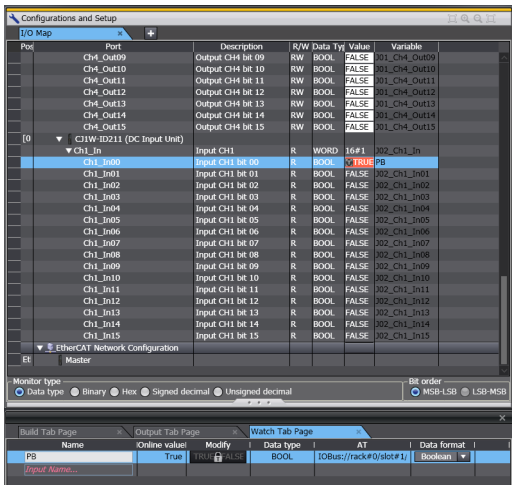
3 Right-click the BOOL variable and select ***Forced Refreshing - TRUE*** from the menu. The I/O port is forced to TRUE.



Or, right-click the BOOL variable and select ***Forced Refreshing - FALSE*** from the menu. The I/O port is forced to FALSE.

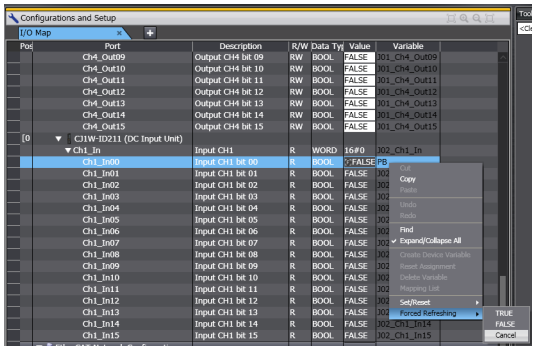


After you force the BOOL device variable to TRUE or FALSE, the value in the *Variable* column in the I/O Map changes to TRUE or FALSE to reflect that change. An icon also appears by the BOOL device variable that represents its current forced value.

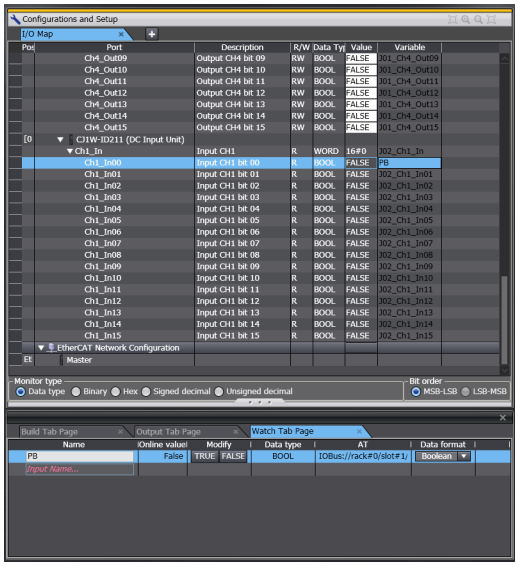


Procedure for Canceling Forced Refreshing from the I/O Map

1 Right-click the BOOL I/O ports in the I/O Map, and then select ***Forced Refreshing - Cancel***.



The forced value for I/O power of the selected BOOL device variable is cleared and the forced value icon disappears.
The TRUE/FALSE value does not change.



2 Select ***Forced Refreshing*** – ***Cancel All*** from the Controller Menu to clear all of the forced refreshing.

6-2-3 Cross References

Cross References

Cross references allow you to see the programs and locations where program elements (see note) are used. You can view all locations where an element is used from this list.

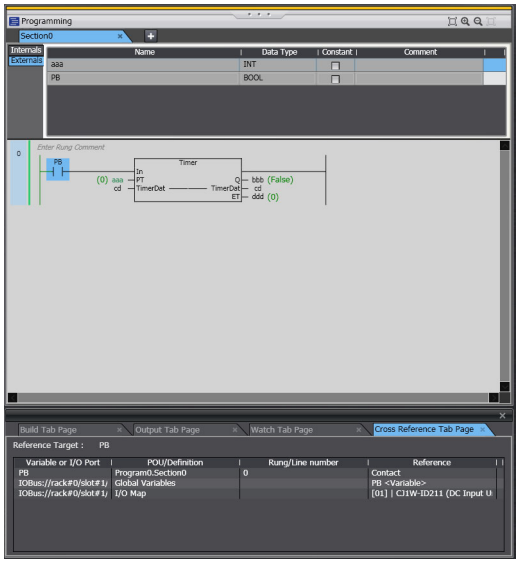
Note The following elements can be cross-referenced.

- Variables
- Data types
- I/O ports
- Functions
- Function blocks

Displaying and Manipulating Cross References

1 Select ***Cross Reference Tab Page*** from the View Menu.

The Cross Reference Tab Page is displayed. Here you can view a list of locations where the element you selected is used.

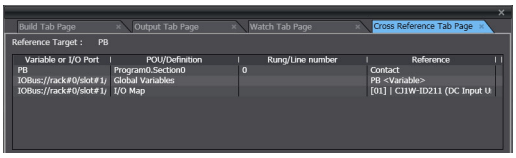


List Details

The following table describes the contents of this list according to the type of element that was cross-referenced.

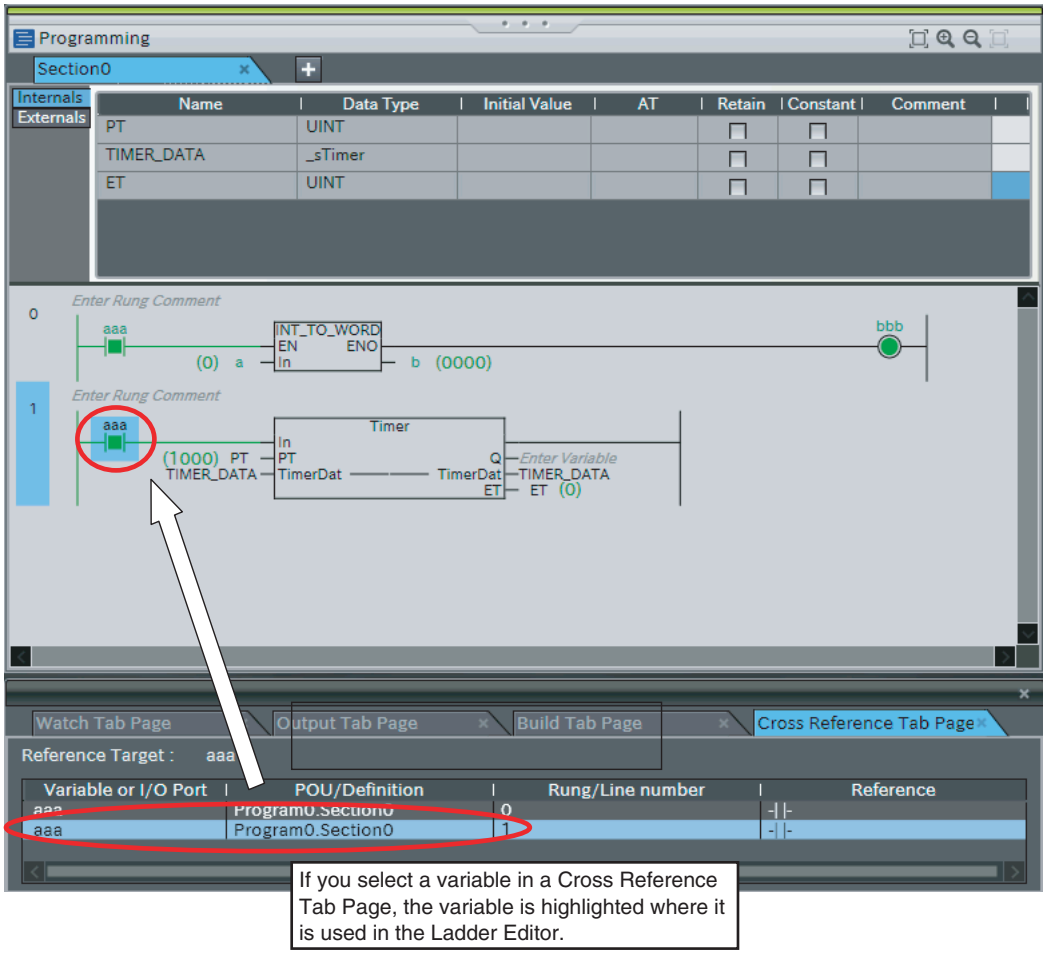
Referenced element	Referenced element (data type)	Program, function block, or section	Rung number	Instruction, variable, or Unit
Variable, axis, axes group, or I/O port	Variables or I/O ports	POU or definition	Rung or line numbers	References
Function	Functions	POU	Rung or line numbers	References
Function block	Function blocks	POU	Rung or line numbers	References
Data type	Data types	POUs or definitions	Not displayed.	References

List Display Example for Data Type Cross References



Viewing Usage Locations from the Cross Reference List

You can view where elements are used from the cross reference list. Select the item you want find references for from the list. The item appears in the Multiview Explorer and the locations where that item is used appear in the Edit Pane.



Additional Information

If the reference location is a program, function block, or section that is different from the referenced element, you can select another active tab in the Edit Pane to view the referenced location on a separate tab page. If the program, function block, or section is the same, the reference location is displayed on the same tab page.

6-2-4 Online Editing

Online Editing

The online editing function is used to add to or change part of a program in the CPU Unit directly from the Sysmac Studio.
You can select any of the following to perform online editing.

- Ladder section
- POU (program, function, or function block) written in ST
- Global variable

Additional Information

You can change the set values of timers and counters during online editing.

WARNING

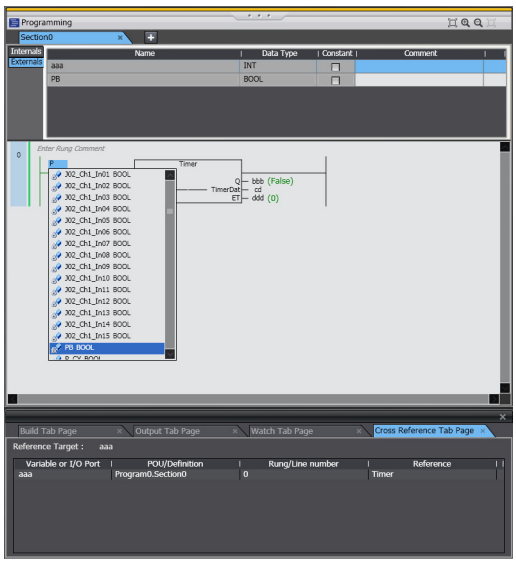
Check the user program for proper execution before you use it for actual operation.

Execute online editing only after you confirm that no adverse effects will be caused to the operation of the master and slave axes if the synchronized control processing time is extended.

Before you perform online editing for a function or a function block, check the locations where the function or function block is used and confirm the range that will be affected.

Starting Online Editing

Go online with the Controller or Simulator and select ***Online Edit - Start*** from the Project Menu. This allows you to edit programs.



- To perform online editing, the data in the NJ-series Controller you are connected to must be the same as the project data in the Sysmac Studio. If they are not the same, an error occurs and online editing does not start.
- When online editing begins, you can edit the items that are displayed in the Edit Pane.

- If there is no data to edit displayed in the Edit Pane, you can edit the selected item in the Multiview Explorer. When you begin online editing, the Edit Pane for the selected data is displayed.
- You cannot start online editing unless editable data is selected in the Multiview Explorer or displayed in the Edit Pane.
- You cannot change the item to edit during online editing. You must first stop online editing, change the item to edit, then start online editing again.

Transferring Changes Made during Online Editing

Perform online editing, and then select ***Online Edit - Transfer*** from the Project Menu. The results of online editing are transferred to the Controller or Simulator.

- If the item you changed during online editing is modified by any other Support Software (i.e., if Controller data is modified after you start online editing), you cannot transfer the changes made during online editing. If that happens, end the current online editing session and start online editing again.
- You can transfer changes made during online editing even if other items are modified by other Support Software.

Canceling Online Editing

Perform online editing, and then select ***Online Edit - Cancel*** from the Project Menu. All changes that were made during online editing are canceled.

Simultaneous Online Editing by More Than One User

More than one user can perform online editing simultaneously under the following restrictions with an NJ-series Controller and the Sysmac Studio.

Operation	Editing condition	Restrictions	Details
Starting online editing	None	None	---
Transferring changes made with online editing	Users editing different POUs or different global variables	Restricted: There are restrictions if the users edit different sections of the same ladder program. **Note** There are no restrictions when the users edit different POUs (not sections of a ladder program) or global variables.	If a local variable table is changed, only the user who first transfers the section can perform the transfer. **Note** Other users must cancel their changes and start online editing again.
	Users editing the same POU or global variable	Restricted.	Only the user who transfers the changes first can perform the transfer. **Note** Other users must cancel their changes and start online editing again.
Canceling online editing	None	None	---

Restrictions in Online Editing

- You cannot delete variables from variable tables during online editing.
- You cannot change the attributes of variables during online editing.

6-2-5 Monitoring Controller Status

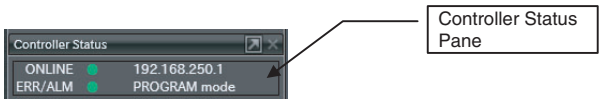
Controller Status Monitor

● Controller Status Monitor

You can monitor the connected Controller and displays the results in the Status Monitor Pane. You can view the Status Monitor Pane only when online with the Controller or connected to the Simulator.

● Displaying the Status Monitor Pane

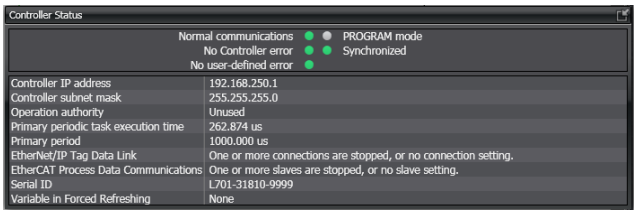
The Status Monitor Pane is displayed in the same area as the Toolbox when online with the Controller or connected to the Simulator.



● Status Monitor Pane Extended Operations

Use the buttons ( ) in the title bar of the Status Monitor Pane to switch between the basic and detailed views.

Detailed View When Connected to a Controller



Detailed View When Connected to the Simulator

Controller Status Information

Information	Displayed information and indicator colors
Communications Status	Normal: Green Communications error: Flashing red
Error Status	Normal: Green Error: Red
Errors, Controller Error	Normal: Green Partial/minor fault level Controller error: Yellow Major fault level Controller error: Lit red.
Errors, User-defined Error	Normal: Green User-defined error: Red
Controller Mode, Operating Mode	RUN mode: Yellow PROGRAM mode: Not lit.
Synchronize Status	Synchronized: Green No synchronized/not performed: Yellow
Verification Status, Operation Authority	Administrator, Maintainer, Unused
System Configuration, Serial ID	Serial ID
System Configuration, Controller IP Address	IP address
System Configuration, Controller Subnet Mask	Subnet mask
Variables with forced refreshing	Yes/No
Control Execution Status, Primary Periodic Task Execution Time	Execution time (μs)
Control Execution Status, Primary Period Time	Execution time (μs)
Control Execution Status, EtherCAT Process Data Communications	Communicating or a slave is stopped
Control Execution Status, EtherNet/IP Tag Data Links	Communicating or a connection is stopped

6-2-6 Task Execution Status Monitor

Task Execution Status Monitor

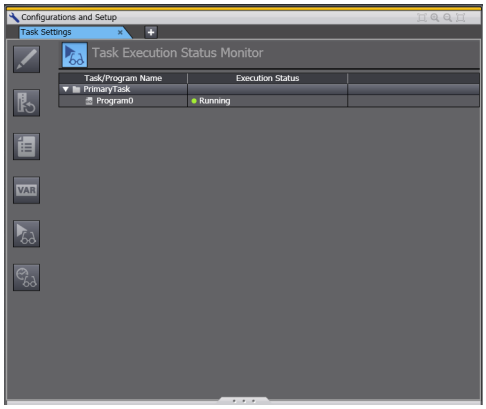
You can monitor the execution status of the tasks that execute programs on an NJ-series Controller or in the Simulator.

Displaying the Task Execution Status Monitor

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

2 Click the **Task Execution Status Monitor** Button ( ) in the Edit Pane.

The names of all tasks/programs that are currently in execution and their execution status are displayed.



6-2-7 Task Execution Time Monitor

● Task Execution Time Monitor

You can monitor the execution time of each task when the user program is executed on an NJ-series Controller or in the Simulator. When you are connected to the Simulator, you can also monitor the real processing time of tasks. This allows you to perform a Controller performance test.

● Contents of the Task Execution Time Monitor

Connected to the Controller

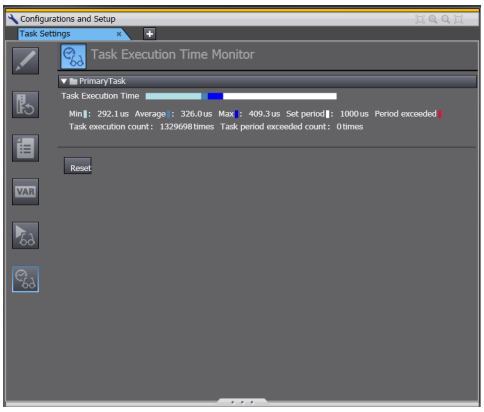
Go online with the Controller and then perform the following procedure.

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

2 Click the **Task Execution Time Monitor** Button ( ) in the Edit Pane.

You can view the following information for all executing tasks: minimum values, average values, maximum values, set periods, exceeded periods, task execution times, and task period exceeded counts.

Note The task period exceeded count is the number of times that the task execution time exceeded the task period. This is not the same as the number of times a Task Period Exceeded Error occurred.



Connected to the Simulator

When connected to the Simulator, the time required from the beginning of task execution until it ends is estimated through a simulation.

- You can display the estimated average execution time, maximum task execution time, and CPU usage for both the execution of periodic tasks and system services that are executed from when task execution is started until it is completed.
- You can use the estimated times as a guide in determining task periods.
- You can run the Simulator in Execution Time Estimate Mode.

Refer to *Estimating Task Execution Times* on page 6-62 for details.

Precautions for Correct Use

- The estimated times are not necessarily the same as the actual task execution times on the physical Controller. Depending on the user program and I/O configuration, the execution times on the physical control may exceed the estimated maximum value. Use the estimated times as a guide in determining task periods.
- If you use tag data links, the execution times on the physical control may exceed the estimated values.

6-2-8 Axis Status Monitor (MC Monitor Table)

● Axis Status Monitor

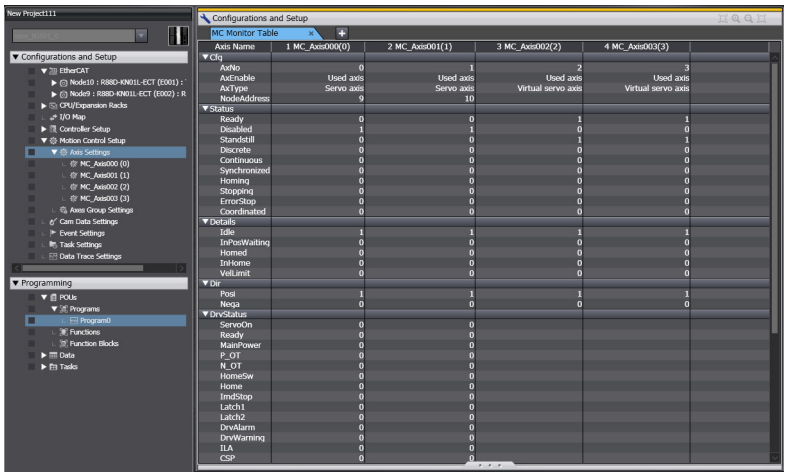
The Axis Status Monitor is used to monitor the error status, input signal status, command values, and actual values.

Note To monitor axis status, the axis must be registered and transferred to the Controller.

1 Go online.

2 Right-click **Axis Settings** under **Configurations and Setup - Motion Control Setup** on the Multiview Explorer and select ***MC Monitor Table*** from the menu.

The Axis Status Monitor is displayed.



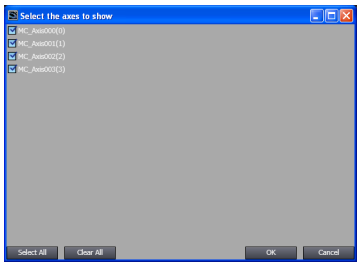
Changing the Axis

Use the following procedure to change the axis to monitor.

1 Open the Axis Status Monitor.

2 Right-click anywhere in the pane and select ***Select Axes to Show*** from the menu.

The following dialog box is displayed.



3 Select the axis you want to display in the Axis Status Monitor, and then click the **OK** Button.

6-2-9 Data Tracing

Data Tracing

Data Tracing

You can use data tracing to sample variables without any additional programming. You can choose between two continuous trace methods: a triggered trace, where you set a trigger condition and data is saved before and after that condition is met, or a continuous trace, in which continuous sampling is performed without any trigger and the results are stored in a file on your computer. However, you can still display data retrieved on the Sysmac Studio and save those results to a file even if you use a triggered trace. These same functions can be used with the Simulator as well.

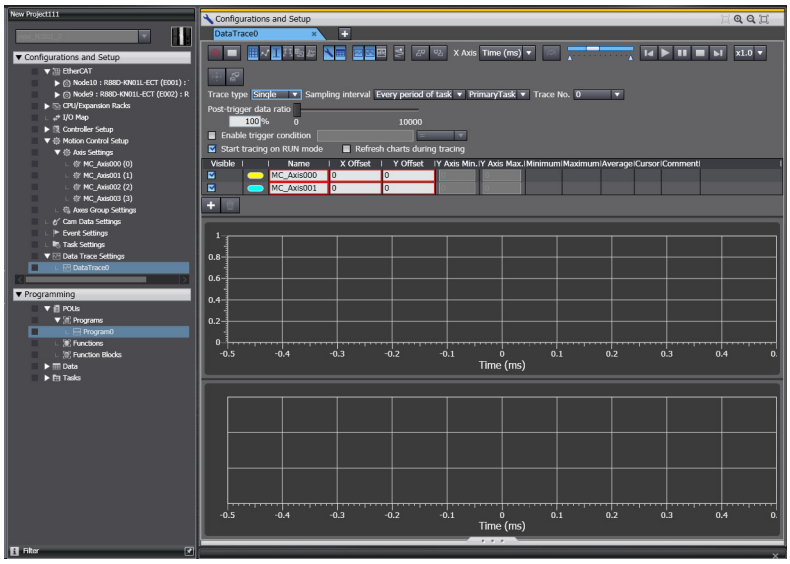
Executing a Data Trace

1 Right-click **Data Trace Settings** under **Configurations and Setup** in the Multiview Explorer and select ***Add*** – ***Data Trace*** from the menu.

DataTrace0 is added to the Multiview Explorer.

2 Double-click **DataTrace0**, double-click the new data trace settings, or right-click the settings and select ***Edit*** from the menu.

The Data Trace Tab Page appears in the Configuration Layer.



Trace Type Setting

Select from the following two different trace types.

Single Trace

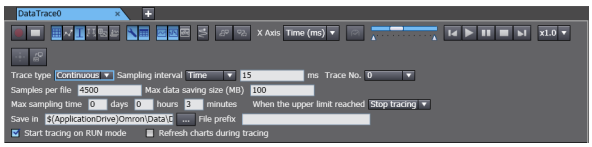
Set a trigger condition to start sampling. Data from before and after the condition is met is saved. Up to 10,000 points of data can be sampled from one variable. After 10,000 points of data are collected, the sampling ends automatically.

Continuous Trace

Sampling starts without any trigger single and continues on even after 10,000 data points are collected. Sample data is transferred to a computer as it is collected and saved to a file.

Procedure

Click the *Type* Box and select either ***Single*** or ***Continuous***.



Precautions for Correct Use

Some data may not be sampled when using a continuous trace depending on your sampling interval and communications status.

Setting Sampling Intervals

You can set the interval to perform sampling on the target data. You can set the sampling interval with any of the three methods described below.

Every Period of Task

Specify a task. The period of that task is set as the sampling period.

Time

The time you enter is set as the sampling period. However, the time you enter is rounded off to an integer multiple of the primary periodic task.

Use Sampling Instruction

With this method, sampling is performed whenever the *TraceSamp* instruction is executed in the user program.

Procedure

1 Click the sampling interval selection box and select *Every period of task*, *Time*, or *Use sampling instruction*.

2 If you select *Every period of task*, select the task you want to use as the sampling period in the task box.

If you chose Time, enter a time in the Time field. The time you entered is automatically rounded off to the nearest integer multiple of the period of the primary period task. (The maximum value is 65,535 times the task period of the primary periodic task.)

Setting Triggers

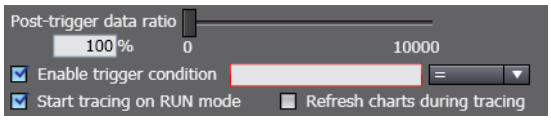
Setting Triggers

To perform a triggered trace, you set a condition to trigger sampling. A suitable trigger condition is set to record data before and after an event.

Procedure

1 Select ***Single*** for the trigger type.

A dialog box to set the trigger is displayed.



2 Select the *Enable trigger condition* Check Box.

3 Enter the variable name to use as a trigger.

4 Set a condition for the variable. (Example: X1>100, x2<16#FF)

5 Set the *Post-trigger data ratio* Slider to the position of the trigger within the sampled data.

If the ratio is set to 100%, all data is sampled after the trigger condition is met. If the ratio is set to 0%, all data is sampled before the trigger condition is met.

Additional Information

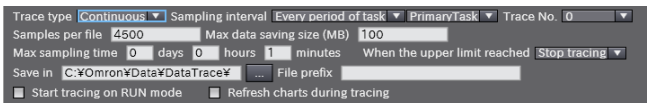
The trigger changes to TRUE when the **Trigger TRUE** Button ( ) is clicked or when the Data Trace Trigger (*TraceTrig*) instruction is executed.

Setting a Continuous Trace

The method to save the data traced during a continuous trace is set.

Procedure

Continuous Trace Settings Dialog Box



1 Set the number of samples to save in each file.

2 Set the maximum size to save in a file.

3 Set the maximum time period to save data for.

4 Select from the following two actions to take when the size or time limit is reached.

- Stop tracing: Stops sampling.
- Delete old files: Continues sampling but deletes the oldest saved data to make room.

5 Select the folder where you want to save the file.

6 Enter the prefix for the file name.
The filename is output as follows: *prefix start_time 5-digit_serial_number*.csv (with no spaces).

Setting Variables to Sample

You must set the variable to trace. For information on the variables that you can set, refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501).

Procedure

Sample Variable Settings Dialog Box

Adding Variables for Tracing

1 Click the **Add Target** Button ( ).

A trace variable line is added to the list.

2 Enter the variable name. Start typing in the field to see a list of variable candidates. Select the variable you want to trace from this list.

Deleting a Variable for Tracing

1 Select the line of the variable you want to delete.

2 Click the **Remove Target** Button or press the **Delete** Key.

Starting and Stopping Tracing

You transfer the data trace settings to the Controller to start tracing. If you selected *Trigger (Single)* as the trace type, tracing waits for the trigger to begin sampling. If you selected *Continuous*, sampling begins immediately and all traced data is transferred to the computer as it is gathered and saved to a file.

Procedures

Starting a Trace

1 Go online with the Controller.

2 Click the **Execute** Button.

Sampling is started. If displaying a graph during tracing is enabled, the graph is drawn as soon as sampling starts.

Stopping a Trace

1 Click the **Stop** Button. Traces also stop automatically in the following cases.

- When the trace type is *Trigger (Single)* and the number of samples reaches 10,000
- When the trace type is *Continuous*, the maximum size or time period is reached, and the action to take when a limit has been reached is set to *Stop Trace*

Additional Information

- If you select the *Start at RUN* Check Box in the Data Trace Setup Dialog Box, data tracing begins automatically the next time the Controller enters RUN mode.
- Up to four data traces can be performed at the same time. You can change the trace number in the Data Trace Setup Dialog Box to perform data tracing with different settings even if another trace is being performed with a different number. With continuous tracing, you can run only one trace at the same time. You cannot perform traces for other trace numbers from the same computer during a continuous trace. (You can perform other traces from another computer.)
- If you attempt to start more than one data trace with the same trace number on the same Controller, the data trace does not start even if you click the button.
- You can click the **Upload Trace Data** Button while the data trace is stopped if there is sampled data on the Controller to upload the data trace settings (except for a continuous trace) and data for the specified trace number. The graph for this data is displayed.

Displaying Trace Results

You view the results of the traced data in either a chart or in 3D Motion Trace Display Mode. Refer to *3D Motion Trace Display Mode* on page 6-45 for information on the 3D Motion Trace Display Mode. After sampling begins, sample data is immediately transferred and drawn on the graph. The trace target variable table shows the maximum, minimum, and average values for each variable.

Switching Graphs

You can toggle between the three different types of graphs: a digital chart for BOOL data, an analog chart for all other types of data, and a 3D Motion Trace Display Mode for viewing the operation of motion axes. You can also view the digital and analog charts overlaid on top of each other.

Procedure

Click the required button.

The buttons are described in the following table.

Button	Description
	Displays and hides a digital chart for BOOL data.
	Displays and hides an analog chart for non-BOOL data.
	Displays and hides a 3D motion trace results for the operation of motion control axes.

Changing the X Axis

Used the following procedure to change the X axis of the digital and analog charts. You can also specify a trace target variable.

Procedure

1 Select the data you want to use for the X axis in the *X Axis* Box.

The digital or analog chart is redrawn using the specified data as the X axis.

Changing the Y Axis Display Mode

You can select whether to use a different Y axis for each variable or a common Y axis for all variables.

Procedure

1 Click the **Independent Y Axes Mode** Button.

2 Select the variable to display as the Y axis in the table.

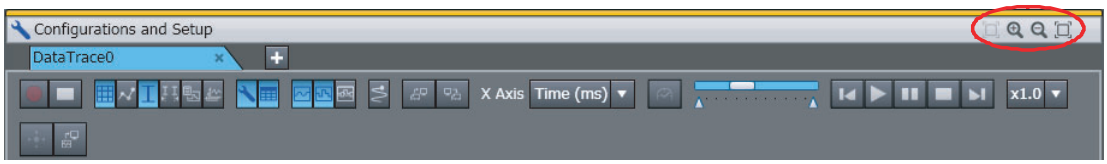
3 You can change the display range for the Y axis for each variable. However, you cannot set the Y offset.

Zoom In and Zoom Out

You can zoom in and zoom out to view digital and analog charts. Digital charts can only be zoomed in and out along the X axis.

Procedure

1 Move your mouse over the axis you want to zoom in or zoom out, then scroll your mouse wheel up or down. Or, you can click the **Zoom In** ( ) or **Zoom Out** ( ) Buttons instead.



- This changes the scale of each axis. Zooming in and out along the X axis is reflected in both the digital and analog charts.
- Click the **Fit to Display** Button ( ) to automatically scale the graph so that it completely fits on the display.

Moving Chart Display Area

This allows you to move the display area of the digital and analog charts.

Procedure

1 Click anywhere inside the chart.
The mouse cursor changes into a move cursor.

2 Drag up, down, left, or right to move the display area.
Movement along the X axis is reflected in both the digital and analog charts.

Specifying a Data Offset

You can shift data on the graph along the X and Y axes. Offsets can be applied only along the X axis for digital charts. This is a useful feature to use when you want to compare trends between data sets with different starting points.

Procedure

1 Enter values for the X offset and Y offset settings in the trace target variable table.

The graph is updated to reflect the changes.

Cursor Display

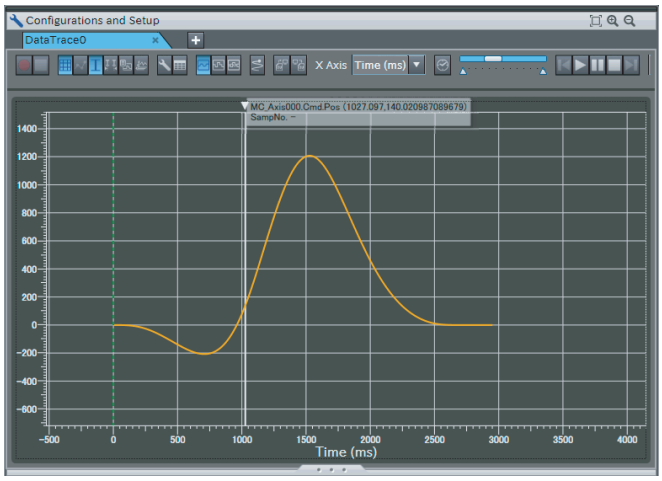
A cursor is displayed to show the values of all variables at the specified X axis value.

Procedure

1 Click the **Cursor** Button to show or hide this cursor.

2 Select the variable for which to check the value in the table.

3 Drag the cursor to the left or right to display the values for different positions along the X axis.



The values for the variable at the cursor position are displayed.

Moving the Cursor

You can move the cursor by dragging it on the chart or by using the playback controller.

① ⑥ ② ③ ④ ⑤

Button		Function
①	Time Slider	You can drag the slider to move the cursor. The left edge is the start of the trace data and the right edge is the end.
②	Playback	The cursor moves automatically at the speed that is specified in the Speed Box.
③	Pause	The cursor stops where it is.
④	Stop	The cursor returns to the start.
⑤	Frame Forward	Moves the cursor to the next sampled point.
⑥	Frame Reverse	Moves the cursor to the previous sampled point.

Displaying the Difference Cursors

The difference cursors show the difference between the two specified points. This is useful for displaying such information as the time between when a certain value changed to TRUE until it changed to TRUE again.

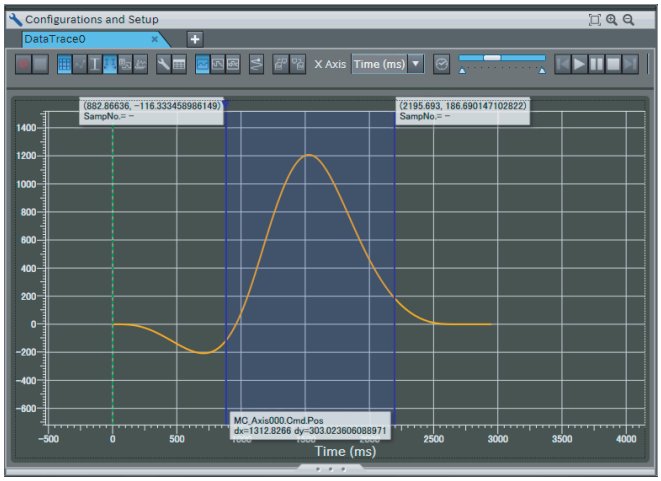
Procedure

1 Click the **Show Range Cursors** Button to show or hide this cursor.

2 Select the variable for which to check the value in the table.

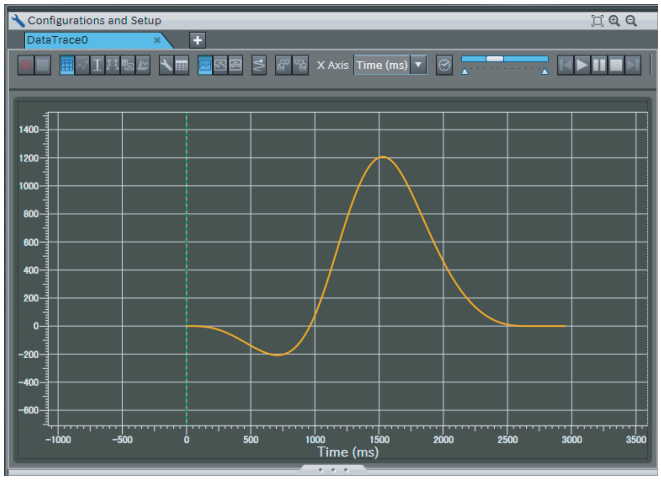
3 Drag the two cursors to the left or right to display the difference in values in the range between the two cursors.

The distance between the two cursors (dx, dy) is shown on the graph.



Displaying the Trigger Location

You can display a Trigger Location Line (a green wave line) to indicate where the trigger changed to TRUE. This information is displayed automatically. You do not have to enter it.



Displaying a Digital Data Legend

You can display a digital data legend.

Procedure

1 Click the **Show Legends** Button. The legends (variable names) are displayed on the left side of the digital chart.

● Exporting Trace Results

Trace results are saved within your project automatically when you save the project on the Sysmac Studio. If you want to save this data as a separate file, you can export the data to a CSV file.

Procedure

1 Click the **Export** Button.

A Save File Dialog Box is displayed.

2 Specify the file name and where you want to save the file.

Precautions for Correct Use

If you change any data trace settings after data tracing is completed and the graph is displayed and then export your data, the data exported will use different settings from when those results were created. Do not change any settings before exporting the data.

Precautions for Correct Use

The exported CSV file of trace results is encoded in UTF-8 character codes.

Additional Information

- The trace number is not exported.
- The 3D device models are not exported.

Importing Trace Results

If you want to import trace results or settings that you have exported, you can import a CSV file that contains trace results data.

Procedure

1 Click the **Import** Button.

A Select File Dialog Box is displayed.

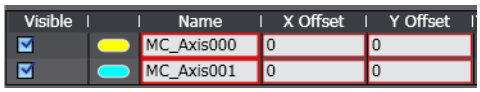
2 Select the CSV file you want to import.

Precautions for Correct Use

To import trace results, use a CSV file encoded with UTF-8 character codes.

Additional Information

- If you import trace results while displaying existing trace results, no settings are imported and only the graph is superimposed over the existing trace results.
- If you want to add data from a file to the trace results but the time axes are not the same, enter an X axis offset to adjust the data accordingly.

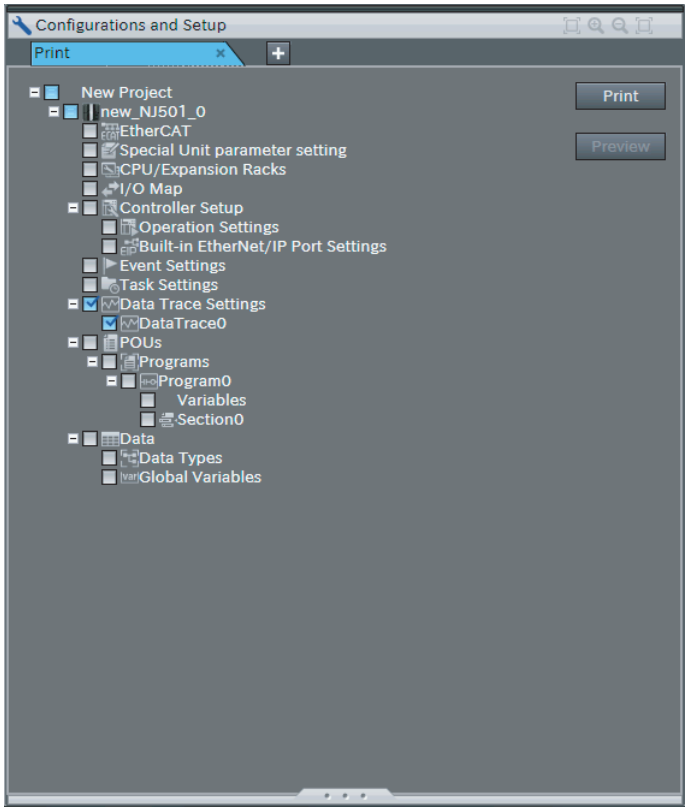


Printing Trace Results

You can print out data trace settings along with digital and analog charts.

Procedure

1 Select ***Print*** from the File Menu.



2 Expand the **Data Trace** Header in the tree in the Print Setup Dialog Box and select the check box beside the trace data you want to print.

3 Click the **Print** Button.

3D Motion Trace Display Mode

You set the axis variables for each element of the 3D device model, and then set the 3D device into motion according to those axis motions. Refer to *Creating 3D Device Models* on page 6-51 for the procedure to create 3D device models.

- This motion is linked to the data trace time chart graph.
- You can also display the path of a marker on the 3D device at the same time.
- You can also display a two-dimensional path marker for each projection of the 3D display.

● Procedure to Display 3D Motion Trace Display Mode

Procedure

1 Add an axis to the Multiview Explorer and then set the parameters of the axis variable. Refer to *4-2-5 Motion Control Setup* for the setting procedure.

2 Create a program to operate the device. Refer to *4-1 Designing the User Program* for the programming procedures.

3 Create the 3D device model with a data trace. Refer to *Creating 3D Device Models* on page 6-51 for the procedure to create 3D device models.

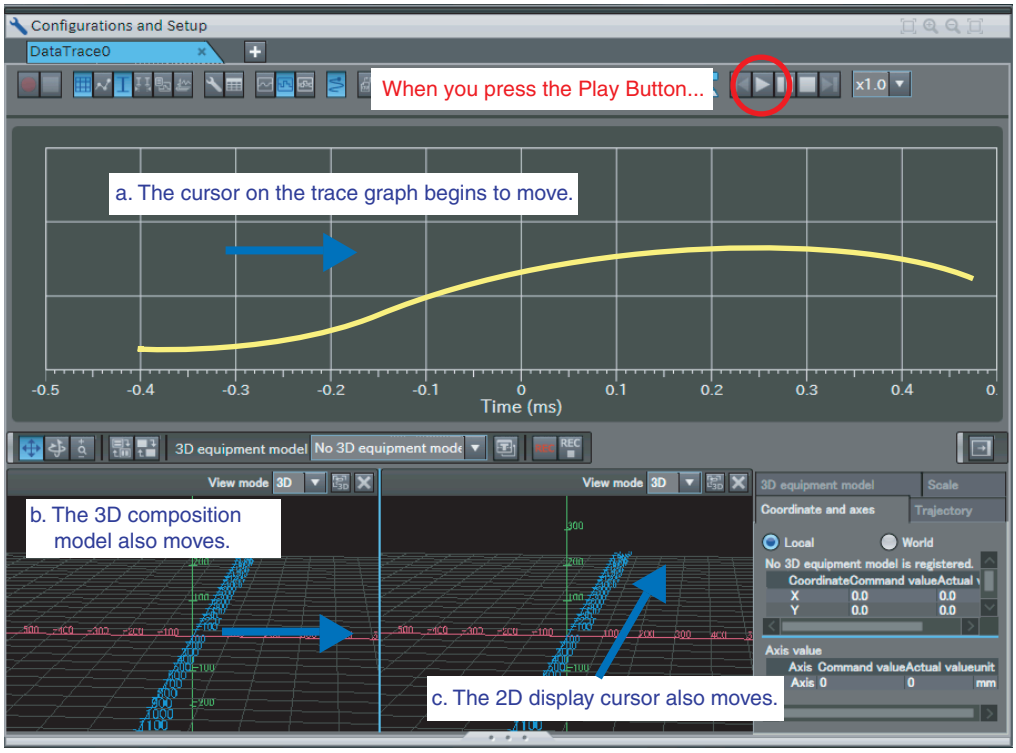
4 Register the trigger setting and variables to trace for the data trace. Refer to *6-2-9 Data Tracing* for the operating procedures for data tracing.

5 Go online with the Controller, change the operating mode to RUN mode, and execute the user program.

6 Start tracing the data with the data trace to sample the data.

7 Check the trace results on the Data Trace Tab Page.

8 Click the **Play** Button in the Data Trace Tab Page. Motion begins according to a) the cursor on the trace graph, b) the 3D composition model, and c) the cursor in the 2D view.



Additional Information

- You can also perform 3D motion traces when the Sysmac Studio is connected to the Simulator. When the Sysmac Studio is connected to the Simulator, perform steps 4 and 5 for the Simulator instead of the Controller.
- You can export trace data to save it in a CSV file and then import the data later to check operation. Refer to *6-2-9 Data Tracing* for the operating procedures to import and export trace data.

Recording 3D Device Model Operation

Click the **Record** Button to save the 3D device model operation into an AVI file. Click the **Stop** Button to stop recording.

● 2D Path Display

The 2D paths of the markers for the projections in the 3D display are also shown. The 2D path appears when you select ***X-Y***, ***Y-Z***, or ***X-Z*** in the box to switch between 3D/2D path displays on the 3D Motion Trace Display.

Optimizing Camera Position and Scale

The axis scale resolution and camera position are automatically optimized so that the entire path fits onto the display.

Viewpoint Manipulation Restrictions

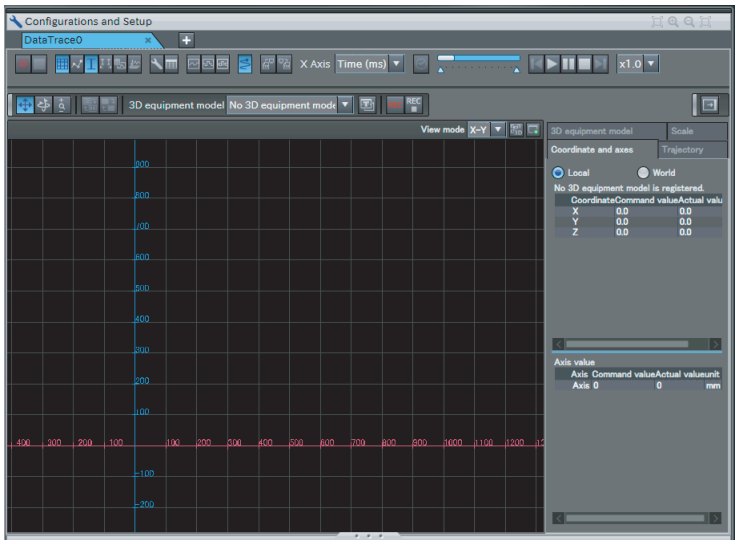
On the 2D path display, you can only zoom in or zoom out. You cannot move or rotate your viewpoint.

Hidden Virtual Compositions

Even if virtual compositions are currently shown on the 3D path display, these virtual compositions are not shown on the 2D path display.

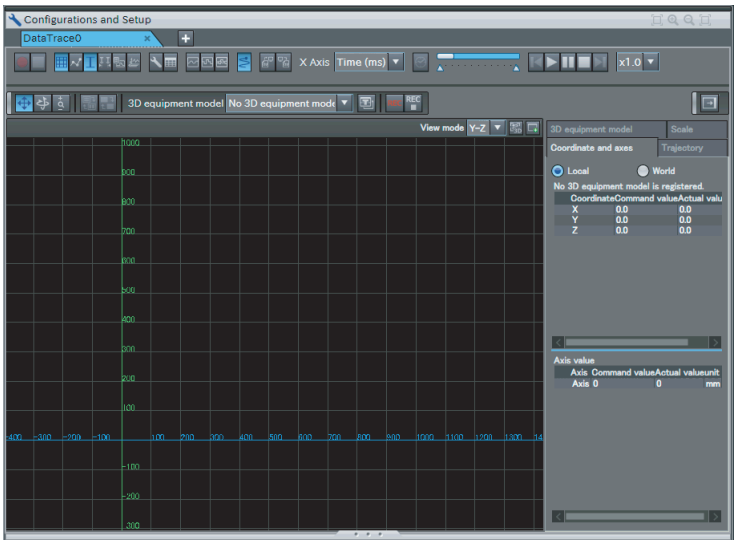
Display When *X-Y* Is Selected

This is what appears when you select *X-Y* in the box to switch between 3D/2D path displays on the 3D Motion Trace Display. In this case, the horizontal axis is the X axis and the vertical axis is the Y axis.



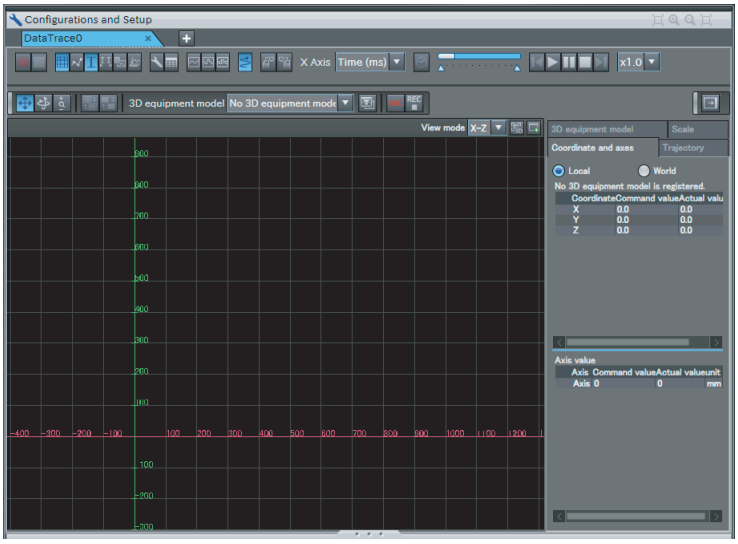
Display When *Y-Z* Is Selected

This is what appears when you select *Y-Z* in the box to switch between 3D/2D path displays on the 3D Motion Trace Display. In this case, the horizontal axis is the Y axis and the vertical axis is the Z axis.



Display When *X-Z* Is Selected

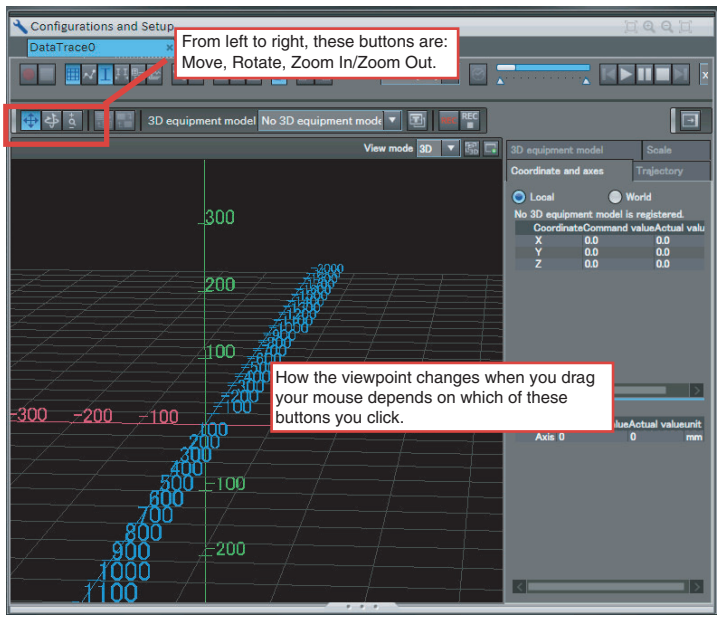
This is what appears when you select *X-Z* in the box to switch between 3D/2D path displays on the 3D Motion Trace Display. In this case, the horizontal axis is the X axis and the vertical axis is the Z axis.



● Operations on the 3D Motion Trace Display

Viewpoint Operations

The movement of the mouse cursor affects the viewpoint depending on which of the three viewpoint operation buttons is currently selected.



Button	Icon	Function
Move Viewpoint Button		The mouse cursor changes when you click this button. This button allows you to drag the mouse around to change your viewpoint up, down, left, or right in the 3D rendering area.
Rotate Viewpoint Mode Button		The mouse cursor changes when you click this button. This button allows you to drag the mouse around to rotate your viewpoint around the center of the 3D display area of the Preview Area.
Zoom In/Zoom Out Button		The mouse cursor changes when you click this button. This button allows you to drag the mouse around to zoom in or zoom out in the 3D display area.
Overhead View Button		Click this button to automatically move the camera so that you can display the entire device model from overhead in the Preview Area.

You can also use the following keyboard shortcuts to change how you want to change the viewpoint.

Shift: Move

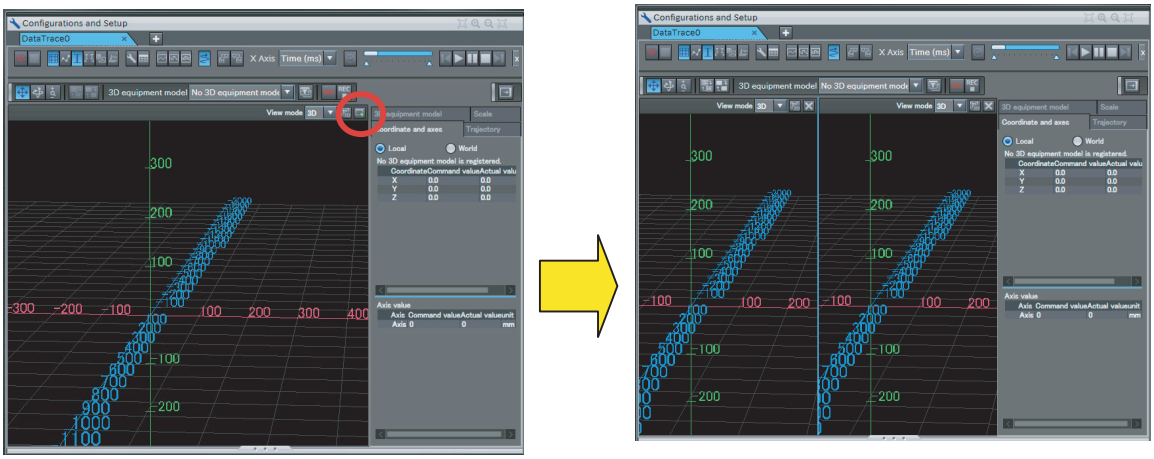
Ctrl: Rotate

Shift + *Ctrl*: Zoom In/Zoom Out

If your mouse has a mouse wheel, you can scroll the wheel up or down to zoom in and zoom out.

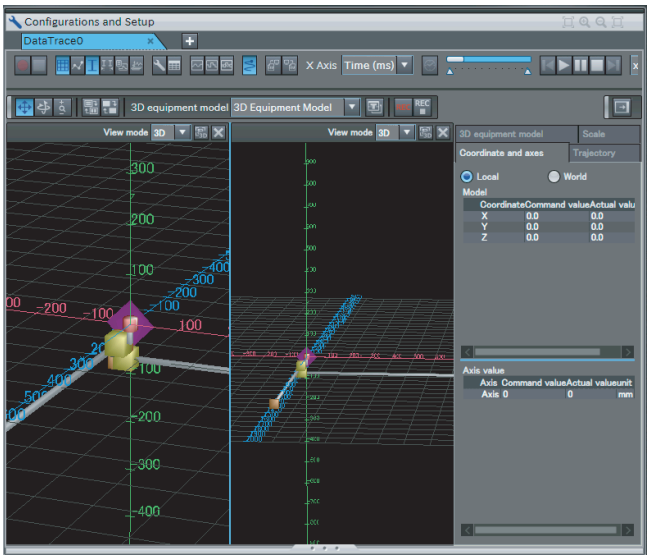
Displays

Click the **Add Display** Button ( ) to add another display that is the same as the current display.



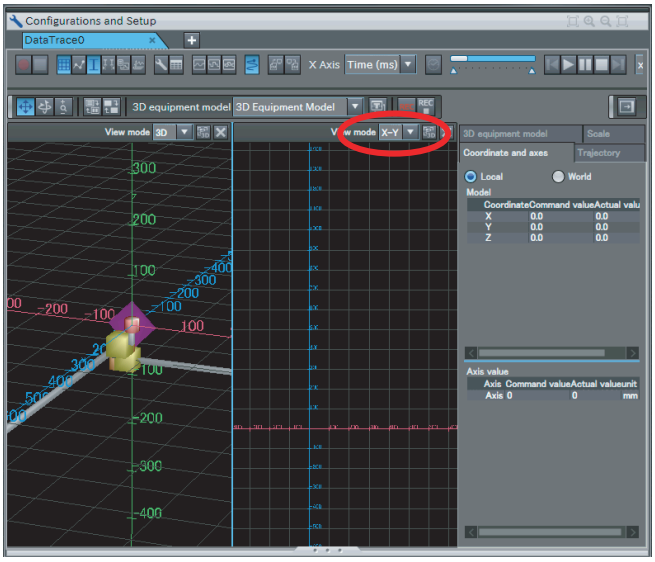
You can now change the viewpoint independently for these two displays.

Example: Overhead View and End Effector Focus



2D Path Display

In the View Mode Box, change *3–D* to *X–Y, Y–Z*, or *X–Z* to display the motion path on a 2D plane.



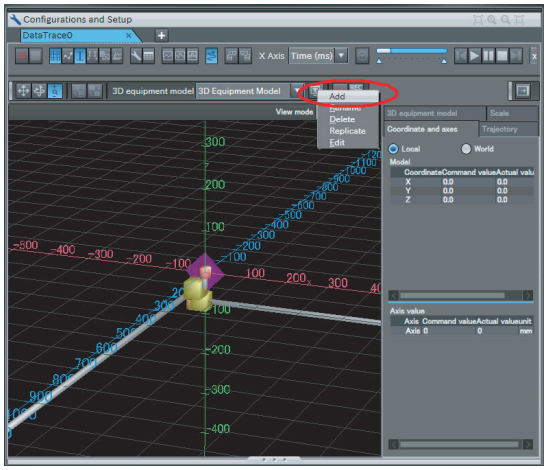
Creating 3D Device Models

You can create a 3D device model at the control target to monitor with the 3D motion trace function.

Procedure

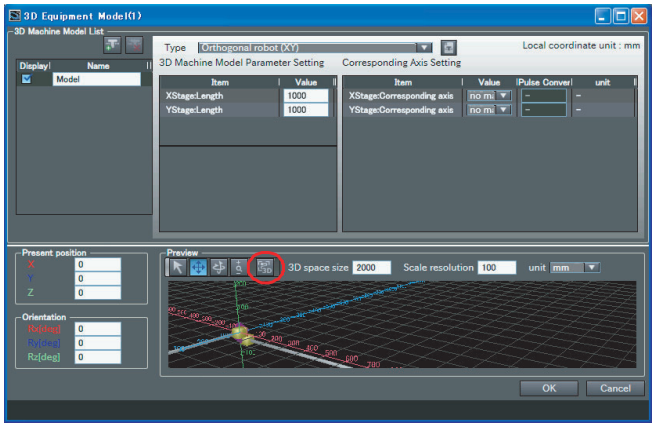
1 Start the data trace and click the **Display 3D Motion Trace** Button ( ).

2 Click the **Settings** Button ( ) for the 3D device model in the 3D Motion Trace Display and select **Add** from the menu.

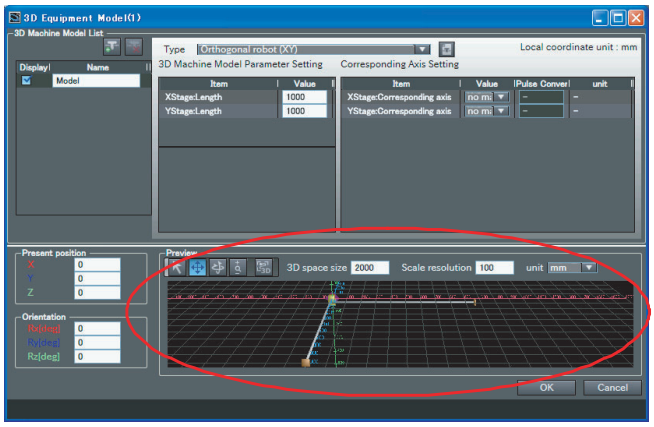


The 3D Device Model Display appears.

3 Click the **Overhead View** Button ( ) in the Preview Area at the bottom of the 3D Device Model Display.

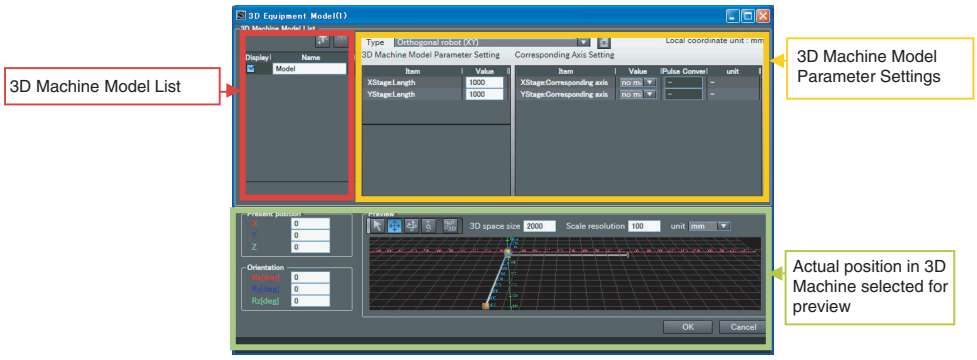


The camera is positioned so that the entire device model can be seen from overhead in the Preview Area.



4 Set the parameters, and then click the **OK** Button. The 3D device model is added. The parameters are described below.

The 3D Equipment Model Window is made up of three sections. The procedures to set up these sections are given below.



● 3D Machine Model List

- You can edit the 3D machine model names in this list. If the name you enter conflicts with another name elsewhere, an icon ( ) is displayed to indicate the error.
- You can click any check box in the list to select a 3D machine model. The color of the check box that you select turns blue, and the parameter settings for that 3D machine model are shown in the yellow-framed area on the right side of the figure above.
- Clear the check boxes beside the 3D machine models you do not want to display when you perform a 3D device motion test. Make sure that unwanted 3D machine models do not appear in the Preview Area.
- Click the **Add** Button to add a 3D machine model to the list.
- Click the **Delete** Button to delete a 3D machine model from the list. After you click the button, click the line of the 3D machine model you want to delete.
- When the 3D machine model display first appears, the first 3D model name in the list is selected automatically.

● 3D Machine Model Parameter Settings

Select a composition type in the *Type* Box. You can select from the following types.

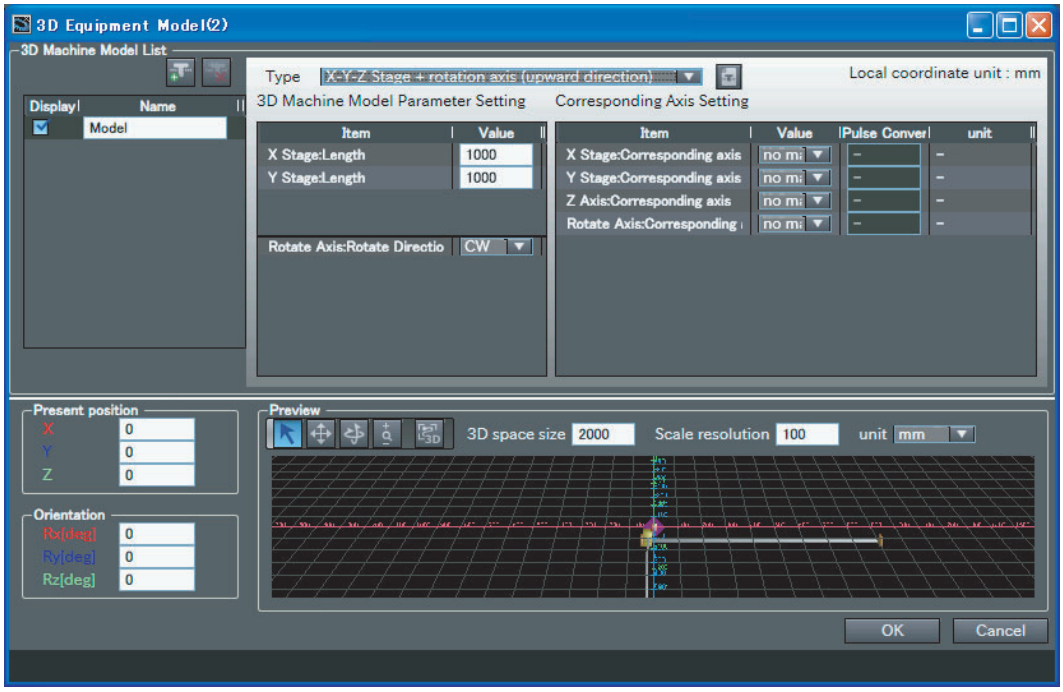
- Orthogonal robot (XY)
- Orthogonal robot (XYZ)
- XYZ stage + rotational axis (upward)
- XYZ stage + rotational axis (downward)
- Direct composition with single axis
- Rotational composition with single axis
- XY table (XYθ)
- XY table (θXY)
- Conveyor

Next, set the parameters for the composition length, rotation direction for rotational axes, and corresponding axes to link axis variables with the movable parts of the composition. The specific parameters depend on the type of composition.

Additional Information

For an axes group in the Motion Control Function Module, select 2, 3, or 4 axes.

The following is an example of the parameter settings for an XYZ stage + rotational axis (upward) composition.



Item	Setting
X Stage: Length	1000
Y Stage: Length	1000
Rotate Axis: Rotate Direction	Clockwise (or counterclockwise)
Corresponding axis settings	Select the following in the boxes in the *Value* Column. Axis MC_Axis000 for X stage, Axis MC_Axis001 for Y stage, Axis MC_Axis002 for Z axis, Axis MC_Axis003 for rotational axis The axes that you added in the previous section, Axis Settings for 3D Device Models, will appear in the boxes in the *Value* Column.
Present position	0,0,0
Orientation	0,0,0

● Preview

The 3D composition you have set up appears in the 3D coordinate system (world coordinates). The position and orientation of the 3D composition is determined by the coordinate values.

Operations in the 3D Display

Button	Icon	Function
Selection Mode Button		The mouse cursor changes when you click this button. This allows you to select the 3D compositions or other models in the Preview Area with your mouse. Use this button to switch between Move Viewpoint Mode (described below) and Selection Mode.
Move Viewpoint Button		The mouse cursor changes when you click this button. This button allows you to drag the mouse around to change your viewpoint up, down, left, or right in the 3D display area in the Preview Area.
Rotate Viewpoint Mode Button		The mouse cursor changes when you click this button. This button allows you to drag the mouse around to rotate your viewpoint around the center of the 3D display area of the Preview Area.
Zoom In/Zoom Out Button		The mouse cursor changes when you click this button. This button allows you to drag the mouse around to zoom in or zoom out in the 3D display area of the Preview Area.
Overhead View Button		Click this button to automatically move the camera so that you can display the entire device model from overhead in the Preview Area.

3D Space Size

You can change the coordinate axes of the 3D space and the size of the grid plane. If you change the size of the 3D space, the length of the coordinate axes and the size of the grid in the Preview Area also change.

Scale Resolution

You can change the scale resolution of the coordinate axes.

Unit

Select from the following units to represent the length of the device: µm, nm, cm, m, inches, or feet.

● Position

The position gives the home position where the 3D composition model is placed in the 3D coordinate system (world coordinates) in the Preview Area. You can change this position by entering the difference (X, Y, Z) from the world coordinate home (0, 0, 0) where you would like the placement home for the model to be. The position in the Preview Area is represented by two purple square pyramids.

● Gradient

The orientation is the angle of rotation of the 3D composition model local axes (Rx, Ry, Rz) centered around the placement home point in 3D world coordinates.

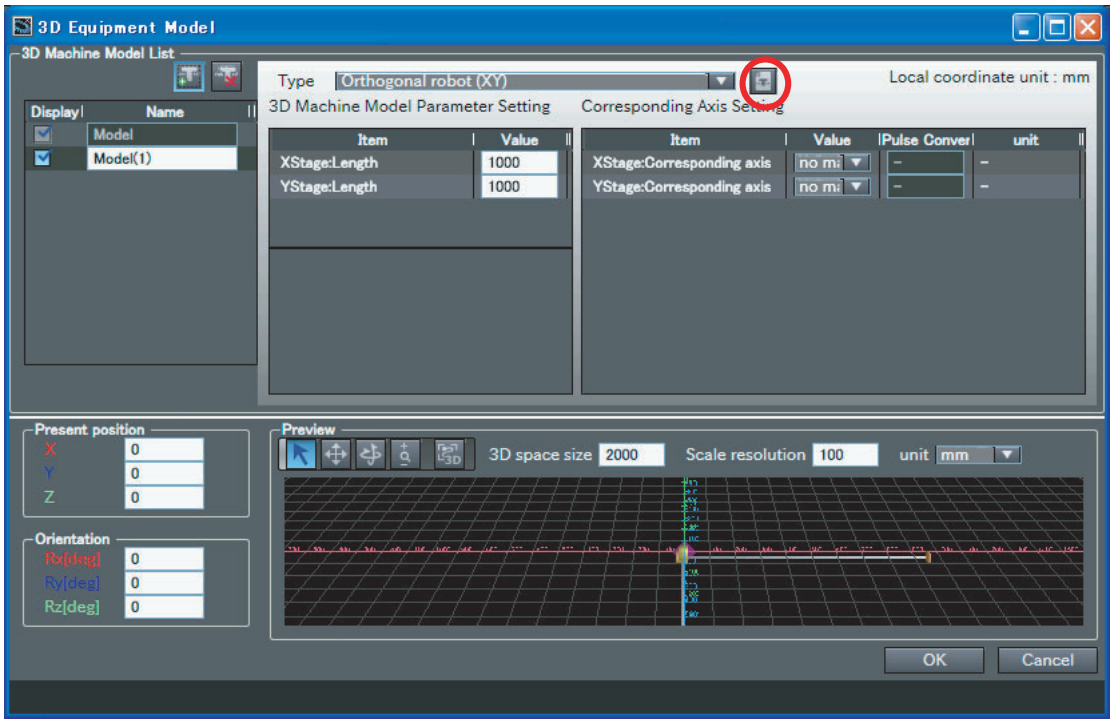
● Placement Home

Click the shape made up of two purple square pyramids in the Preview Area. The local axes (X, Y, Z) are displayed. Drag these local axes with your mouse to place the object directly in the Preview Area. Select between position and orientation to modify the actual position and angle of rotation of the model.

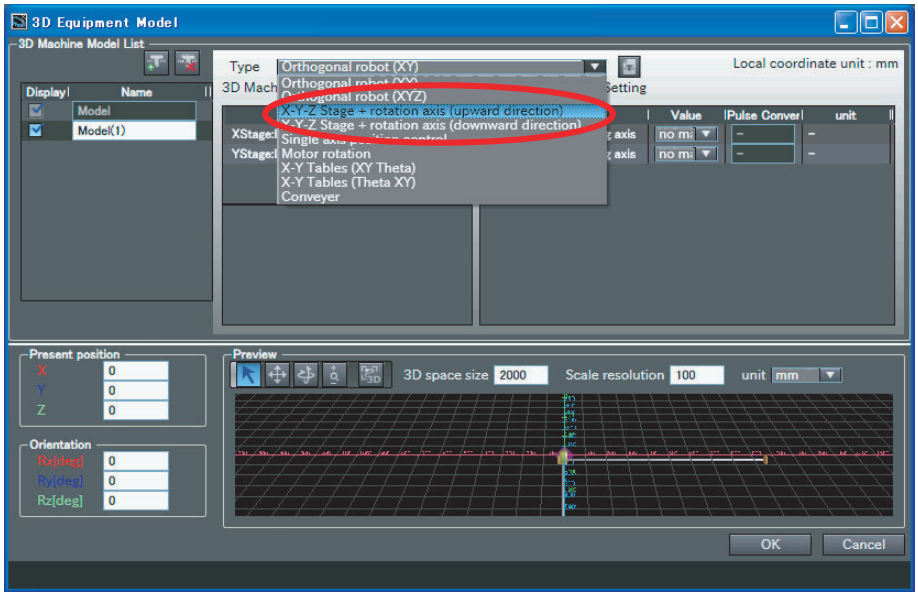
Setting Example

In the following example, we add one orthogonal robot (XYZ + rotational axis) composition and create a device made up of two orthogonal robots.

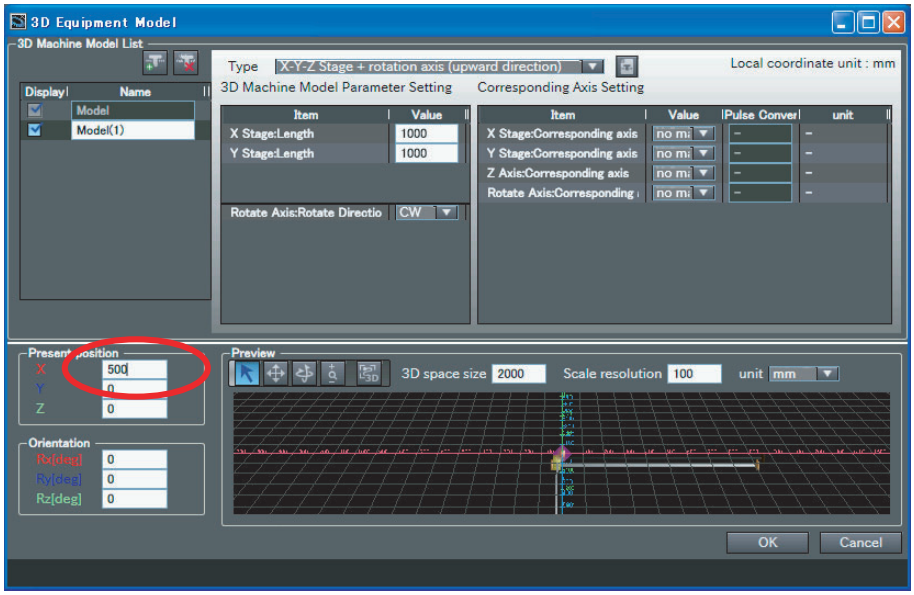
1 Click the **Add** Button ( ) in the 3D Composition Model List to add another 3D composition.
A new model is added to the 3D Composition Model List.



2 Select a composition type in the *Type* Box.



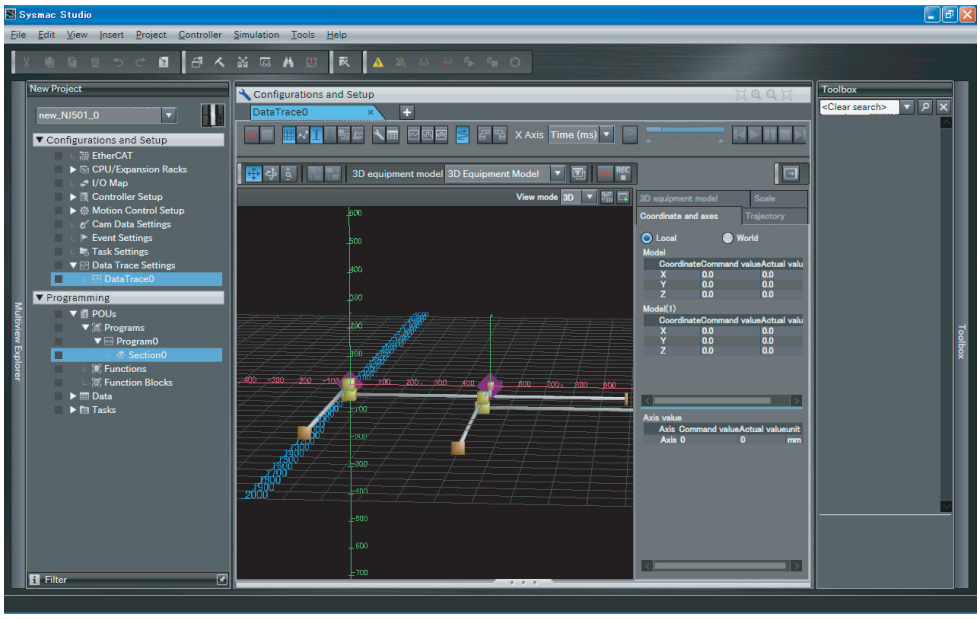
3 Move the position of the composition 500 (mm) along the X axis. Enter 500 into the *X* text box in the Position Area Confirm that the composition changed positions in the Preview Area.



4 Click the **OK** Button.

The information you entered is saved, and the 3D Device Model Display closes.

A table representing the two orthogonal robots is added and the coordinate values for the end effector position of each robot appears in the 3D Motion Monitor.



6-3 Offline Debugging

Offline debugging allows you to debug a program when you are not connected online to a Controller. You can debug on a Simulator to check control program logic before transferring the project to the Controller.

⚠ Caution

Although the Simulator simulates the operation of the Controller, there are difference from the Controller in operation and timing. After you debug the user program on the Simulator, always check operation on the physical Controller before you use the user program to operate the controlled system. Accidents may occur if the controlled system performs unexpected operation.

The Simulator instructions are not processed on the physical Controller and all outputs from the instructions will be FALSE. After you debug the user program on the Simulator, always check operation on the physical Controller before you use the user program to operate the controlled system. Accidents may occur if the controlled system performs unexpected operation.

6-3-1 Debugging with Program Simulation

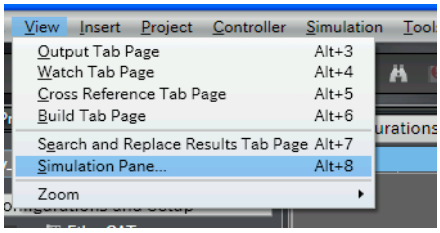
To debug a control program, it is best to simulate the control program on the computer first to check the operation logic and parameter settings. This process is called simulation debugging. The Sysmac Studio comes with a Simulator that emulates all CPU Unit functions.

Simulation Procedures

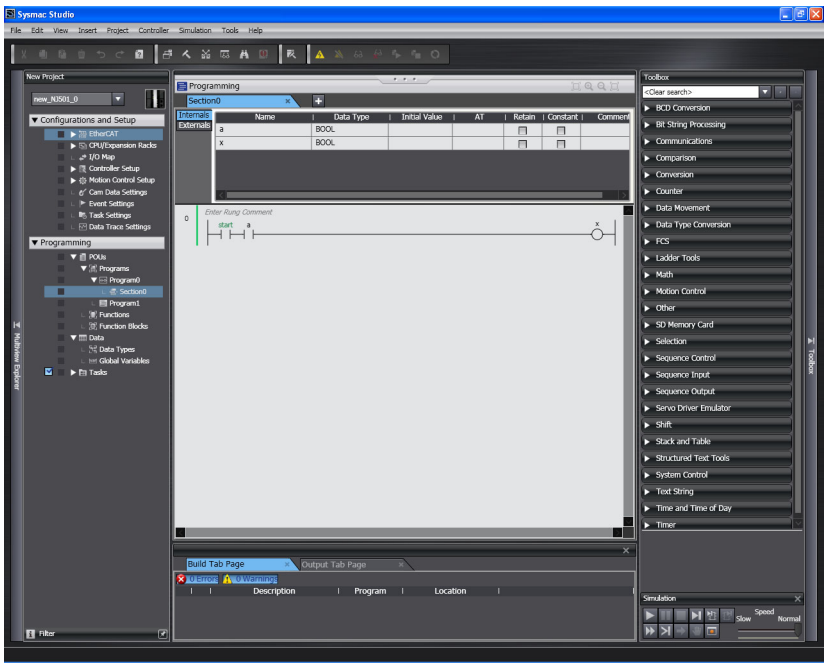
Use the following procedure to start the Sysmac Studio and connect to the Simulator.

1 Start the Sysmac Studio and create a project.

2 Select ***Simulation Page*** from the View Menu.



The Simulation Pane is displayed below the Toolbox Pane on the right of the window.



3 Use the Sysmac Studio to set the Controller Configurations and Setup and create a program.

4 Select ***Build Controller*** from the Project Menu to build the user program.

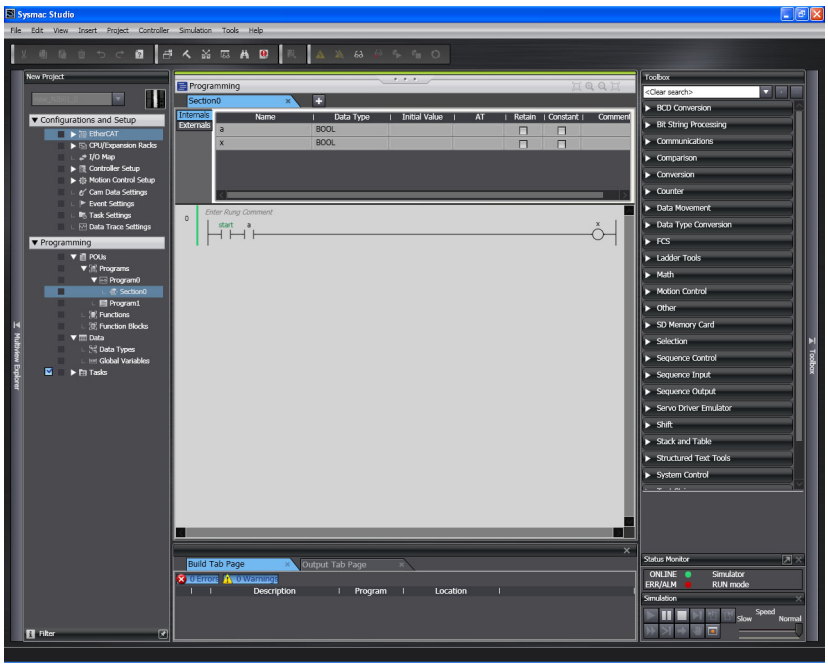
Additional Information

You cannot connect to the Simulator if the programs are not built.

5 If you want to execute a specific task or only a part of a section or program, select the item for simulation under **Programming** – **Tasks** in the Multiview Explorer. (Refer to *Setting Simulation Programs* on page 6-60.)

6 Click the **Run** Button in the Simulation Pane. Select ***Execute*** from the Simulation Menu.

7 After the Simulator is started and connected, the *Online* Indicator in status monitor is lit green and “Simulator” is displayed. In this status, the project is completely transferred to the Simulator and RUN mode continues.



8 To stop the simulation, click the **Stop** Button in the Simulation Pane.

The connection to the Simulator is broken and the Simulator is exited.

9 To end the simulation, click the **Close** Button (×) in the Simulation Pane.

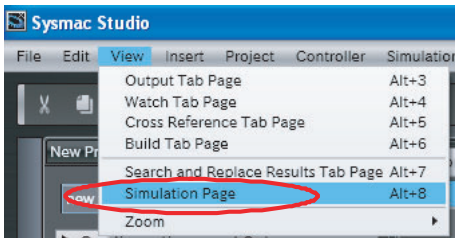
Setting Simulation Programs

Simulation Programs

You can set the task or programs to simulate. You can choose to simulate some or all of the programs in the user program.

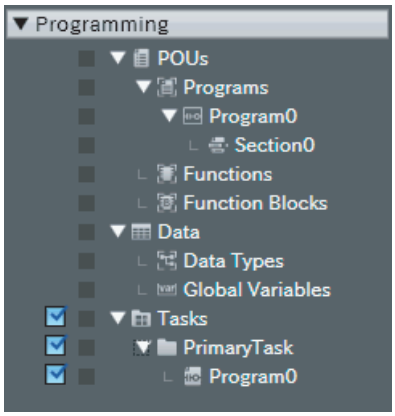
Procedure for Setting Simulation Programs

1 Select ***Simulation Page*** from the View Menu.

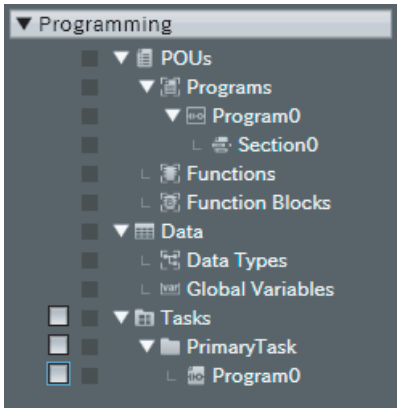


The Simulation Pane is displayed.

A check box is displayed to the left of the names of programs listed under tasks in the Multiview Explorer project to designate programs for simulation. These check boxes are selected by default.



2 Clear the check boxes in the Multiview Explorer for any tasks, programs, or sections you do not want to simulate.



Simulations are performed only for the selected tasks and programs.

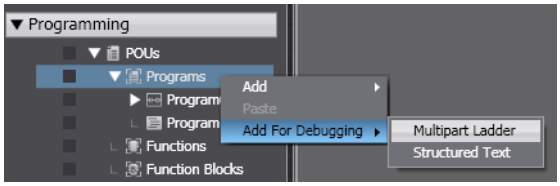
Setting the Debug Programs

Debug Programs

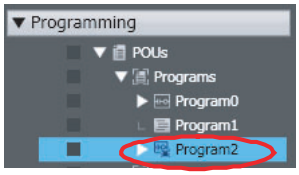
A debug program is program code used for offline debugging. This code contains instructions to perform virtual input processing on inputs received from outside of the Controller, force user-defined errors, and perform other such debugging tasks. The debug program attributes can be set for each program. These programs can be executed only on the Simulator. Simulation programs are treated as normal programs by the Simulator. Assign them to a task to execute them. Debug programs are not included in the Simulator's estimation of execution times. This can increase the accuracy of the time estimates.

Procedure for Setting Debug Programs

1 Right-click **Programs** under **Programming - POU** in the Multiview Explorer and select ***Add for Debugging - Multipart Ladder*** or ***Add for Debugging - Structured Text*** from the menu.



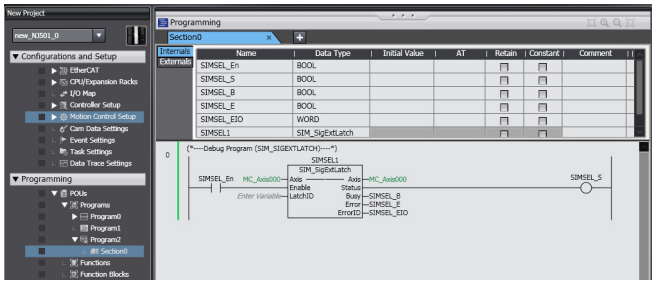
A debug program is created.



2 Double-click the debug program that was inserted.

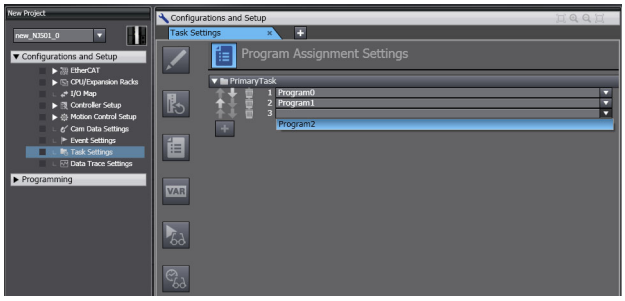
The Debug Program Editor is displayed.

3 Enter program code to test in the Debug Program Editor (virtual input processing, forcing user-defined errors to occur, etc.).



- After you have written a program as a debug program, you can right-click the debug program and select ***SettingsForDebugging - Disable*** to change the program to a normal program.
- You can also change a normal program into a debug program in the same way.

4 Assign the completed debug program to a task.

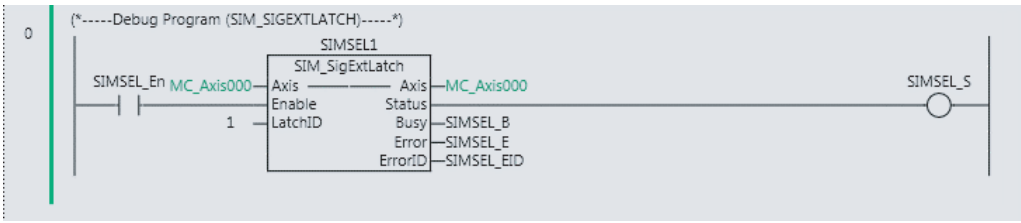


Debug Program Example with Special Instructions

The following example shows a debug program that uses special simulation instructions. You can use the simulation instructions only in the Debug Program Editor. Refer to *A-6 Simulation Instructions* for details.

Debug Program Example

When SIMSEL_En changes to TRUE, an external input signal is sent to axis number 0 and latch ID 1. *MCMF_InFeed* (Feeding) changes to TRUE and interrupt feeding is performed.



Estimating Task Execution Times

The time required from the beginning of task execution until it ends is approximated through a simulation.

- You can display the estimated average and maximum task execution time for both the execution of periodic tasks and for system services that are executed from when task execution is started until it is completed.
- You can use the estimated times as a guide in determining task periods.

Run the Simulator in Execution Time Estimate Mode after you have calibrated execution time estimation.

Precautions for Correct Use

- The estimated times are not necessarily the same as the actual task execution times on the physical Controller. Depending on the user program, I/O configuration, and whether communications are used the execution times on the physical control may exceed the estimated maximum value. Use the estimated times as a guide in determining task periods.

Calibrate for Execution Time Estimates

To calculate estimated program execution times, calibration is performed for the relative performance of the physical Controller and the CPU of the computer. To increase the accuracy of execution time estimation, perform this procedure at least once after you install the Sysmac Studio.

Additional Information

Perform the following operations before you calibrate for execution time estimation.

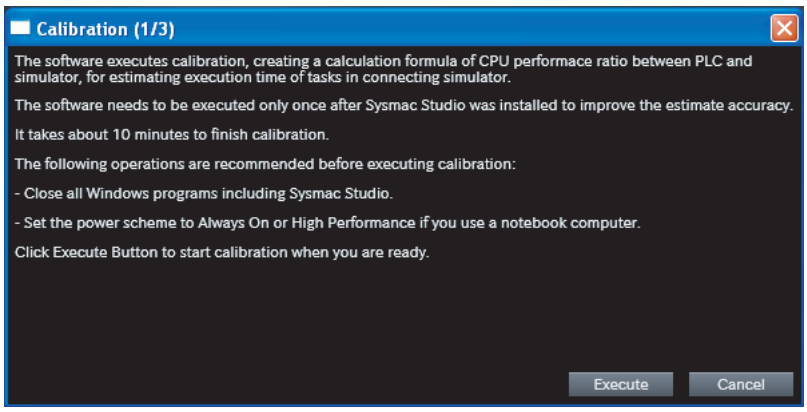
- Except for this utility, exit all programs that are running on the computer, including the Sysmac Studio. This utility will continue operation even if you close the Sysmac Studio.
- If you are using a notebook computer, set the power supply to remain ON continuously.

Procedure

1 Select ***Calibration*** from the Simulation Menu.

The calibration tool for execution time estimation is started.

2 Follow the instructions in the dialog box and click the **Execute** Button.



Calibration is started. Approximately 10 minutes is required to complete calibration.

● Displaying Estimated Task Execution Times

Additional Information

Exit all programs that are running on the computer except for the Sysmac Studio. Other programs may affect the accuracy of estimates.

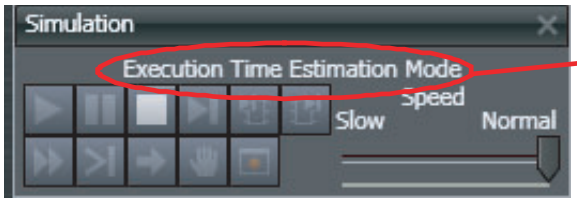
To run the Simulator in Execution Time Estimate Mode, set the following configurations so that they agree with the actual configurations and create the programs to execute.

- EtherCAT axes and slave configuration
- CPU Unit and Unit configuration

Procedure

1 Select ***Run in Execution Time Estimation Mode*** from the Simulation Menu.

The Simulation Pane is displayed and simulation is started in the Execute Time Estimation Mode.

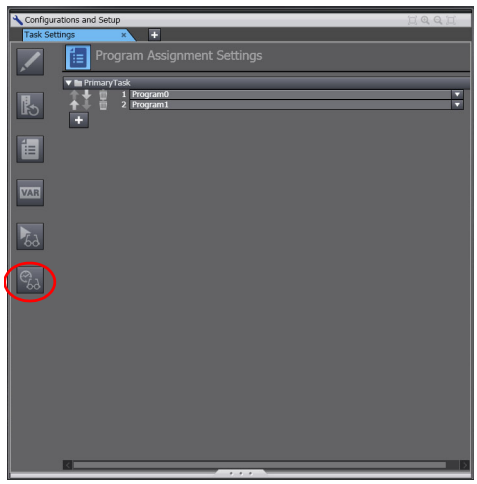


The Execution Time Estimation Mode is displayed.

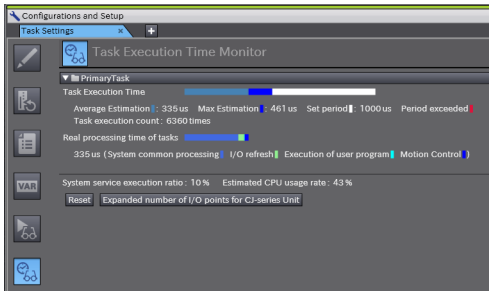
2 Double-click **Task Settings** under **Configurations and Setup** in the Multiview Explorer.

The Task Settings Tab Page is displayed in the Edit Pane.

3 Click the **Task Execution Time Monitor** Button ( ).



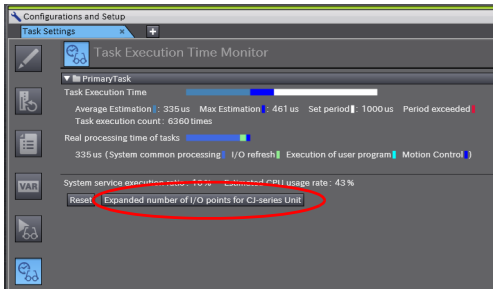
The Task Execution Time Monitor is displayed.



● Contents of the Task Execution Time Monitor

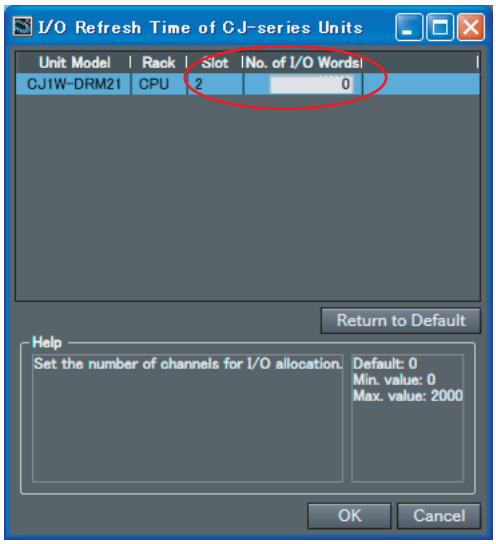
Item	Description
Task Execution Time	• Average and Maximum: The estimated, average and maximum execution times for each task are displayed from when execution of the primary periodic task was started. • Set Period: The task period that is set in the Task Setup is displayed. • Task Execution Count: The number of times the task is executed is displayed.
Real Processing Times of Tasks	The I/O refreshing time, system common processing times, user program execution time, motion control processing time, and the total of all those times are displayed.
Others	Estimated CPU Usage: The percentage of the total of the following times in the task period is displayed. • Estimated maximum value of the task processing time + Required system service processing time (for system service monitoring) If CPU usage exceeds 100% for the total of these values, it means that there is not sufficient time for task processing and the system service monitoring settings.
Resetting Execution Times	Click the **Reset** Button. The average and maximum task execution times and the real processing times of the tasks are initialized and estimated again.
Expanded number of I/O points for CJ-series Unit	Enter the total number of input and output words for CJ-series Units.

4 Click the **Expanded number of I/O points for CJ-series Unit** Button.



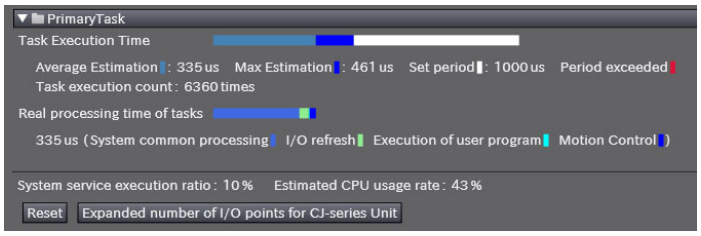
The Expanded Number of I/O Points for CJ-series Unit Dialog Box is displayed.

5 Create the user-defined variables for the specified CJ-series Special Units, enter the total size of the expansion area for AT specifications (e.g., fixed I/O allocations for DeviceNet Units), and the click the OK Button.



The size of the expansion areas is used to calculate the I/O refresh time for the specific CJ-series Special Units.

6 Make sure that the task execution times do not exceed the task execution processing times (i.e., the task periods).



Additional Information

The following debugging operations cannot be used in Execution Time Estimation Mode. To debug normal programs, select ***RUN*** from the Simulation Menu.

- Pausing, step execution, continuous step execution, one-scan execution, breakpoints, and online editing

Changing the Simulation Speed

Changing the Simulation Speed

When debugging, you may want to run the Simulator at a slower speed than normal. To do this, drag the *Simulation Speed Slider* in the Simulation Pane. You can change the simulation speed from 0.1x to 1x. You can change simulation speed while a simulation is in progress or when it is stopped.

Procedure

1 Drag the **Simulation Speed Slider** in the Simulation Pane.

The simulation speed on the computer will change between 0.1x and 1x.

Setting Breakpoints

Setting Breakpoints

You can set breakpoints to stop execution of a simulation, e.g., to see the status after a specific program is executed.

Procedure

There are three ways to set breakpoints.

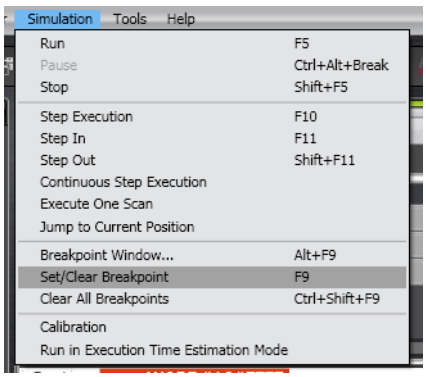
- Right-click an element in a ladder diagram rung or a specific line of ST code, and select ***Breakpoints - Set/Clear Breakpoint***. A breakpoint is added at the specified position in the program.
- Select a ladder diagram element or line of ST code and select ***Simulation - Set/Clear Breakpoint*** from the Main Menu.
- Select a ladder diagram element or line of ST code and click the ***Set/Clear Breakpoint*** Button in the Simulation Pane.

Use the following procedure to set a breakpoint in the ST Editor.

1 Click the **Run** Button in the Simulation Pane.

2 Place your cursor on the line number of the line where you want to set a breakpoint in the ST Editor.

3 Select ***Set/Clear Breakpoint*** from the Simulation Menu.



A breakpoint is set on the line designated by the cursor in the ST Editor, as shown below. The program stops at the breakpoints you set.

```
1   varA := 13;
2   varB := 49;
3   IF varA < DINT#1 THEN
4       varA := DINT#100;
5   END_IF;
6   IF varA > DINT#12 THEN
7       varA := DINT#200;
8   END_IF;
9   FOR varB := 0 TO 2 BY 1 DO
10      varA := varB;
11  END_FOR;
```

Step Execution

Step Execution

You can execute a program one line at a time in the ST Editor or one instruction at a time in a ladder diagram.

1 When offline or when you execute a program through the Simulator, click the **Step Execution** Button in the Simulation Pane when the program is stopped or when it is paused at a breakpoint.

The cursor moves to the next execution step in the ST Editor.

```
1   aaa:=WORD#16#FFFF;
2   IF aaa = bbb THEN (*if aaa = bbb, ccc = true*)
3       ccc := TRUE;
4   END_IF;
5   //End of program1.
```

2 Select ***Simulation Page*** from the View Menu. The Watch Tab Page is displayed so that you can check for changes in the value of variables.

Continuous Step Execution

Use the following procedure to perform continuous step execution.

1 When offline or when you execute a program through the Simulator, click the **Continuous Step Execution** Button in the Simulation Pane when the program is stopped at a breakpoint, paused, or stopped during step execution.

The cursor moves to the next execution step in the ST Editor after a fixed period of time (1 second). The time required to move to the next step depends on the program.

Pausing

Use the following procedure to pause simulations.

1 Click the **Pause** Button in the Simulation Pane when a simulation is in progress.

The cursor stops moving. Execution of the program is paused, but the Simulator does not close.

Step In Execution

Use the following procedure to perform step execution of source code inside a function or function block.

1 When you execute a program through the Simulator, click the **Step In** Button in the Simulation Pane when the program is at a function or function block instance when execution is stopped for a breakpoint, paused, or stopped during step execution.

Step Out Execution

Use the following procedure to leave a function or function block currently in Step In Execution.

1 Click the **Step Out** Button in the Simulation Pane when the simulation is stopped in a function block currently in step in execution.

One-period Execution

Use the following procedure to execute the current task for one period. This function pauses execution at the start of the program in the next period.

1 When offline or when you execute a program through the Simulator, click the **Execute One Scan** Button in the Simulation Pane when the program is stopped at a breakpoint, paused, or stopped during step execution.

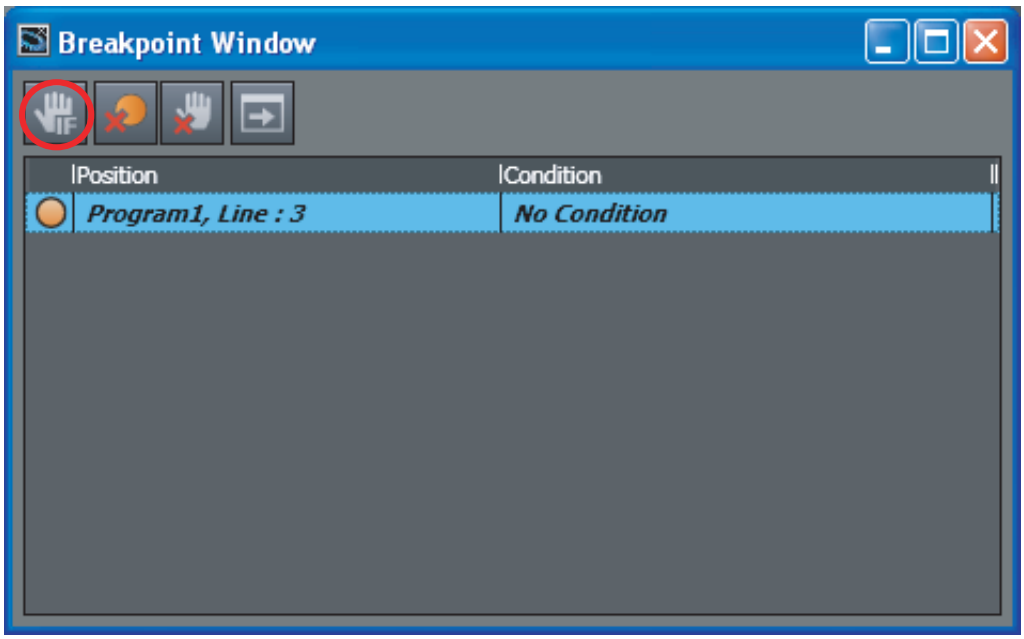
Setting Conditional Breakpoints

Conditional breakpoints allow you to set conditional expressions at breakpoints that are set in a program.

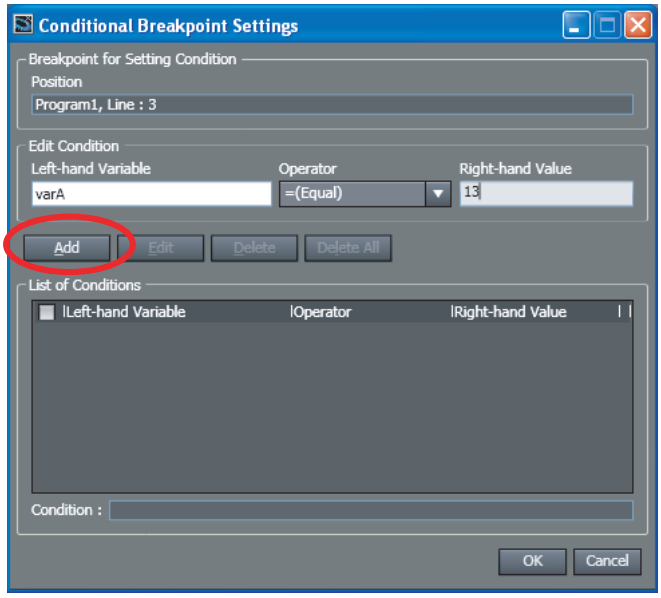
1 Click the **Breakpoint Window** Button in the Simulation Pane.

The Breakpoint Window is displayed with a list of the breakpoints that you have already set.

2 Select a breakpoint. Click the **Set Conditional Breakpoint** Button.

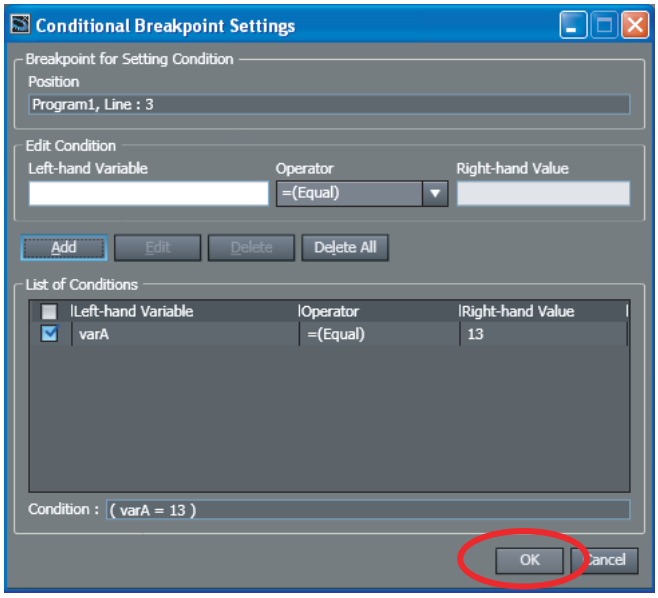


The following dialog box for editing is displayed.



For this example, here we have entered a conditional expression of VarA = 13. (*VarA* is the variable name.)

3 In the Edit Condition Area, enter the condition for breaking, and then click the **Add** Button.



4 Check to confirm that your conditional expression was added under *List of Conditions*, and then click the **OK** Button.

5 Click the **Run** Button in the Simulation Pane.

Execution pauses at the specified location when any of the specified breakpoint conditions are met.

6-3-2 Offline Debugging of Sequence and Motion Control Programs

You can visualize the operation of sequence and motion control programs in a Data Trace Tab Page. You use a Data Trace Tab Page for offline debugging when connected to the Simulator. You can use any of the following three formats on the Data Trace Tab Page.

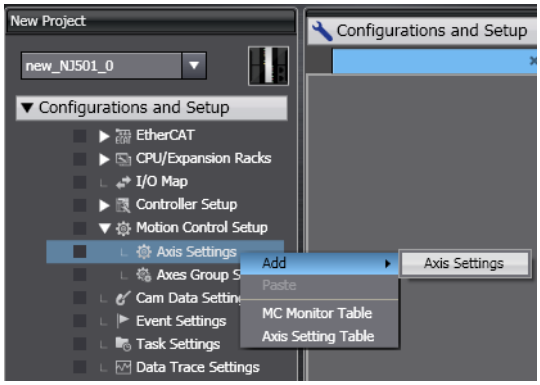
- Time chart graph for each variable
- Path graph for each axis
- 3D machine operation on 3D graph

Axis Settings for 3D Device Models

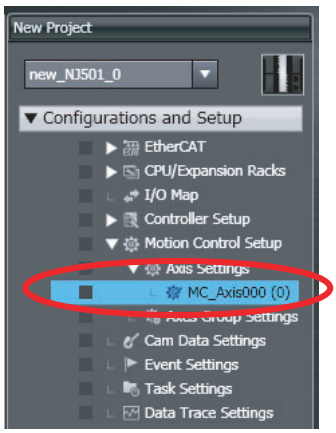
You must perform axis settings to link axis variables for motion control to a 3D device model composition. The following is an example of how to set up four axes in a 3D device model.

1 Add the axes in the Motion Control Setup.

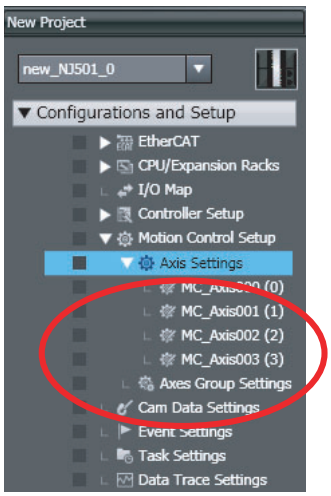
Right-click **Axis Setup** under **Configurations and Setup - Motion Control Setup** and select ***Add - Axis Settings*** from the menu.



As shown below, a new axis called MC_Axis000 (0) is added.



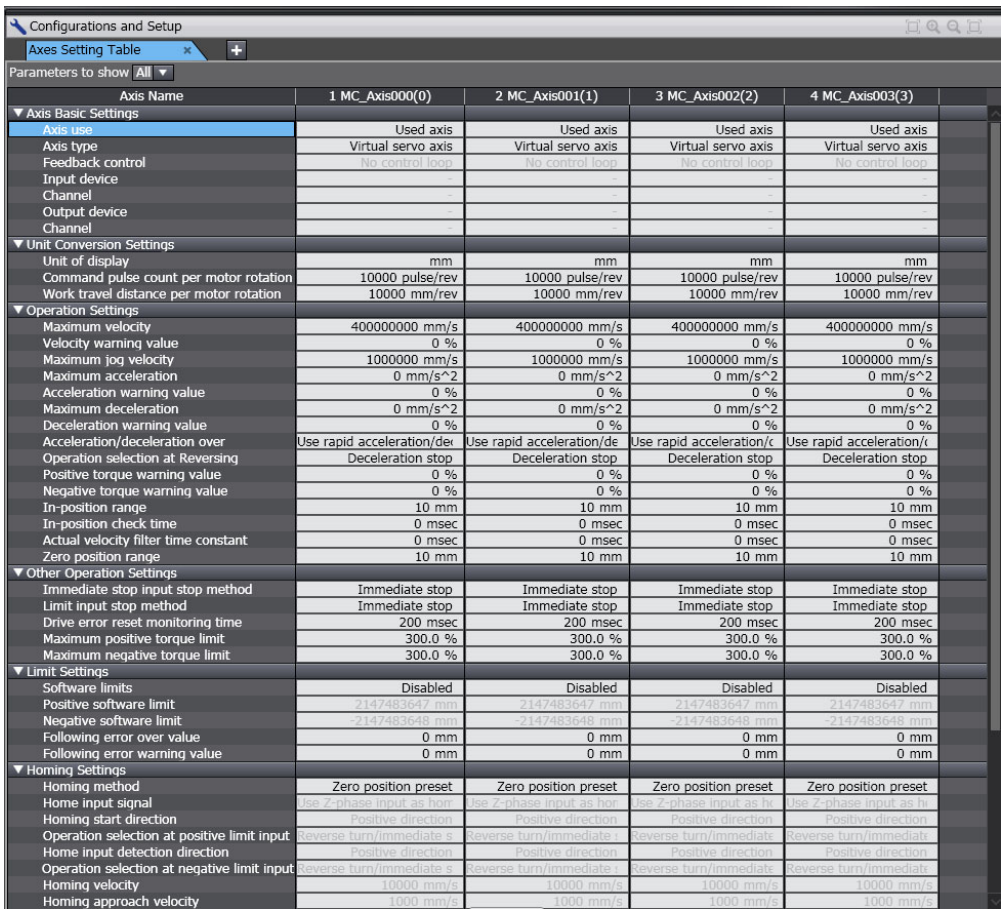
2 Perform the same steps three more times to add axes MCAxis001 (1) to MC_Axis003 (3).



3 Specify the axis settings.

Right-click **Axis Settings** and select ***Axis Setting Table*** from the menu. Enter the following settings for axes MC_Axis000 (0) to MC_Axis003 (3).

Item	Setting
Axis Use	Used axis
Axis type	Virtual servo or servo axis
Unit	mm



Configurations and Setup

Axes Setting Table

Parameters to show All

Axis Name	1 MC_Axis000(0)	2 MC_Axis001(1)	3 MC_Axis002(2)	4 MC_Axis003(3)
▼ Axis Basic Settings				
Axis use	Used axis	Used axis	Used axis	Used axis
Axis type	Virtual servo axis	Virtual servo axis	Virtual servo axis	Virtual servo axis
Feedback control	No control loop	No control loop	No control loop	No control loop
Input device	-	-	-	-
Channel	-	-	-	-
Output device	-	-	-	-
Channel	-	-	-	-
▼ Unit Conversion Settings				
Unit of display	mm	mm	mm	mm
Command pulse count per motor rotation	10000 pulse/rev	10000 pulse/rev	10000 pulse/rev	10000 pulse/rev
Work travel distance per motor rotation	10000 mm/rev	10000 mm/rev	10000 mm/rev	10000 mm/rev
▼ Operation Settings				
Maximum velocity	400000000 mm/s	400000000 mm/s	400000000 mm/s	400000000 mm/s
Velocity warning value	0 %	0 %	0 %	0 %
Maximum jog velocity	1000000 mm/s	1000000 mm/s	1000000 mm/s	1000000 mm/s
Maximum acceleration	0 mm/s^2	0 mm/s^2	0 mm/s^2	0 mm/s^2
Acceleration warning value	0 %	0 %	0 %	0 %
Maximum deceleration	0 mm/s^2	0 mm/s^2	0 mm/s^2	0 mm/s^2
Deceleration warning value	0 %	0 %	0 %	0 %
Acceleration/deceleration over	Use rapid acceleration/de	Use rapid acceleration/de	Use rapid acceleration/c	Use rapid acceleration/c
Operation selection at Reversing	Deceleration stop	Deceleration stop	Deceleration stop	Deceleration stop
Positive torque warning value	0 %	0 %	0 %	0 %
Negative torque warning value	0 %	0 %	0 %	0 %
In-position range	10 mm	10 mm	10 mm	10 mm
In-position check time	0 msec	0 msec	0 msec	0 msec
Actual velocity filter time constant	0 msec	0 msec	0 msec	0 msec
Zero position range	10 mm	10 mm	10 mm	10 mm
▼ Other Operation Settings				
Immediate stop input stop method	Immediate stop	Immediate stop	Immediate stop	Immediate stop
Limit input stop method	Immediate stop	Immediate stop	Immediate stop	Immediate stop
Drive error reset monitoring time	200 msec	200 msec	200 msec	200 msec
Maximum positive torque limit	300.0 %	300.0 %	300.0 %	300.0 %
Maximum negative torque limit	300.0 %	300.0 %	300.0 %	300.0 %
▼ Limit Settings				
Software limits	Disabled	Disabled	Disabled	Disabled
Positive software limit	2147483647 mm	2147483647 mm	2147483647 mm	2147483647 mm
Negative software limit	-2147483648 mm	-2147483648 mm	-2147483648 mm	-2147483648 mm
Following error over value	0 mm	0 mm	0 mm	0 mm
Following error warning value	0 mm	0 mm	0 mm	0 mm
▼ Homing Settings				
Homing method	Zero position preset	Zero position preset	Zero position preset	Zero position preset
Home input signal	Use Z-phase input as hom	Use Z-phase input as hom	Use Z-phase input as ho	Use Z-phase input as ho
Homing start direction	Positive direction	Positive direction	Positive direction	Positive direction
Operation selection at positive limit input	Reverse turn/immediate s	Reverse turn/immediate s	Reverse turn/immediate	Reverse turn/immediate
Home input detection direction	Positive direction	Positive direction	Positive direction	Positive direction
Operation selection at negative limit input	Reverse turn/immediate s	Reverse turn/immediate s	Reverse turn/immediate	Reverse turn/immediate
Homing velocity	10000 mm/s	10000 mm/s	10000 mm/s	10000 mm/s
Homing approach velocity	1000 mm/s	1000 mm/s	1000 mm/s	1000 mm/s

● Procedure

1 Add an axis to the Multiview Explorer and then set the parameters of the axis variable. Refer to *4-2-5 Motion Control Setup* for the setting procedure.

2 Create a program to operate the device. Refer to *Designing the User Program* on page 4-2 for the programming procedures.

3 Create the 3D device model with a data trace. Refer to *Creating 3D Device Models* on page 6-51 for the procedure to create 3D device models.

4 Register the trigger setting and variables to trace for the data trace. Refer to *6-2-9 Data Tracing* for the operating procedures for data tracing.

5 Execute a simulation. Refer to *Simulation Procedures* on page 6-57 for the execution procedures.

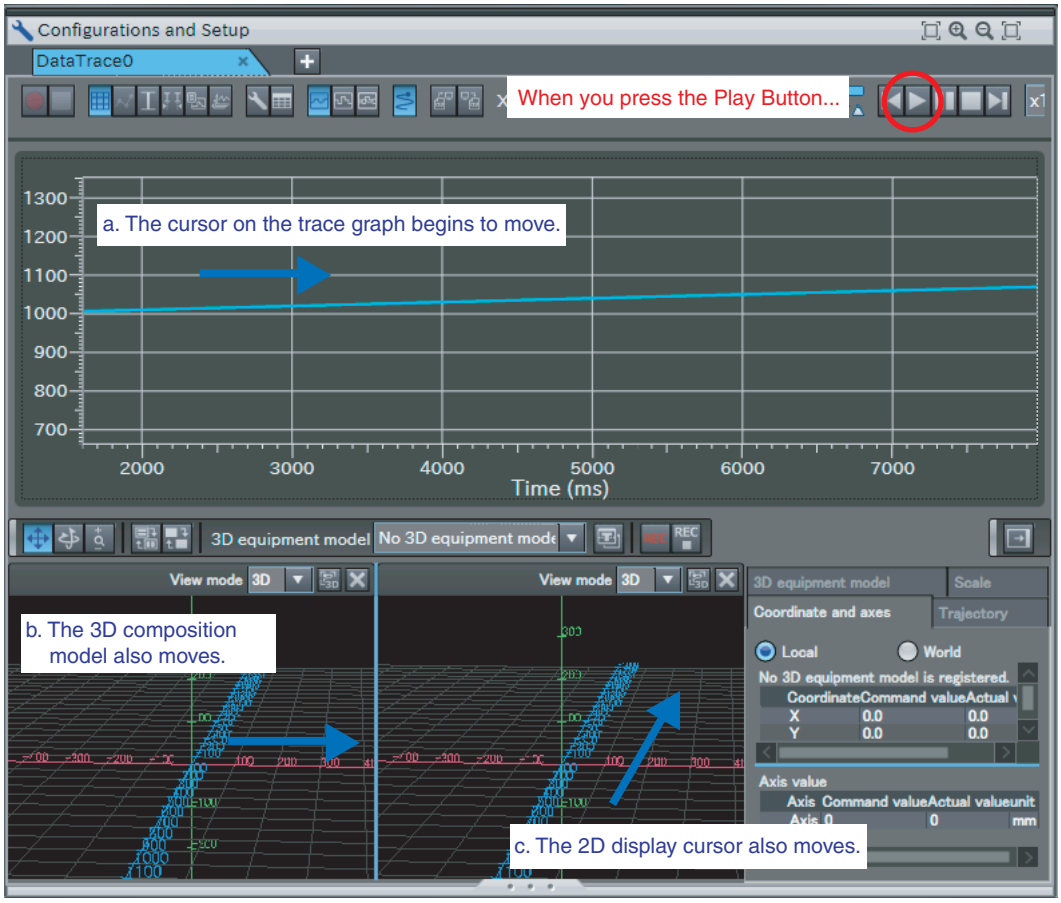
6 Start tracing the data with the data trace to sample the data.

7 Check the trace results on the Data Trace Tab Page.

8 Click the **Play** Button on the Data Trace Tab Page.

For example, the following move synchronously: a) the cursor on the trace graph, b) the 3D composition model, and c) the cursor in the 2D view.

Refer to *3D Motion Trace Display Mode* on page 6-45 for the operating procedures for 3D motion traces.



6-4 Online Debugging

● Online Debugging

You can check and adjust the operation of programs you develop by establishing an online connection between the Sysmac Studio and your NJ-series Controller, then changing variables to TRUE or FALSE, changing actual values, and performing other debugging tasks.

6-4-1 Preparations for Online Debugging

● Preparing for Online Debugging

The Sysmac Studio and NJ-series Controllers separate the variables that you use in the programs from the I/O information for external devices. Therefore, there is no longer any need to spend time defining the connection between variables and I/O information, as there was with the CS/CJ-series PLCs.

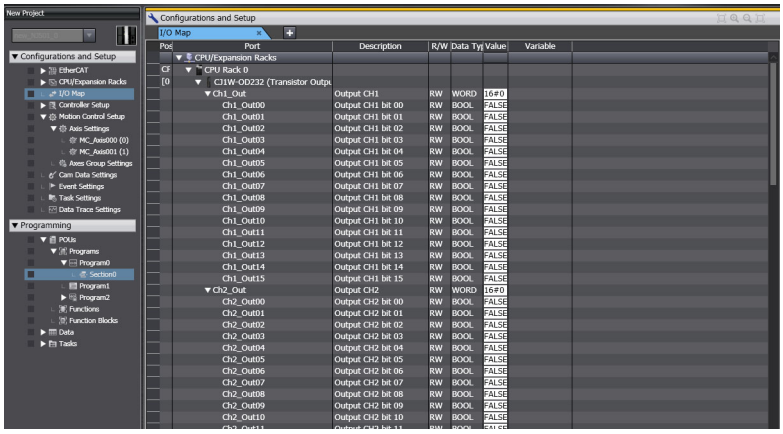
Assigning Variables and Real I/O

● Assigning Variables and Real I/O

Defining the connection between logic and physical devices means to define the connection between the variables used in the programs and the actual I/O information of the physical devices. Specifically, this involves assigning global variables and I/O ports.

● Procedure to Start Assigning Variables and Real I/O

1 Double-click **I/O Map** under **Configurations and Setup** on the Multiview Explorer.



Precautions for Correct Use

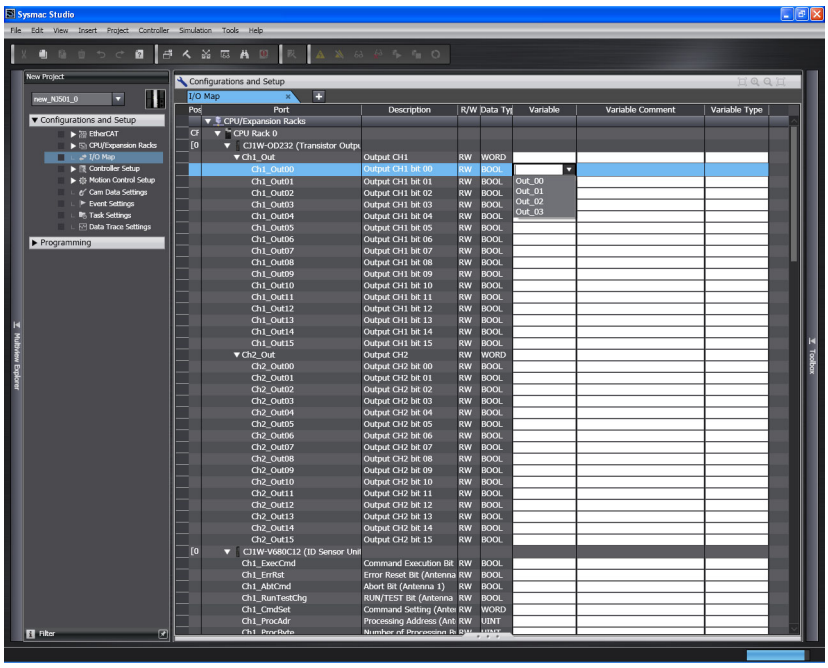
To perform this operation, the Units in the actual configuration must already be registered under **Controller Configurations and Setup** – **CPU/Expansion Racks**.

● Procedure to Assign Variables and Real I/O

Use the following procedure to assign a variable in the *Variable* Column to the I/O device in the *Port* Column.

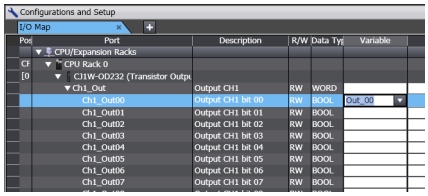
1 Click cell for the I/O device in the *Variable* Column. Or, move the cursor to the cell and press the **F2** Key.

This places you in Edit Mode and displays a list of the global variables.



2 Select a global variable from the list. (Click the global variable or move your cursor to the variable you want to select and press the **Enter** Key.) The specified variable is displayed as shown below.

You can also enter a variable directly. The list will be narrowed based on the text you enter so that you can more easily find the variable you need.



- To display I/O ports, you must register the Units in advance in **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. After registering a Unit, all I/O ports of that Unit are registered automatically.
- Click the icons in the *Port* Column (▶, ▼) to expand or collapse the display of I/O port configuration for the CPU Rack, Expansion Rack, or Unit.
- For variables to appear in the selection lists, you must first register them in the global variable table.
- You can also enter a variable directly from the I/O map to create a new global variable.

I/O Map Columns

The contents of the I/O Map columns are described below.

Column	Meaning	Editable
Position	Display information on the position of the Unit (for Rack or Unit lines only).	No
Port	Displays the networks and Units that the I/O port belongs to in a nested hierarchy. If more than one variable is registered to the same port, a caution icon and tooltip are displayed.	No
Description	Displays a description of the I/O port.	No
R/W	Displays the Read/Write attribute of the I/O port as shown below. Read only: R, Write only: W, Read/Write: RW	No
Data type	Displays the data type of the I/O port. The basic data types and arrays of the basic data types are displayed.	No
Variable	• You can enter a variable directly into the *Variable* cell to assign that variable to the port. • If the variable you enter is already assigned to another port, or if that variable is already defined under a different data type, an error icon and tooltip are displayed. • The variable assigned to the I/O port is displayed here. If no variable is assigned to the I/O port, this cell is blank. • Select ***Mapping List*** from the popup menu to display all variables assigned to the selected port.	Yes
Variable comment	• Displays comments for the variable. You can edit the comments. • If there is text in the *Variable* cell, you can edit the comment cell.	Yes
Variable type	• Displays the variable table that the device variable belongs to. You can edit the table. Select one of the following variable tables from the box. Global variables and registered programs, functions, and function blocks • If a variable is assigned to the I/O port, the variable table that the variable belongs to is displayed. If no variable is assigned to the I/O port, this cell is initially blank. If it is blank, the global variable table is selected.	Yes

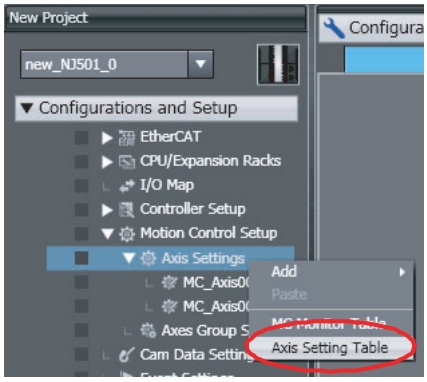
Assigning Axis Variables and EtherCAT Slaves

Assigning Axis Variables and EtherCAT Slaves

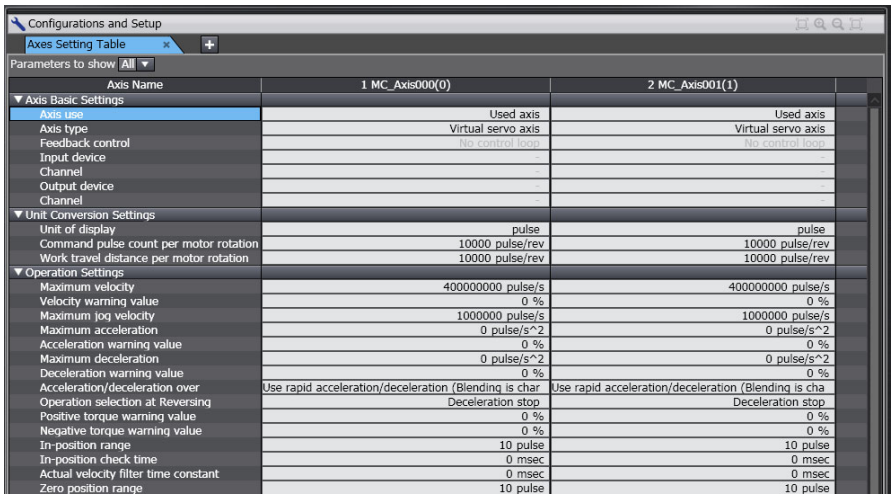
You assign Axis Variables to axis to define the motor axes that actually operate the device and the variables that are used in the programs.

Displaying the Axis Setting Table

1 Right-click **Axis Settings** under **Configurations and Setup - Motion Control Setup** on the Multiview Explorer and select ***Axis Setting Table*** from the menu.



The Axis Setting Table is displayed.



- To display axis variable names as the titles, you must register the axes in advance in **Axis Settings** under **Configurations and Setup - Motion Control Setup** in the Multiview Explorer.

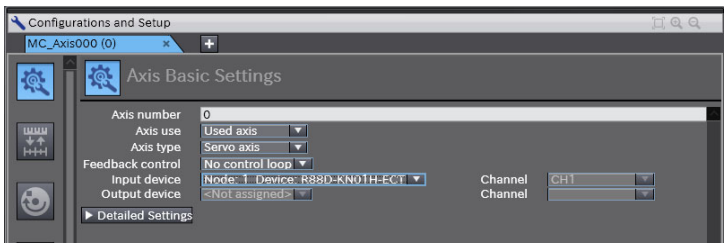
Procedure to Assign Axis Variables and EtherCAT Slaves

Use the following procedure to assign EtherCAT slaves to the Axis Variables that are registered in the Multiview Explorer.

1 Double-click the Axis Variable under **Configurations and Setup - Motion Control Setup - Axis Settings** in the Multiview Explorer. Or, right-click the Axis Variable and select ***Edit*** from the menu.

2 The Basic Axis Settings ( ) are displayed. Enter the axis number, axis use, axis type, and feedback information. You can select from the lists. Select the EtherCAT slave to assign from the list in the *Input device* Text Box.

The specified variable is displayed as shown below.



- You must register the axis to use for the axis variable in advance under **Configurations and Setup - Motion Control Setup - Axis Settings** in the Multiview Explorer. When you register an axis, the variable for that axis is automatically registered as well.
- For the EtherCAT slave to appear in the list in the Input device Text Box, an EtherCAT slave Axis Function Unit must be registered in advance under **Configurations and Setup - EtherCAT** in the Multiview Explorer. After registering an Axis Function Unit, the EtherCAT slave of that Unit is registered automatically.

6-4-2 Performing Online Debugging

WARNING

Check the user program for proper execution before you use it for actual operation.

Caution

Sufficiently confirm safety at the connected slave or Unit before you change the value of an I/O port or device variable. Not doing so may result in injury.

Always confirm safety at the destination node before you transfer parameters or data from the Sysmac Studio to another node. Not doing so may result in injury.

Precautions for Safe Use

- Unexpected operation may result if you transfer inappropriate network configuration settings. Even if appropriate network configuration settings are set, confirm that the controlled system will not be adversely affected before you transfer the data.
- Check the parameters for proper execution before you use them for actual operation.
- Always confirm the safety of the system before you change the operating mode of the Controller.
- Always confirm safety at the destination node before you transfer parameters or data from the Sysmac Studio to another node on the network configuration. Not doing so may result in injury.
- Before you restart operation, make sure that the required data, including device variables, the user program, and parameters, is transferred to a CPU Unit, Special I/O Unit, CPU Bus Unit, or externally connected device that was replaced.

Precautions for Correct Use

After you transfer the user program, the Controller is restarted. Communications with the EtherCAT slave is cut off for up to 45 seconds.
During that period, the slave outputs behave according to the slave settings.
Before you transfer the user program, confirm the safety of the controlled system.

Synchronizing (Uploading/Downloading after Automatic Verification)

Synchronizing

"Synchronize" means to automatically compare the data for the Sysmac Studio on the computer with the data in the NJ-series Controller and transfer the data in the direction that is specified by the user. Use the following procedure.

- Download: Select ***Synchronization*** from the Controller Menu, and then click the **Transfer To Controller** Button.
- Upload: Select ***Synchronization*** from the Controller Menu, and then click the **Transfer From Controller** Button.

Additional Information

As shown above, the Synchronize Menu Command is used to both upload and download data on the Sysmac Studio. The following terms are used in the NJ-series Controller manuals:

- Transferring data from the Sysmac Studio to the Controller: Download
- Transferring data from the Controller to the Sysmac Studio: Upload

Additional Information

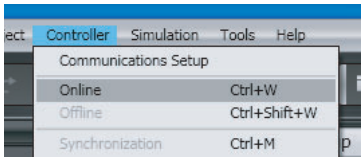
Information on synchronization is updated in the project file when synchronization is performed. After you perform synchronization, save the project file before you close it. If you do not save the project file, a message that says that the program execution IDs are different and that all data will be transferred is displayed the next time you perform synchronization.

Precautions for Correct Use

Do not perform any other operations on the Sysmac Studio while the Synchronize Pane is active. An error will occur and synchronization will fail.

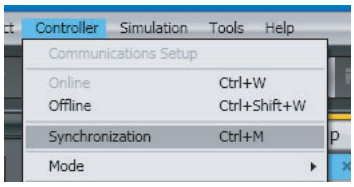
Automatic Verification Procedure

1 Physically connect the computer to the Controller and then select ***Online*** from the Controller Menu. (Or click the Button.)

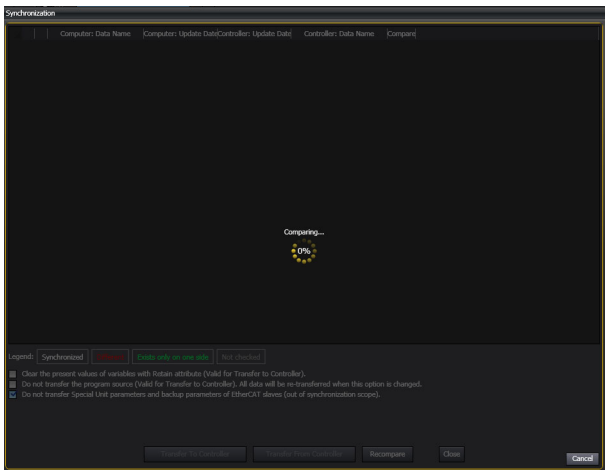


The Sysmac Studio goes online with the Controller.

2 Select ***Synchronization*** from the Controller Menu. (Or, click the Button on the toolbar.)

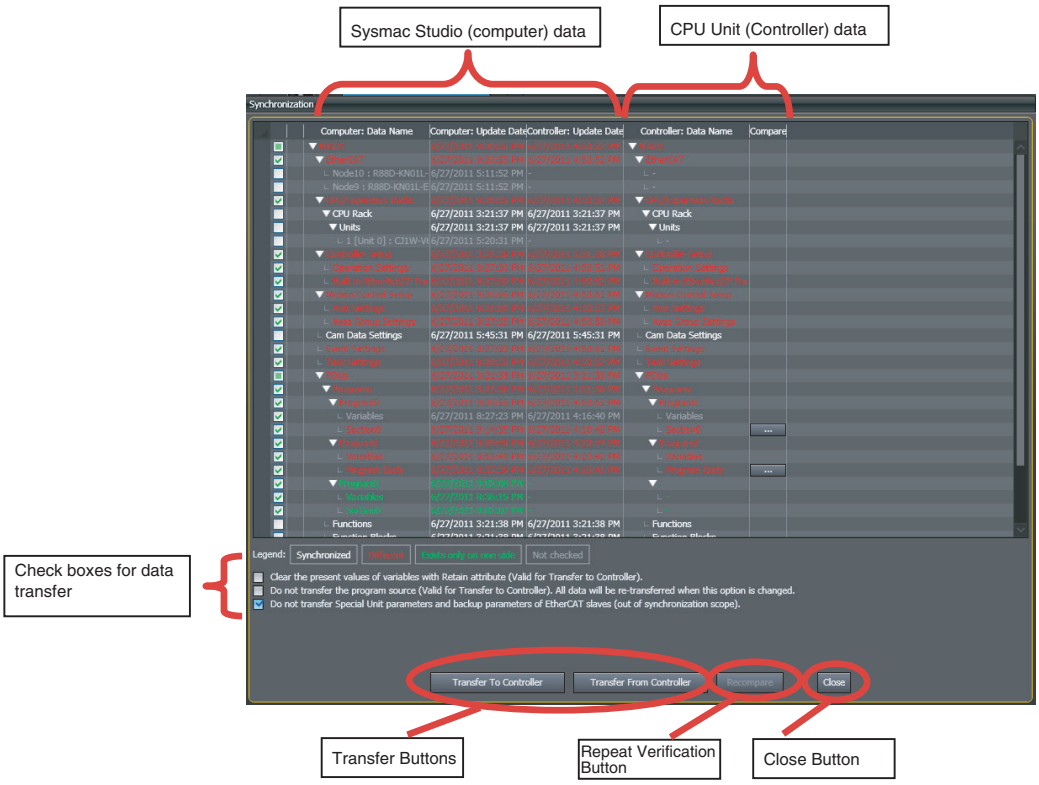


The Synchronization Pane is displayed in the same location as the Toolbox Pane, and verification of the user program and parameter settings between the Sysmac Studio and the Controller is started. You can press the **Cancel** Button to cancel the operation.



Verification Results

The verification results are displayed as shown below. When valid data is not present, - is displayed.



Verification Results Example

The verification results are displayed as shown in the following example.

Column	Item
Computer: Data name	Project name on the Sysmac Studio
Computer: Update Date	The last time that the project was built on the Sysmac Studio
Controller: Update Date	The project name on the NJ-series Controller
Controller: Data name	The last time that the project on the NJ-series Controller was built
Compare	*

* If ladder and ST program POUs are synchronized, a **Compare** Button ( ) is displayed in the *Details* Column. Refer to the following page for details.

Verification Units

The units for comparison that are shown in the Synchronization Pane are listed in the following table.

Synchronization data name	Level	Qty	Compare	Remarks
NJ501	1	1	None	
EtherCAT	2	1	None	
Slaves	3	N	None	Transferred to slaves.
CPU/Expansion Racks	2	1	None	
CPU Rack	3	1	None	Transferred to memory used for CJ-series Units.
Units	4	1	None	
Units	5	N	None	
Expansion Racks	3	1	None	
Units	4	1	None	
Units	5	N	None	
Controller Setup	2	1	None	
Operation Settings	3	1	None	
Built-in EtherNet/IP Port Settings	3	1	None	
Motion Control Setup	2	1	None	
Axis Settings	3	1	None	
Axes Group Settings	3	1	None	
Cam Data Settings	2	1	None	
CamProfile*	3	N	None	
Event Settings	2	1	None	
Task Settings	2	1	None	
POUs	2	1	None	
Programs	3	1	None	
Programs*	4	N	None	Ladder programs
Variables	5	1	None	Ladder programs
Section	5	N	Available	Ladder programs
Programs*	4	N	None	ST programs
Variables	5	1	None	ST programs
StructuredTextBody	5	1	Available	ST programs
Functions	3	1	None	
Function*	4	N	None	Ladder programs
Variables	5	1	None	Ladder programs
LadderBody	5	1	Available	Ladder programs
Function*	4	N	None	ST programs
Variables	5	1	None	ST programs
StructuredTextBody	5	1	Available	ST programs
Function Blocks	3	1	None	
FunctionBlock*	4	N	None	Ladder programs
Variables	5	1	None	Ladder programs
LadderBody	5	1	Available	Ladder programs
FunctionBlock*	4	N	None	ST programs
Variables	5	1	None	ST programs
StructuredTextBody	5	1	Available	ST programs

Synchronization data name	Level	Qty	Compare	Remarks
Data	2	1	None	
Data Types	3	1	None	
Global Variables	3	1	None	

Icons and Display Text Colors

The verification results are displayed with icons and display text colors.

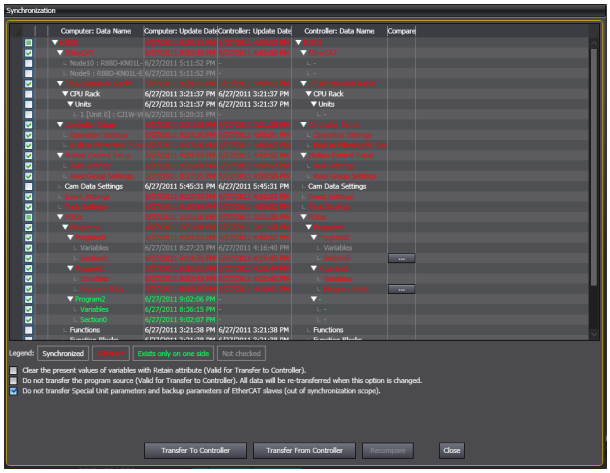
Icon	Text color	Status	Description
None	White	Synchronized	The Sysmac Studio data and NJ-series Controller data are the same.
	Red	Difference	The Sysmac Studio data and NJ-series Controller data are not the same. The following cases are displayed as differences. • When there is even one difference in the data for a verification item • When the display order of synchronized data is not the same (If the display order is not the same, the data is displayed in the order on the Sysmac Studio.)
	Green	Data missing	The data exists either only in the NJ-series Controller or only on the Sysmac Studio.
	Gray	Build not completed	The project is not built or an error has occurred.
		Non-synchronized data	This icon is displayed for parameters for CJ-series Special Units and EtherCAT slaves.

Repeating Verification

Click the **Compare Again** Button to repeat the verification.

● Uploading and Downloading Data

If there are any differences in the data, the following dialog box is displayed after automatic verification.



Procedure

1 Select the items to check for synchronization. The transfer process depends on which of these items are selected. This is shown in the following table.

Synchronization Check Items

Item	Default	When transfer is enabled	Description
Clear the present values of variables with Retain attribute (Valid for Transfer to Controller).	Not selected.	Values written to Controller	If this check box is selected, the present values of Retain variables are cleared after the data is downloaded.
Do not transfer the program source (Valid for Transfer to Controller). All data will be re-transferred when this operation is charged. *1	Not selected.	Values written to Controller	If this check box is selected, the program source code (restoration information) is not transferred (user program transfer with no restoration information). If this check box is selected, programs are not displayed when they are uploaded from another computer. However, variables and settings are transferred even if this check box is selected.
Do not transfer Special Unit parameters and backup parameters of EtherCAT slaves (out of synchronization scope). *2	Selected.	Transferred both direction	If this check box is selected, parameters are not transferred for any Units or EtherCAT slaves.

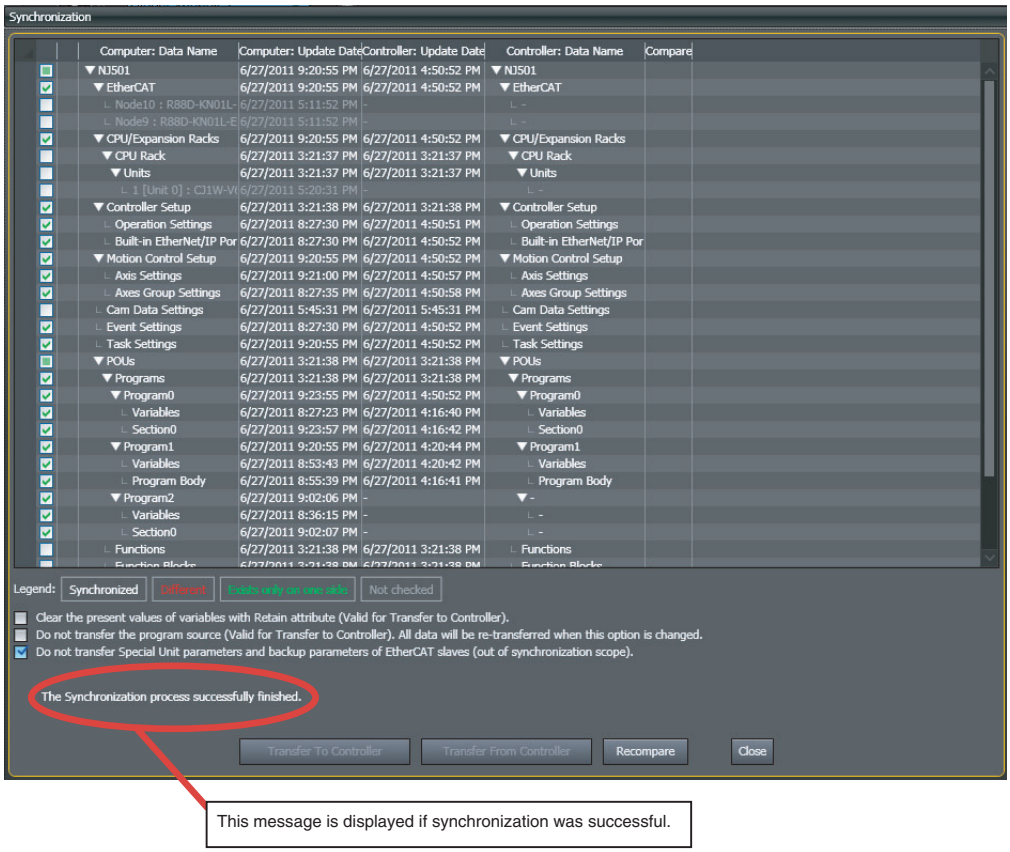
*1 When this check box is changed, all data is transferred for the first transfer performed.

*2 Data is not transferred if the data in the Controller and on the Sysmac Studio are not the same.

2 Select the items to transfer from the verification results in the Details Area of the Synchronize Pane.

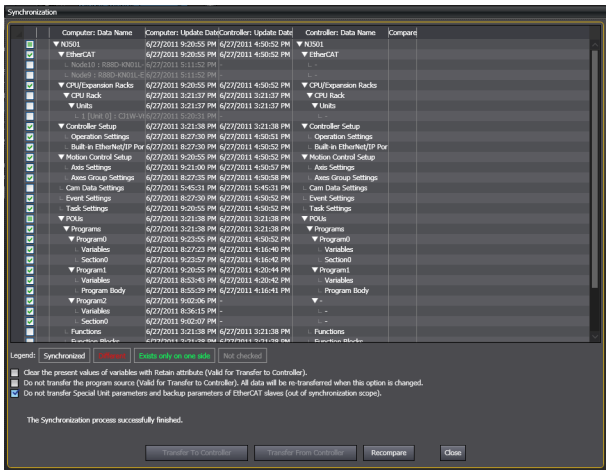
• If the data in the computer is correct	Click the **Transfer To Controller** Button (download).
• If the data in the Controller is correct	Click the **Transfer From Controller** Button (upload).

The Sysmac Studio data and NJ-series Controller data will be the same after the transfer.



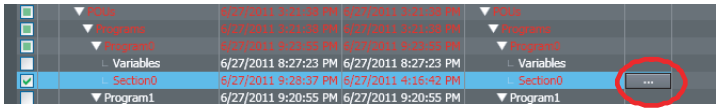
Closing the Synchronization Pane

Click the **Close** Button to close the Synchronize Pane.

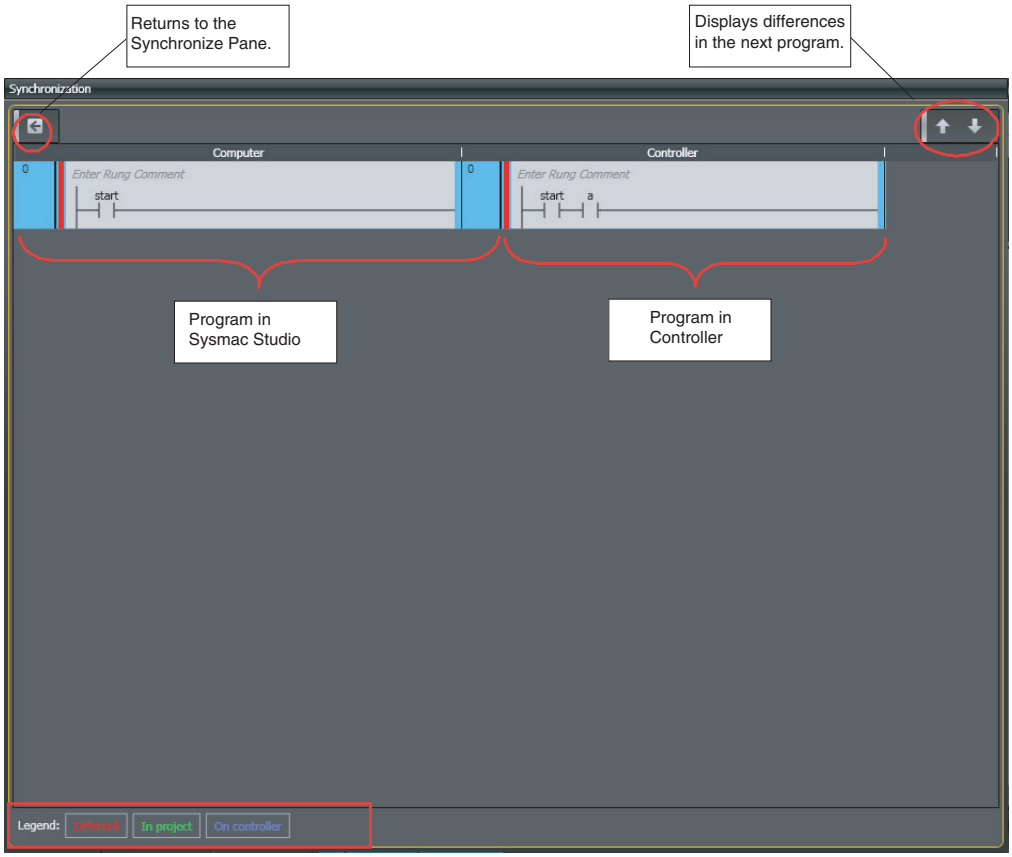


Verification Details

You can perform detailed verifications for POUs (i.e., ST and ladder programs, functions, and function blocks). Click the button in the *Compare* Column ( ) in the Synchronization Pane.



The Verify Details Pane is displayed.



The differences in the program on the Sysmac Studio are displayed with the following text colors.

Text color	Meaning
Gray	The rung or line is the same on the Sysmac Studio and the Controller.
Red	The rung or line exists on both the Sysmac Studio and the Controller, but there are differences.
Green	The rung or line exists only on the Sysmac Studio.
Blue	The rung or line exists only in the Controller.

● Synchronizing, Transferring, and Verifying the EtherCAT Configuration

Synchronizing, Transferring, and Verifying the EtherCAT Configuration

These functions allow you to synchronize data between the Sysmac Studio and an NJ-series Controller through various methods. You can transfer actual network configurations from the NJ-series Controller to the Sysmac Studio and transfer slave backup parameter settings between the Sysmac Studio and the NJ-series Controller.

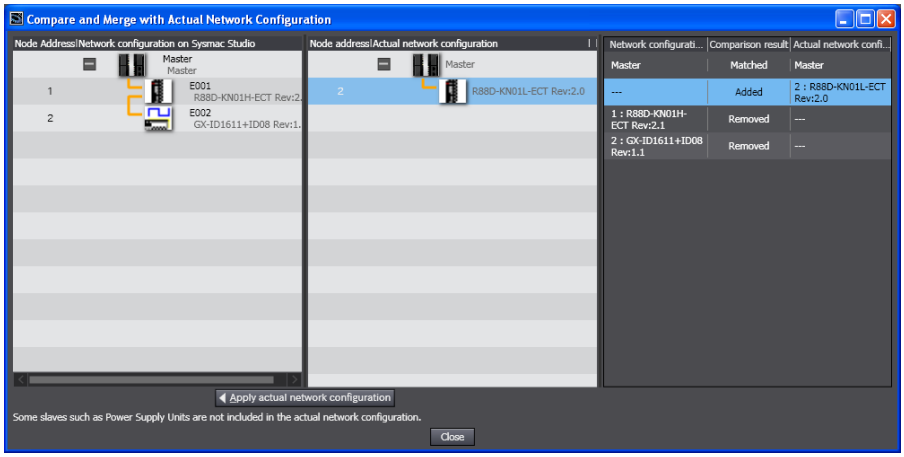
Procedure to Display the Actual Network Configuration Comparison and Merge Dialog Box

1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select ***Edit*** from the menu.

The Edit EtherCAT Configuration Tab Page appears on the Configuration layer.

2 Right-click the master in the Edit Network Configuration Tab Page and select ***Compare and Marge with Actual Network Configuration***.

The actual network configuration is read and compared with the network configuration on the Sysmac Studio. The results are displayed in the Actual Network Configuration Compare and Merge Window.



3 If there are slaves for which the comparison results do not match, correct the network configuration on the Sysmac Studio or correct the actual network configuration until the comparison results for all slave match.

To correct the network configuration in the Sysmac Studio, you can drag slaves from the actual network configuration to the Sysmac Studio network configuration, or you can delete slaves from the Sysmac Studio network configuration. If you correct the actual network configuration, click the **Close** Button, return to the Edit Network Configuration Tab Page and start the Compare and Merge with Actual Network Configuration Window again to confirm the comparison results again.

4 Click the **Close** Button.

The Edit Network Configuration Tab Page is displayed.

Additional Information

You can right-click a Unit in the actual configuration in the Compare and Merge Window and select ***Apply actual network configuration*** to use the actual network configuration information as the configuration information in the project. If you use this menu command, all of the variable assignments for I/O ports and I/O allocation settings in the task settings in the project will be cleared.

Additional Information

Matched, *Deleted*, *Added*, *Moved*, and *Connection Unmatched* are displayed in the *Comparison results* Column to give the results of comparing the network configuration on the Sysmac Studio with the actual network configuration. The following items are compared.

- Node addresses
- Vendor IDs
- Product codes
- Revisions
- Connection ports

The results that are displayed in the *Comparison results* Column have the following meanings.

Matched: All of the comparison items match for the slave.
Deleted: The slave exists only in the network configuration on the Sysmac Studio.
Added: The slave exists only in the actual network configuration.
Moved: The slave is connected in a different order.
Connection Unmatched: There is a difference in the connected Unit or connected port on the connected Unit for the slave.

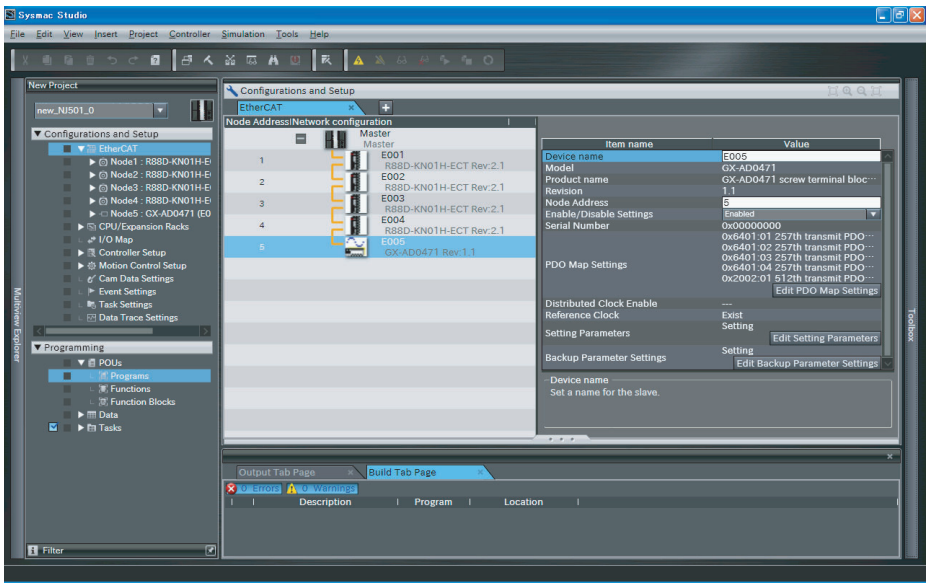
Precautions for Correct Use

- Make sure that the communications cables between the master and slaves are connected correctly before you perform this operation. The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if the connections are not correct. Refer to the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for information on the correct connection methods.
- The Compare and Merge with Actual Network Configuration Dialog Box is not displayed if there is a slave in the actual network configuration for which the node address is not set or if the same address is set for more than one slave in the actual network configuration. Make sure that node addresses are set correctly for the slaves in the actual network configuration before you perform this operation.
- When the compare and merge operation is performed, the synchronization between the Sysmac Studio and the Controller is lost. Synchronize the Sysmac Studio and Controller before you perform any online operations for the slaves. Refer to *6-4-2 Performing Online Debugging* for information on the synchronization operation.

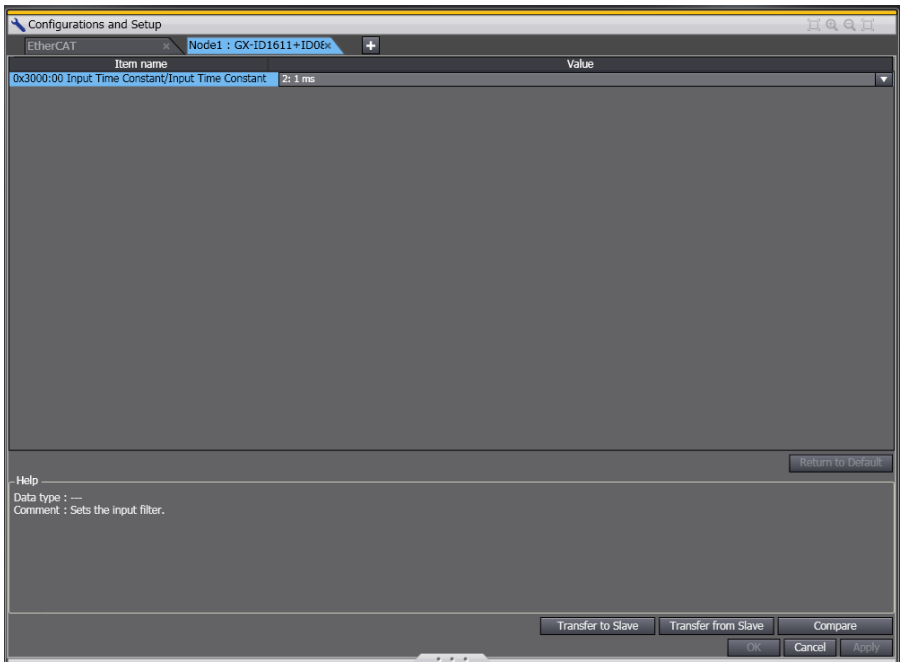
Procedure for the Comparison and Transfer of Backup Parameter Settings

1 Select the slave in the Edit Network Configuration Tab Page.

2 Click the **Edit Backup Parameter Settings** Button in the Slave Parameter Settings Area on the right of the network configuration.



The Edit Backup Parameter Settings Dialog Box for the selected slave is displayed.



3 Click the **Compare** Button.

The parameters in the Sysmac Studio are compared with the parameters from the slave. If any parameters are not the same, they are indicated with "≠" in the results.

4 Click the **Transfer from Slave** Button to transfer the backup parameter settings from the slave to the Sysmac Studio.

Click the **Transfer to Slave** Button to transfer the backup parameter settings from the Sysmac Studio to the slave.

● Synchronization, Transfer, and Comparison of CPU Rack and Expansion Rack Components

Synchronizing, Transferring, and Verifying the EtherCAT Configuration

These functions allow you to synchronize data between the Sysmac Studio and an NJ-series Controller through various methods. You can transfer the actual unit configuration from the NJ-series Controller to the Sysmac Studio and transfer Special Unit settings between the Sysmac Studio and the NJ-series Controller.

Procedure to Display the Unit Configuration Comparison and Merge Dialog Box

1 Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **CPU/Expansion Racks** under **Configurations and Setup** and select ***Edit*** from the menu.

The Unit Editor appears on the Configuration layer.

2 Right-click anywhere in the Unit Editor where there is no Unit and select ***Compare and Merge with Actual Unit Configuration***.

The actual Unit configuration is read and compared with the Unit configuration on the Sysmac Studio. The results are displayed in the Actual Unit Configuration Compare and Merge Window.

3 Click the ***Apply actual Unit configuration*** Button to synchronize with the actual configuration.

4 Click the **OK** Button. This returns you to the Unit Editor.

Additional Information

Matched, Deleted, Added, Moved, and *Version Unmatched* are displayed in the Comparison results Column to give the results of comparing the Unit configuration on the Sysmac Studio with the actual Unit configuration.
The following items are compared.

- Rack numbers
- Slot numbers
- Model numbers
- Unit versions of Special Units
- Unit numbers of Special Units

The results that are displayed in the *Comparison results* Column have the following meanings.

Matched: All of the comparison items match for the Unit.

Deleted: The Unit exists only in the Unit configuration on the Sysmac Studio.

Added: The Unit exists only in the actual Unit configuration.

Moved: A Unit has the same model number, Unit version, and unit number, but the rack number or slot number is different.

Version unmatched: The unit version of the Unit does not match.

Precautions for Correct Use

If you select to unify to the actual Unit configuration, all of the settings for any Units that are deleted as a result will be discarded (including the I/O response times, Special Unit settings, device variable assignments in the I/O map, and control task assignments in the Task setup). If the slot position of a Basic I/O Unit is different, first correct the Unit configuration on the Sysmac Studio so that the slot positions agree in the comparison and then specify unifying to the actual Unit configuration.

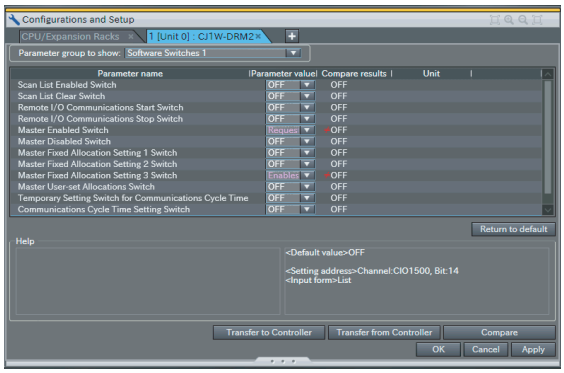
Procedure for Comparison and Transfer of the Special Unit Settings

1 Double-click a Unit in the Unit Editor, or right-click and select ***Edit Special Unit Settings***.

The Edit Special Unit Settings Dialog Box for the selected Unit is displayed.

2 Click the **Compare** Button.

The parameters in the Sysmac Studio are compared with the parameters from the NJ-series Controller. If any parameters are not the same, they are indicated by “≠” in the results.



3 To synchronize the Controller settings with the set values in the Sysmac Studio, click the **Transfer To Controller** Button. This transfers the set values from your computer to the Controller.

Testing Axis Operation (MC Test Run)

You can send commands directly from the Controller without any ladder diagrams to operate a motor in order to check wiring or perform simple operation tests on any OMRON Servo Drive assigned to an axis.

Precautions for Safe Use

- Confirm the axis number carefully before you perform an MC Test Run.
- An MC Test Run operation involves motor operation. Refer to the operation manual before you execute an MC Test Run. Be particularly careful of the following points.
  - Confirm safety around all moving parts.
  - When you click the **Run** Button, the motor begins actual operation at the specified velocity. Only begin motor operation if you are absolutely sure there is no danger if you start the motor.
  - Always have an external emergency stop device available.
  - Sometimes you may be unable to stop the motor from your computer. Install an external emergency stop device so that you can stop the motor immediately if needed.
  - Only operate the motor when you can clearly confirm the motor operation so that you can react quickly in the case of any danger that may arise due to operation of the motor.
  - Perform test run operations after establishing EtherCAT communications.
  - A communications error will occur if you attempt to begin operations without EtherCAT communications. Always establish EtherCAT communications first.
- Precautions during MC Test Run Operation
  - During test run execution, only the Sysmac Studio has any control of the operation. Any commands from motion control instructions are ignored.
  - Make sure that you are operating the correct axis.

Precautions for Correct Use

Before you start an MC Test Run, make sure that the operation parameters are set correctly.

● How to Perform MC Test Run

To begin a test run, the following items must be registered or set, and then transferred to the Controller. (Refer to *4-2-5 Motion Control Setup* for detailed settings.)

- Registration of the axes
- Registration of the slave (Servo) to use

- Links between the axis and slave

You cannot start an MC Test Run in the following condition.

- When the Simulator is online
- During an MC Test Run

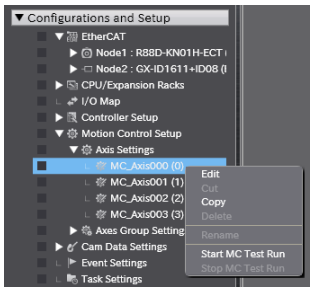
Let's look at an example that performs jogging of MC_Axis000 to demonstrate how to do a test run.

1 Eliminate any building errors in the project.

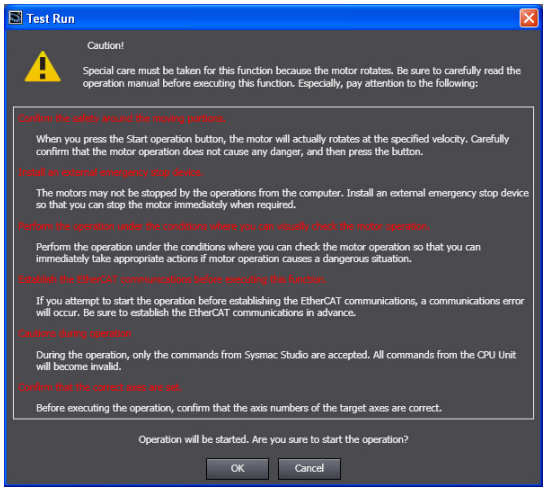
If you will create a new project, delete the programs.

2 Go online.

3 Right-click **MC_Axis000** under **Configurations and Setup** – **Motion Control Setup** – **Axis Settings** on the Multiview Explorer and select ***Start MC Test Run*** from the menu.

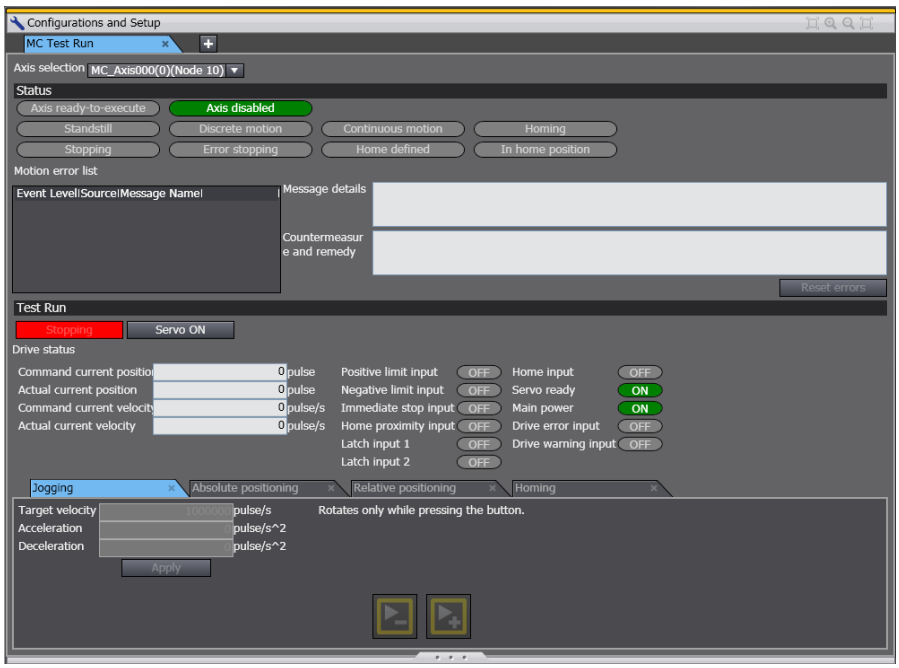


A warning message is displayed.

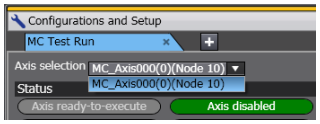


4 Check the items and then click the **OK** Button.

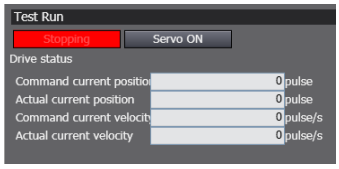
The MC Test Run Tab Page is displayed.



5 Select the target axis (MC_Axis000) at the upper left of the MC Test Run View.



6 Click the **Servo ON** Button.



The Servo turns ON and motor control is enabled.

7 Click the **Jogging** Tab, and then perform the following operations.

- Click and hold the **Rotate CW** Button ( ). The motor rotates clockwise as long as you hold the button.
- Click and hold the **Rotate CCW** Button ( ). The motor rotates counterclockwise as long as you hold the button.

8 Right-click **MC_Axis000** under **Configurations and Setup - Motion Control Setup - Axis Setup** on the Multiview Explorer and select ***Stop MC Test Run*** from the menu.

Test Run Mode is left.

● MC Test Run Tab Page Functions

The MC Test Run View is made up of the Status Monitor and Test Run sections.

Status Monitor Section

The status monitor displays axis status, motion errors and details on them, and corrections for any errors that have occurred. You can also reset motion control errors and start the Servo error monitor.

Function	Description
Status	Displays information about the status of an axis (ready to execute, axis disabled, stopped, in a discrete motion, in continuous motion, homing, decelerating to a stop, decelerating to a stop due to an error, home defined, and stopped at home).
Motion Error List	Displays a list of errors that have occurred in the motion control functions. The *Message Details* Area gives details on the error and the *Correction* Area contains information about how to fix the error.
Reset Errors	Resets all errors that have occurred in the motion control functions. Select an error from the list of errors that have occurred to display detailed information about that error in the *Message Details* Area. Possible solutions to that error can be found in the *Corrections* Area.

Test Run Section

A test run allows you to operate a motor using the motion control patterns listed below without any programming. You can switch between each pattern by clicking on the different tabs in this section.

Pattern	Description
Jogging	Jogs the Servomotor. This operation is only performed while the button is clicked and held.
Absolute positioning	Performs positioning towards the target position at the specified acceleration/deceleration rate. Specify the target position as an absolute value.
Relative Positioning	Performs positioning towards the target position at the specified acceleration/deceleration rate. Specify the target position as a relative value from the actual position.
Homing	Performs homing based on the homing settings in the axis parameters.

You can use the following functions to switch between different motions for the axis in operation.

Function	Contents
Stopping Button	Decelerates the axis in operation to a stop.
Servo ON/OFF Button	Toggles the Servo ON and OFF.
Servo Drive Status	Displays connected Servo parameters.

Changing the Operating Mode

● Operating Modes

There are two operating modes for NJ-series Controllers, depending on if control programs are executed or not. These are RUN mode and PROGRAM mode.

Precautions for Safe Use

Always confirm the safety of the system before you change the operating mode of the Controller.

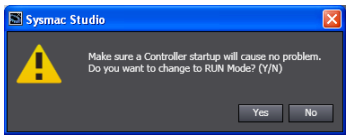
● Procedure for Changing the Operating Mode

Use the following procedure to change the operating mode of the connected Controller.

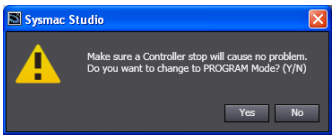
1 Select ***Mode - RUN Mode*** or ***Mode - PROGRAM Mode*** from the Controller Menu.

One of the following confirmation dialog boxes is displayed.

Changing from PROGRAM to RUN Mode



Changing from RUN to PROGRAM Mode



2 Confirm that no problem will occur even if you change the operating mode, and then click the **Yes** Button.

- To change the operating mode of the Simulator, select ***Run***, ***Stop***, or ***Pause*** from the Simulation Menu. A confirmation dialog box is not displayed for the Simulator.
- When you change the operating mode, the values of all I/O devices except for those for variables with a Retain attribute are cleared.
- I/O devices are refreshed even in PROGRAM mode. Check for any external influences on I/O device operations before you change the operating mode.

Resetting the Controller

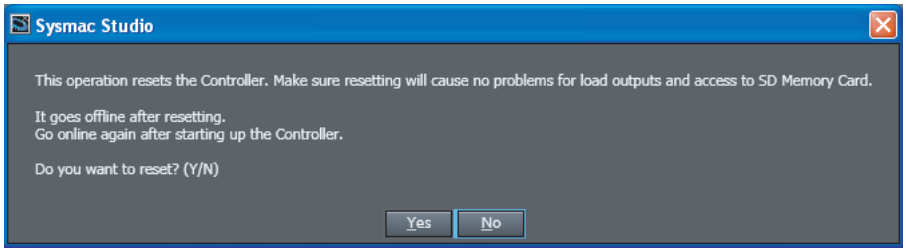
Resetting the Controller

A Controller reset emulates the operations and status when the power supply to the Controller is cycled. This can be performed only in PROGRAM Mode. You cannot reset the Controller in RUN Mode. You also cannot reset the Controller when connected to the Simulator.

Procedure

1 Select ***Reset Controller*** from the Controller Menu.

A confirmation dialog box is displayed.



2 Confirm that no problem will occur even if you reset the Controller, and then click the **Yes** Button.

Precautions for Safe Use

Always confirm the safety of the system before you reset Controller.

Precautions for Safe Use

It takes up to approximately 10 to 20 s to enter RUN mode after the power is turned ON. During that time, outputs are OFF and external communications are not performed. Use the RUN output on the Power Supply Unit, for example, to implement fail-safe circuits so that external devices do not operate incorrectly.

Additional Information

After a reset is performed, the Sysmac Studio goes offline.

7

Other Functions

This section describes Sysmac Studio functions other than system design functions.

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7-1 SD Memory Card Operations

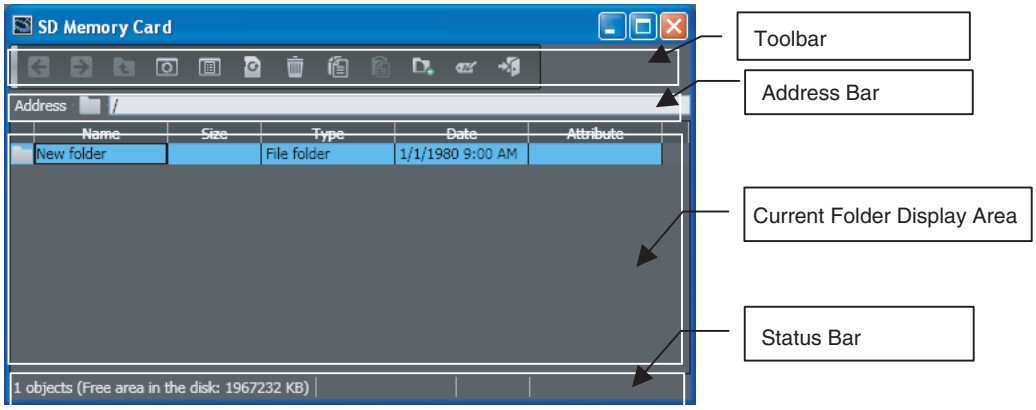
● SD Memory Card Operations

The following procedures are used to execute file operations for the SD Memory Card mounted in the Controller and to copy files between the SD Memory Card and computer.

7-1-1 SD Memory Card Pane Procedures

1 Select ***SD Memory Card*** from the Controller Menu when online.

The SD Memory Card Pane is displayed.



Overview of the SD Memory Card Pane

● Toolbar

Use the buttons in the toolbar or shortcut keys to execute SD Memory Card file operations.

Button	Operation (shortcut)	Function
	Back (Alt + ←)	Returns to previous file or folder.
	Forward (Alt + →)	Goes forward to next file or folder.
	Up (Backspace)	Goes to one higher folder.
	Update (F5)	Updates the display to the latest information.
	Properties (Alt + Enter)	Used to display the properties and change the attributes of the selected file or folder (cannot be used when no file or folder is selected or when more than one file or folder is selected).
	Initialize SD Memory Card (Ctrl + Alt + A)	Formats the SD Memory Card.
	Delete (Del)	Deletes the selected files or folders.
	Copy (Ctrl + C)	Copies the selected files or folders.
	Paste (Ctrl + V)	Pastes the copied files or folders.

Button	Operation (shortcut)	Function
	New Folder (Ctrl + Alt + F)	Creates a new folder in the current location.
	Rename (F2)	Changes the name of the selected file or folder (cannot be used when no file or folder is selected or when more than one file or folder is selected).
	Exit (Alt + F4)	Ends SD Memory Card operations.

● Address Bar

The address bar displays the current folder on the SD Memory Card. You can also specify the folder you need.

● Current Folder Display Area

This area displays a list of the files in the current folder on the SD Memory Card. The following items are displayed. Click a title to sort the files by that item.

Title	Description
Name	File/folder name (long file names)
Size	Actual file size (Kbytes)
Type	Type of file registered on the computer
Date	Time and date the file was modified
Attribute	R: Read only

● Status Bar

The status bar displays information on the files in the current folder on the SD Memory Card. The following items are displayed.

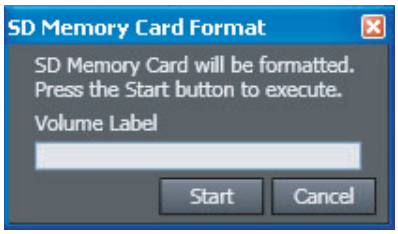
Item	Description
Status	Number of objects in the file list (number of files and folders) **Note** “SD Memory Card is not inserted or not formatted” is displayed if an SD Memory Card is not inserted, power is not supplied to the SD Memory Card , or the SD Memory Card is not formatted.
Volume Label	The volume label of the SD Memory Card
Free Area	The size of free area in the SD Memory Card (KB)

SD Memory Card Procedures

● Formatting an SD Memory Card

1 Click the **Format** Button ( ).

A confirmation dialog box is displayed.



2 Click the **Start** Button.

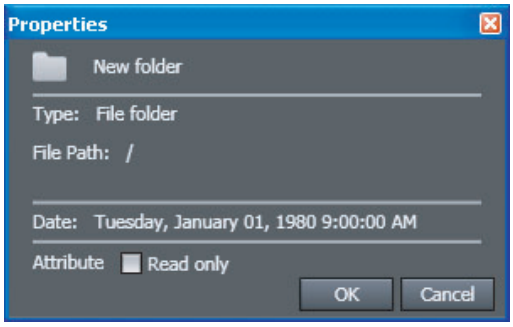
Displaying Properties

1 Select the file or folder.

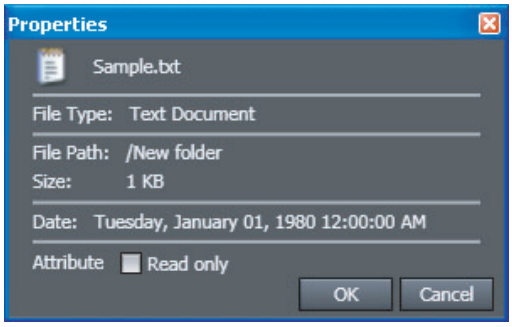
2 Click the **Properties** Button ( )

The properties of the selected file or folder are displayed.

When a Folder Is Selected



When a File Is Selected



Copying Files and Folders in the SD Memory Card

1 Select files or folders and click the **Copy** Button ( ).

2 Specify the copy destination, and then click the **Paste** Button ( ).

The selected files or folders are copied.

Copying Files and Folders between the SD Memory Card and the Computer

Copying Files and Folders from the SD Memory Card to the Computer

1 Select files or folders in the SD Memory Card Pane, and then click the **Copy** Button ( ).

2 Specify the copy destination in Windows Explorer, and then paste the files or folders (Ctrl + v).

The selected files or folders are pasted.

Copying Files and Folders from the Computer to the SD Memory Card

1 Select and copy files or folders in Windows Explorer (Ctrl + c).

2 Specify the copy destination in the SD Memory Card Pane, and then click the **Paste** Button ( ).

The selected files or folders are pasted.

Precautions for Correct Use

- Multibyte characters (e.g., Japanese) cannot be used in the CPU Unit even if they can be used on the computer.
- You can create up to 511 files in the root directory.
  You cannot create this many files if you use MS-DOS 8.3 file names or long file names.

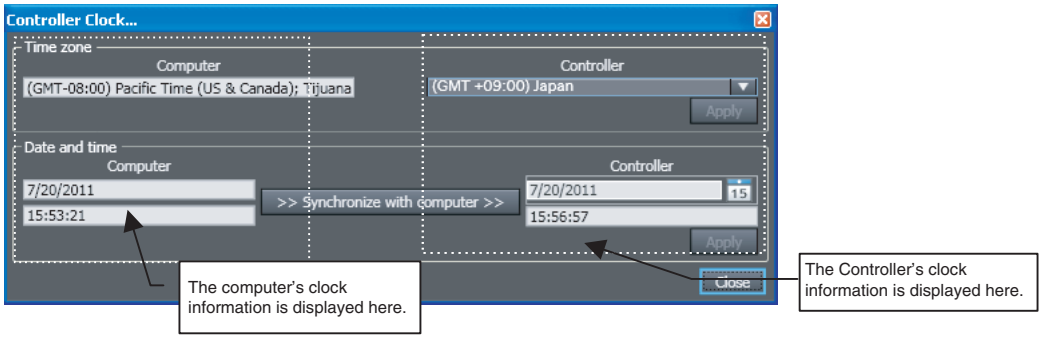
7-2 Clock Information Settings

The computer's clock information is also displayed. You can read and set the Controller's clock.

● Displaying and Setting Clock Information

This function can be used only online.

1 Select ***Controller Clock*** from the Controller Menu of the Sysmac Studio.



2 Click the **Synchronize with computer** Button to synchronize the Controller's clock information with the computer's clock information.

3 Click the **Apply** Button to set the clock in the Controller.

7-3 Security Settings

To protect assets and prevent incorrect operation, you can protect user programs and data in the Controller and restrict operations in the Sysmac Studio.

● Overview of Security Settings

An overview of the applications and functions of security settings is given below.

Function	Application	Outline of function
Operation authority verification	Prevention of incorrect operation	This limits the operations that each operator can use based on the authority of the operator.
User program execution ID	Prevention of the theft of assets	This ensures that a user program cannot be operated on another CPU Unit even if copied.
Write Protect Setting Switch	Prevention of incorrect operation	You can prevent rewriting data in the Controller.

7-3-1 Operation Authority Verification

If you change the data in the Controller, operating errors may cause human injury or physical damage. You can restrict the operations that each operator can perform based on the authority of the operator to prevent operating mistakes.

Operation Authority Verification

● Operation Authority Verification

You can restrict online operations with operation rights to prevent damage to equipment or injuries that may be caused by operating mistakes.

An operation authority password is required to go online. If you pass password verification, you can perform online operations according to your operation authority.

The Administrator sets a password for each operation authority. Users are notified of the operation authority name and password according to their skills.

Verification of operation authority is performed when you access the Controller from another computer, because the Operation Authority Verification Settings are transferred to the Controller and stored there.

Precautions for Correct Use

- You can set operation authority verification only online.
- Only the Administrator can change operation authority verification or transfer it to the Controller.

Types of Operation Authorities

There are two types of operation authority for the Sysmac Studio, as given below.

Administrator
Maintainer

Applicable Online Operations

The functions, authorities, and operation restrictions that require verification are given below.

OK: Operation possible, VR: Verification required for each operation, NP: Operation not possible

Monitoring status	Administrator	Maintainer
Monitoring Controller status	Supported	Supported
Monitoring the status of Special Units I/O and slaves	Supported	Supported
Troubleshooting and event logs	Supported	Supported

Operations to monitor I/O	Administrator	Maintainer
Reading I/O	Supported	Supported
Writing I/O	Supported	Supported
Changing BOOL variables to TRUE/FALSE (SET/RESET)	Supported	Supported
Forced refreshing (TRUE/FALSE/Clear)	Supported	Supported

Controller operations	Administrator	Maintainer
RUN mode	Supported	VR
PROGRAM mode	Supported	VR
Online editing	Supported	VR
Releasing access rights	Supported	NP
Clearing all memory	Supported	NP
Resetting the Controller	Supported	NP
Resetting errors (troubleshooting)	Supported	Supported
Clearing event logs (error logs)	Supported	Supported
Controller clock	Supported	NP
SD Memory Card operations	Supported	Supported

Transfer operations	Administrator	Maintainer
Synchronization **Note** Uploading or downloading.	Supported	Supported
Transferring data to the Controller from the Unit Editor	Supported	Supported
Transferring data from the Controller from the Unit Editor	Supported	Supported
Transferring data to the Controller from the EtherCAT Configuration Display Tab Page	Supported	Supported
Transferring data from the Controller from the EtherCAT Configuration Display Tab Page	Supported	Supported
Transferring operation authority verification settings	Supported	NP

Backup and restore operations	Administrator	Maintainer
Backing up variables and memory	Supported	Supported
Restoring memory	Supported	NP

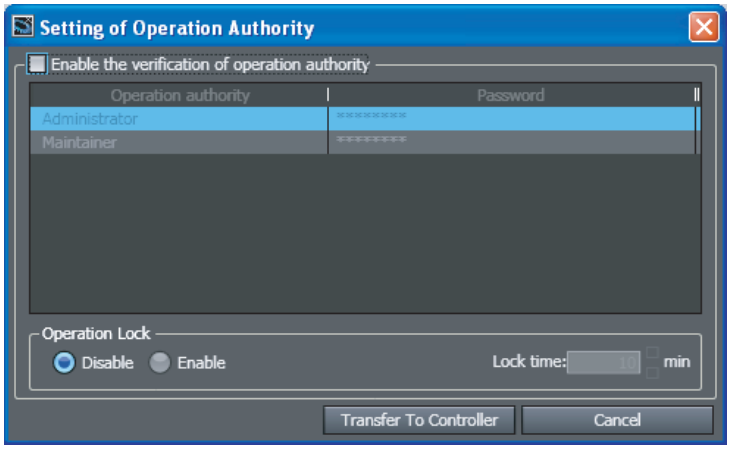
Password Setting Ranges

Item	Description
Valid number of characters	8 to 32
Applicable characters	Single-byte alphanumeric characters (case sensitive)

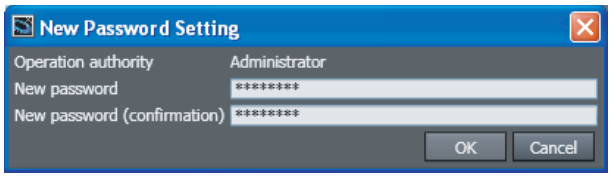
Procedure for Setting New Authorities

1 Select ***Security - Setting of Operation Authority*** from the Controller Menu.

The Setting of Operation Authority Dialog Box is displayed.



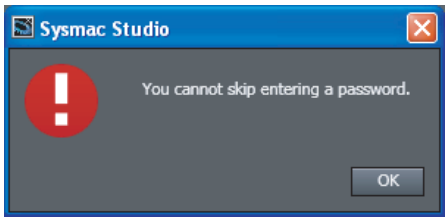
2 Select the *Enable the verification of operation authority* Check Box and double-click *Administrator* in the *Operation authority* Column.



3 Enter the Administrator's password in the *New password* textbox. Enter the same password in the confirmation field, and click the **OK** Button.

4 Set the Maintainer's password in the same way.

You cannot omit the Maintainer's password. Always set the Maintainer's password. If it is omitted, the following confirmation dialog box is displayed.



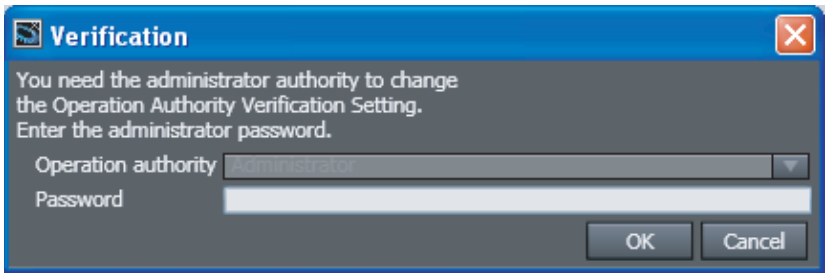
5 Enter the Administrator's and Maintainer's passwords, and then click the **Transfer To Controller** Button to write the settings into the Controller.

Procedure for Changing Authority Verification Settings

You cannot change authority verification settings unless you are the Administrator.

1 Select ***Security - Setting of Operation Authority*** from the Controller Menu.

The Administrator Authentication Dialog Box is displayed.



2 Enter the Administrator's password, and click the **OK** Button.

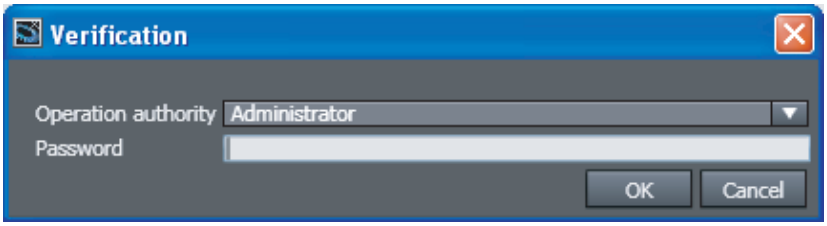
3 Use the same procedure as for a new password to set the password in the Setting of Operation Authority Dialog Box.

Verification When Going Online

When operation authority verification is set on the Controller, operation authority verification is performed when going online. If verified, you can perform online operations according to your authority.

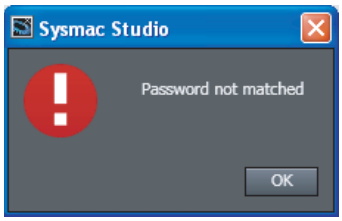
● Procedure for the Verification Dialog Box

The Verification Dialog Box is displayed when you attempt to go online.



1 Select the operation authority, enter the password, and click the **OK** Button. The following warning is displayed if the password does not match.

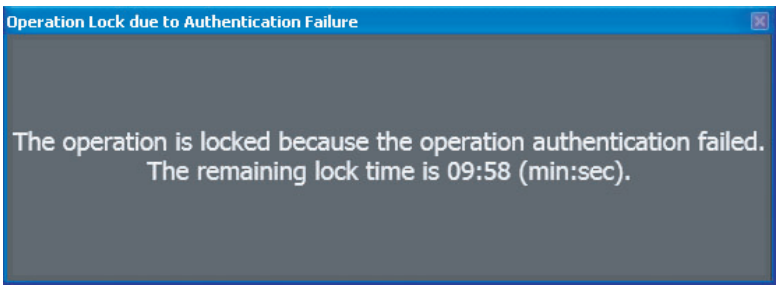
Click the **OK** Button, and then try to go online again.



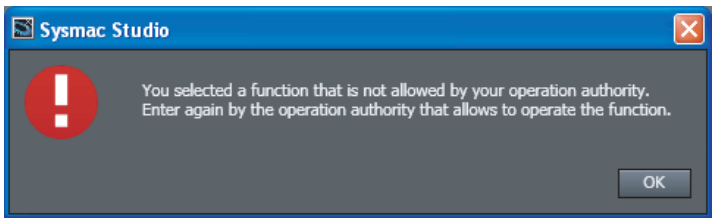
Verification for Individual Operations

Verification is performed each time a user with a certain authority or lower performs an operation that may damage equipment or cause injury due to incorrect operation. Refer to *Applicable Online Operations* on page 8 for information on the applicable operations.

Be careful when you enter the password in the Verification Dialog Box. The Sysmac Studio is locked for 10 minutes if you enter the wrong password 5 times.



If you select an operation that cannot be used with the current authority, the following error message is displayed and the operation is not performed.



Go online again and change the operation authority before you perform the operation.

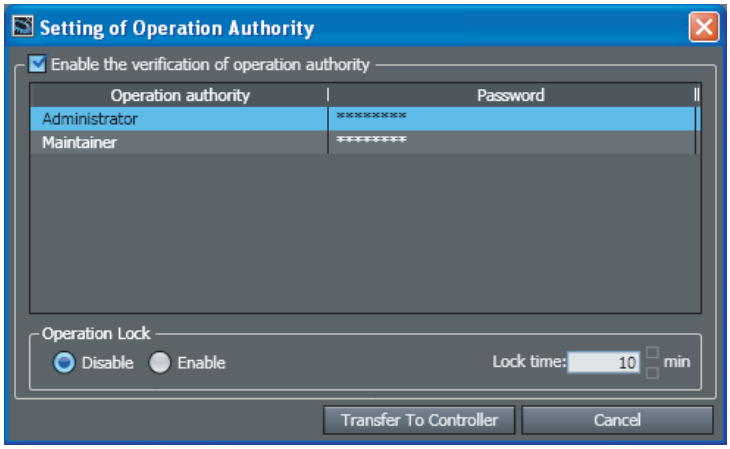
Operation Lock

You can set a lock on verification to prevent user operations if there are no user operations for the time that is specified in the Setting of Operation Authority Dialog Box. This prevents the wrong user from mistakenly performing operations. If operation is locked, you need to perform verification again. Operation authority must be set to use the operation lock. It cannot be used alone.

● Procedure to Set the Operation Lock

1 Select ***Setting of Operation Authority*** from the Controller Menu.

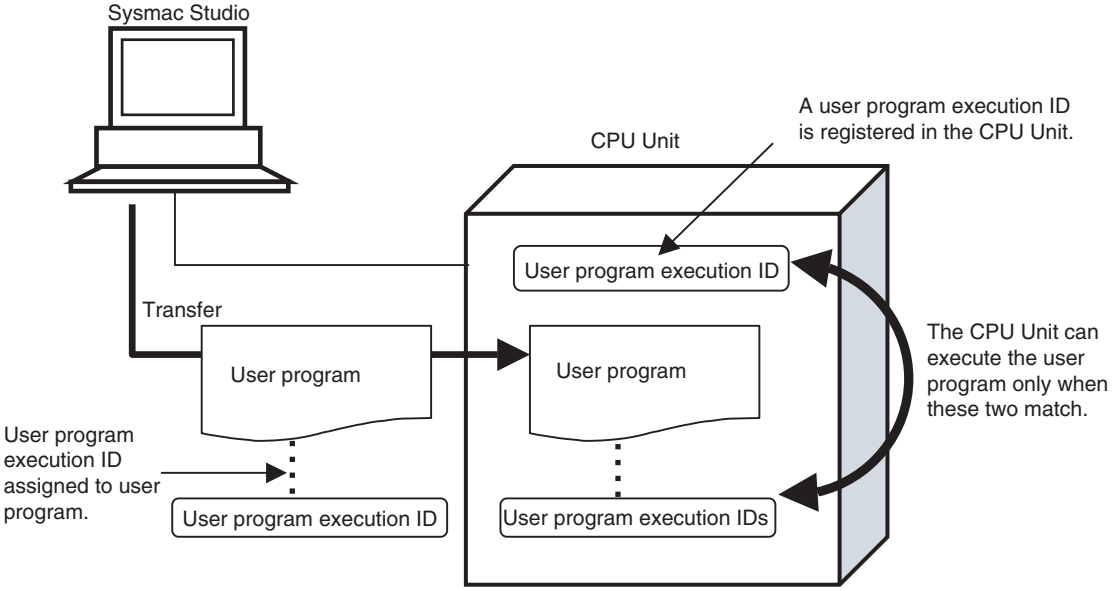
The Setting of Operation Authority Dialog Box is displayed.



2 Select the *Enable* Option in the *Operation Lock* Area, enter the *Lock time,* and click the **OK** Button.

7-3-2 Authentication of User Program Execution IDs

If you enter a specific ID for the Controller in advance (called a user program execution ID), only a user program that is assigned that ID can be executed on the Controller.



This function can be used to achieve the following:

- A Controller can be restricted to execute only a specific user program.
- You can prevent a user program from use on a different Controller (hardware).

This function is different from the protection functions in that the user program can be viewed and edited.

● Setting Ranges for User Program Execution IDs

Item	Description
Valid number of characters	8 to 32 characters
Applicable characters	Single-byte alphanumeric characters (case sensitive)

Setting User Program Execution IDs for User Programs

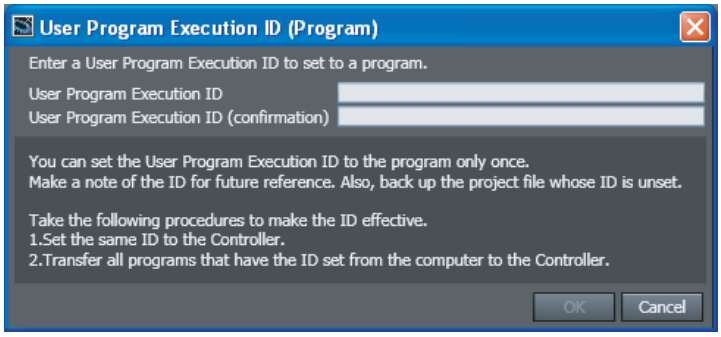
User program execution IDs for user programs are set offline.

Precautions for Correct Use

- A user program execution ID can be set only one time for a user program.
- Record the user program execution ID to ensure you do not lose it.
- We recommend that you backup the project file before you set the user program execution ID.

1 Select ***Security - ID for User Program Execution*** from the Controller Menu.

The User Program Execution ID for Program Dialog Box is displayed.



2 Enter the user program execution ID.

3 Enter the same ID in the *User Program Execution ID (Confirmation)* field, and then click the **OK** Button.

Use the following settings to enable user program execution ID verification.

1 Set the same ID as the Controller.

Refer to *Setting User Program Execution IDs for Controllers,* below.

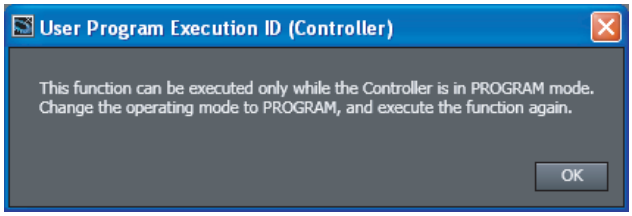
2 Synchronize (download) the user program for which the user program execution ID is set.

Setting User Program Execution IDs for Controllers

User program execution IDs for Controllers are set online.

Precautions for Correct Use

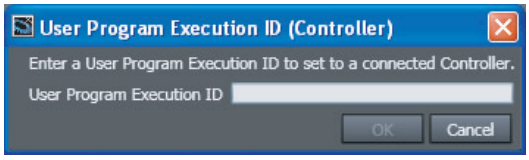
- If operation authority verification is set, you must go online as the Administrator.



- Be sure to record the user program execution ID to ensure you do not lose it. You cannot change the user program execution ID even if you lose it.
- The user program execution ID that is set for the Controller is deleted by the Clear All Memory Operation.

1 Select ***ID for User Program Execution*** from the Controller Menu.

The Set User Program Execution ID for Controller Dialog Box is displayed.

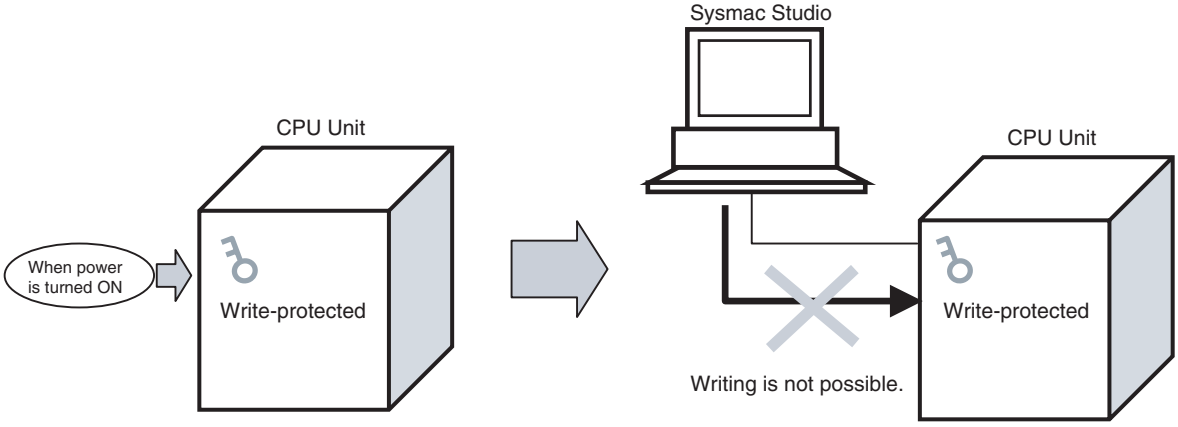


2 Enter the same ID as the user program execution ID that is set for the user program, and click the **OK** Button.

3 Cycle the power supply to the Controller to enable the setting in the Controller.

7-3-3 Controller Write Protection

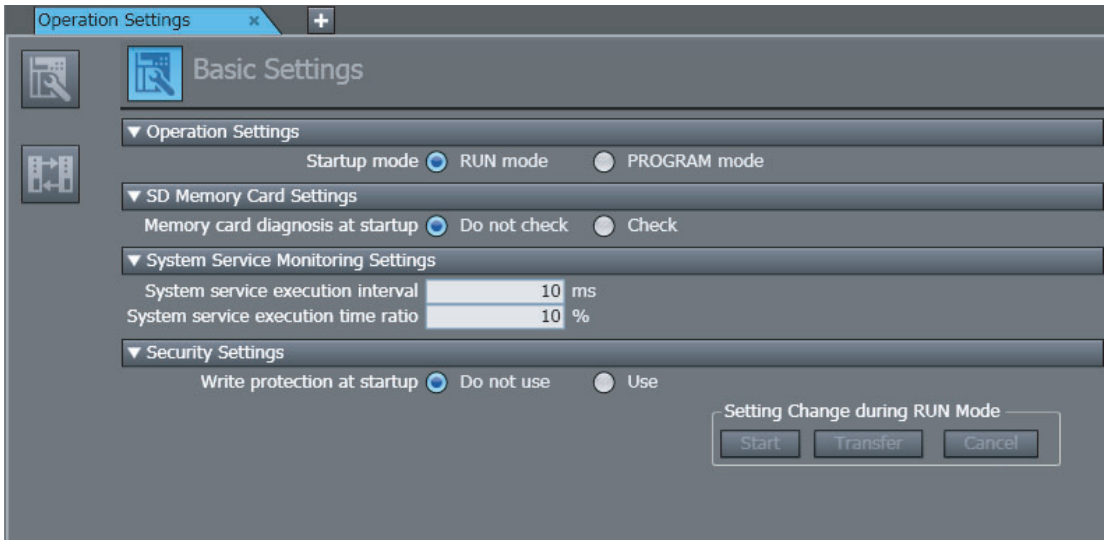
You can automatically enable write protection when the Controller is turned ON to prevent write operations from the Sysmac Studio.



Settings for Write Protection at Startup

1 Select **Operation Settings** under **Configurations and Setup - Controller Setup.**

The Basic Settings Pane for the Controller's Operation Settings is displayed.



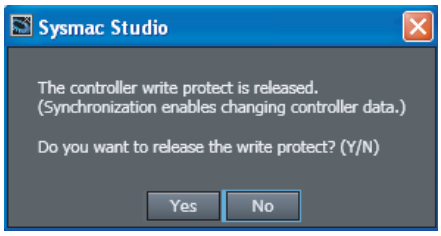
2 Select the *Use* Option for *Write protection at startup* in the *Security Settings Area*.

3 Execute *Transfer to Controller* to enable the setting.

Clearing Write Protection

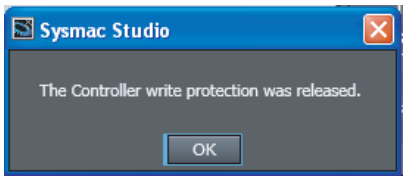
You can temporarily clear the write protection on a Controller that is write-protected.

1 Select ***Security - Change Write Protect Switch*** from the Controller Menu while online.



2 Click the **Yes** Button.

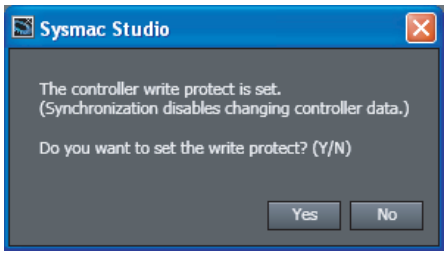
This removes write protection. The following dialog box is displayed.



Setting Write Protection

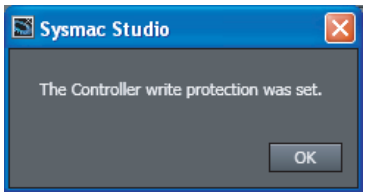
You can temporarily set write protection on a Controller that is not write-protected from the Sysmac Studio.

1 Select ***Security - Change Write Protect Switch*** from the Controller Menu while online.



2 Click the **Yes** Button.

This sets write protection. The following dialog box is displayed.



7-4 User Memory Usage Monitor

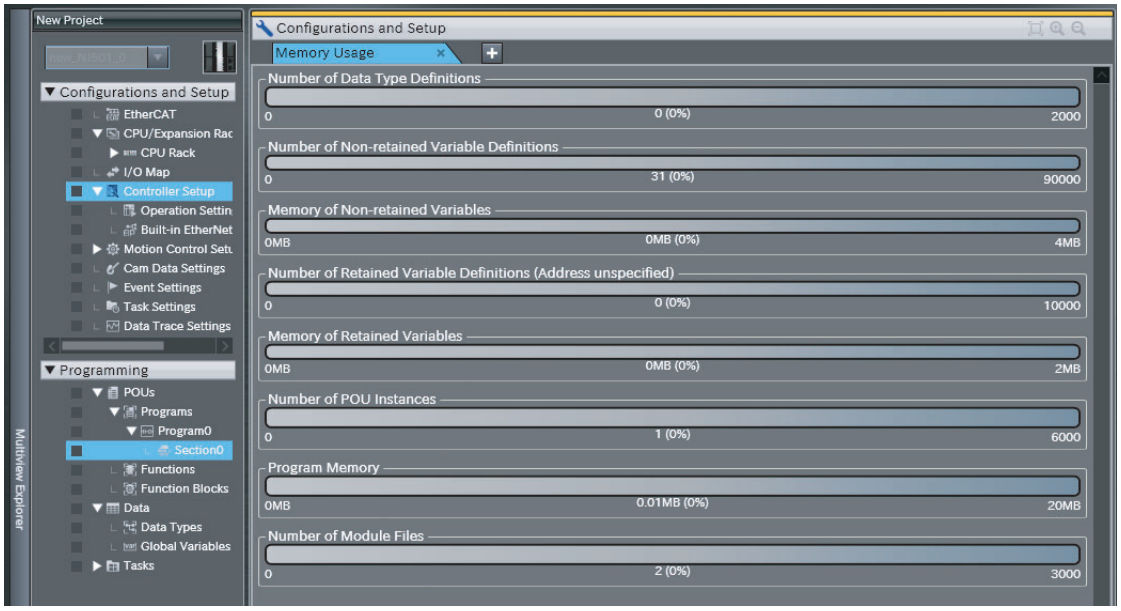
● User Memory Usage Monitor

The User Memory Usage Monitor displays the space used by the project file being edited in the Sysmac Studio in relation to the size of the Controller's memory. The file cannot be transferred to the Controller if the files size exceeds the available space.

Displaying Memory Usage

1 Select ***Memory Usage*** from the Project Menu.

Memory usage is displayed.



Item	Displayed information
Number of Data Type Definitions	Displays the number of data types that are used.
Number of Non-retained Variable Definitions	Displays the number of non-retained variables that are used.
Memory of Non-retained Variable	Displays the usage of non-retained variable memory.
Number of Retained Variable Definitions (Address Unspecified)	Displays the number of retained variables with addresses specified that are used.
Memory of Retained Variable	Displays the usage of retained variable memory.
Number of POU Instances	Displays the number of POU instances that are used.
Program Memory	Displays the usage of user program memory.
Number of Module Files	Displays the number of module files to execute.

7-5 Printing

This section describes printing operations.

7-5-1 Items You Can Print

You can print the following items. You can select any of the items to print.

- EtherCAT
- Special Unit parameters settings
- CPU/Expansion Racks configuration
- I/O map
- Controller Setup
- Motion Control Setup (axis settings)
- Cam data settings
- Event settings
- Task settings
- Data trace settings
- Programs, functions, and function blocks in Ladder Editor
- Programs, functions, and function blocks in ST Editor
- Local variable tables (programs, functions, and function blocks)
- User-defined data types in Data Type Editor
- Global variable table

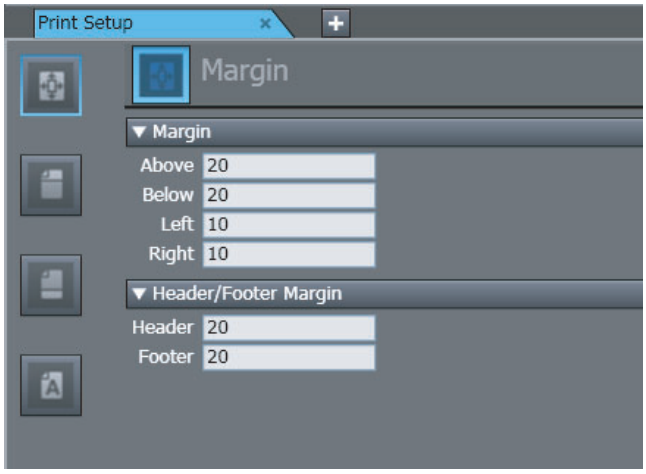
Note Refer to *7-11 Troubleshooting* for information on printing during troubleshooting.

7-5-2 Page Settings

You can specify settings such as the margins and fonts when printing.

Use the following procedure for the Page Settings.

1 Select ***Page Settings*** from the File Menu.



2 Use the buttons on the left to select the settings.

Button	Icon	Description
Margins Button		Click to set the page margins and header/footer spaces.
Header Button		Click to set the header position and contents.
Footer Button		Click to set the footer position and contents.
Font Button		Click to set the font to use for printing.

3 Specify each setting.

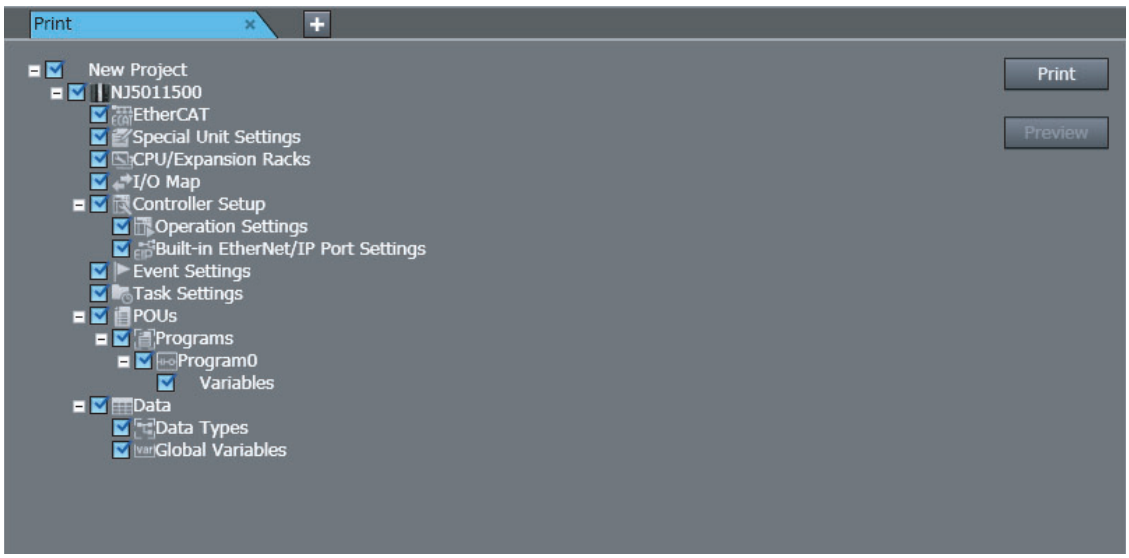
You can use the following field codes in the header and footer.

Item	Specification
Date	&d
Time	&t
File name	&f
Page number	&#
Total pages	&o
Item to print	&l
Project name	&j
Controller name	&v
Controller model	&y

7-5-3 Printing

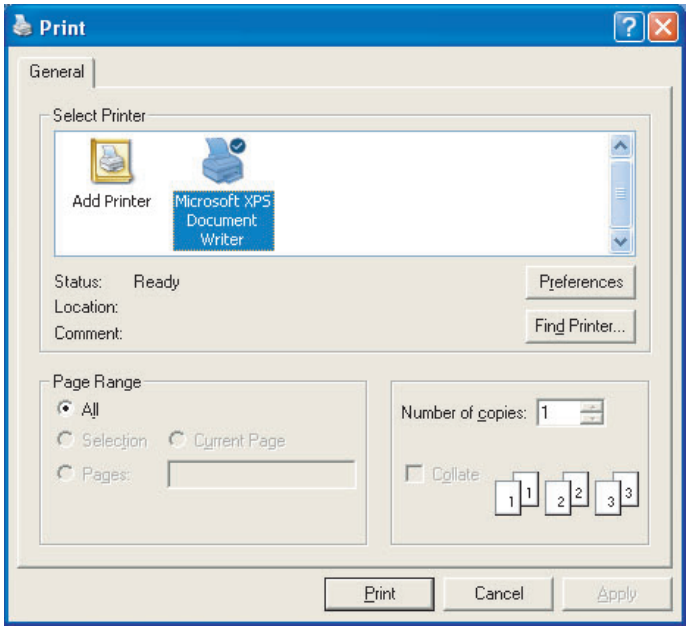
Use the following procedure to print.

1 Select ***Print*** from the File Menu.



2 Select the check boxes for the items to print.

3 Click the **Print** Button.



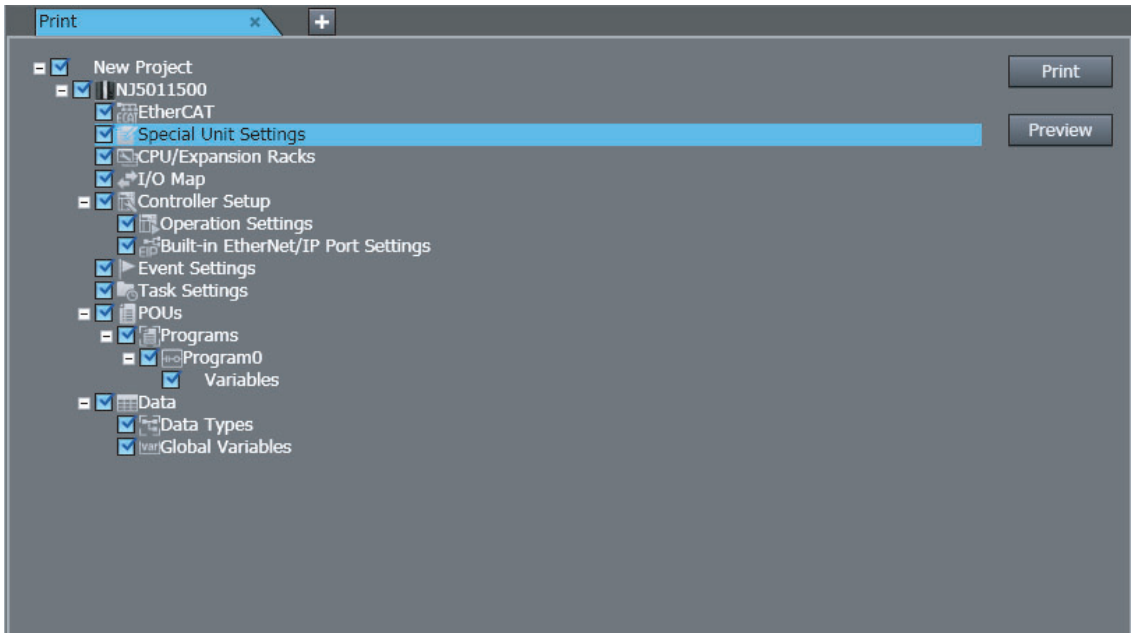
4 Select the printer to use, and then click the **Print** Button.

7-5-4 Print Preview

Use the following procedure to display a print preview.

1 Select ***Print*** from the File Menu.

2 Select the check boxes for items to display in the print preview.



3 Click the **Preview** Button.

7-6 Clearing Memory

Clearing Memory

The Clear All Memory Menu command is used to initialize the user program, Controller Configurations and Setup, and variables in the CPU Unit to the defaults from the Sysmac Studio.

Items Cleared by the Command and Their Status after Clearing Memory

Data		Status after Clear All Memory operation
User program		One program is assigned to the primary periodic task (task period: 4 ms). The program will be empty.
Controller configurations and setup		The default settings are restored. Security information (protection, verification, etc.) is also initialized.
Variables	**System-defined variables**	Depends on the type of variable
	Device variables	Clearing the variable tables deletes the device variables.
	User-defined variables	User-defined variables are deleted when the variable tables are cleared.
Event logs		Event logs can be selected when clearing the memory.
Absolute encoder home offset		Not cleared.

Precautions for Safe Use

After you clear the memory, the Controller operates in the same way as immediately after you create the system configuration with the Controller in the factory default condition. The absolute encoder home offset is not cleared.

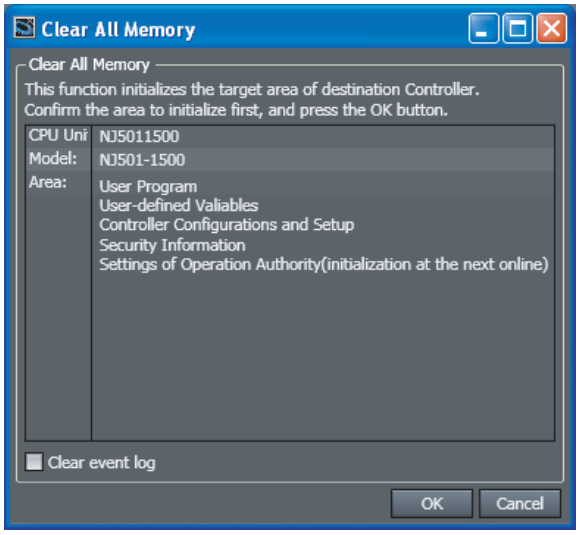
Precautions for Correct Use

- The Clear All Memory Operation can be performed only in PROGRAM mode.
- The Clear All Memory Operation cannot be performed when write protection is set in the Security Settings. Clear the write protection and then perform the Clear All Memory Operation.

Procedure for Clearing Memory

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

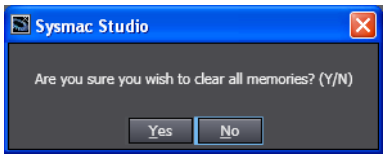
The Clear All Memory Confirmation Dialog Box is displayed.



2 Check the areas to initialize. Select the check box to clear the event logs.

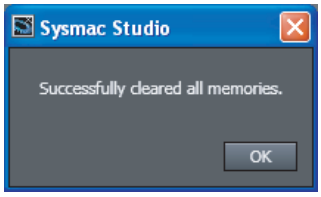
3 Click the **OK** Button to clear the memory.

The following dialog box is displayed to confirm the process of clearing all memories.



Click the **Yes** Button to clear all memories.

After the memory is cleared, the following dialog box is displayed.



4 Click the **OK** Button.

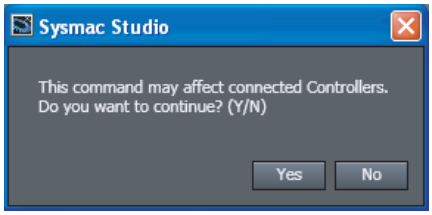
7-7 Releasing Access Rights

Releasing Access Rights

Access rights may be retained by the Controller if the online connection is abnormally broken between the Controller and the Sysmac Studio. In this case, normally access from the Sysmac Studio is no longer possible. Use the Sysmac Studio to release the access rights in the Controller.

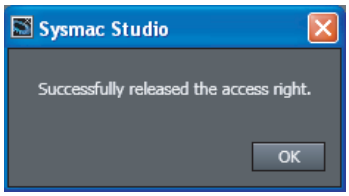
Procedure for Releasing Access Rights

1 Select ***Release Access Rights*** from the Controller Menu.



2 Click the **Yes** Button.

The following dialog box is displayed when the access rights are released.



3 Click the **OK** Button.

7-8 Displaying Unit Production Information

7-8-1 Displaying Unit Production Information

● Displaying Unit Production Information

When the Sysmac Studio is online with the CPU Unit, you can display the production information in the CPU Unit and Special Units.

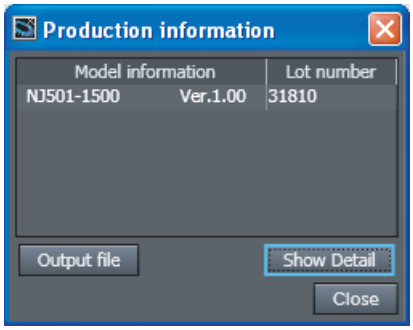
● Procedure for Displaying Unit Production Information

1 Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **CPU/Expansion Racks** under **Configurations and Setup** and select ***Edit*** from the menu.

The Unit Editor is displayed for the Controller Configurations and Setup layer.

2 Right-click any location where there is no Unit in the Unit Editor and select ***Production Information***.

The Production Information Dialog Box is displayed.



The following items are displayed.

Controller	Special Units
Unit model number and unit version	Rack number, slot number, and unit number
Hardware version (Show Detail)	Unit model number and unit version
Software version (Show Detail)	Unit revision (Show Detail)
Lot number	PCB revision (Show Detail)
	Software revision (Show Detail)
	Lot number
	Rack number, slot number, and unit number

● Saving Unit Production Information to a File

1 Click the **Output file** Button in the Production Information Dialog Box.

The Save File Dialog Box is displayed.

2 Input a file name, and then click the **Save** Button.

A file with a .csv extension is saved.

7-8-2 Displaying EtherCAT Slave Production Information

● Displaying EtherCAT Slave Production Information

You can display the node addresses, models, and serial IDs that are set in the EtherCAT slaves.

* If the model of a slave cannot be determined (e.g., if there is no ESI file), the vendor ID, product code, and revision number are displayed.

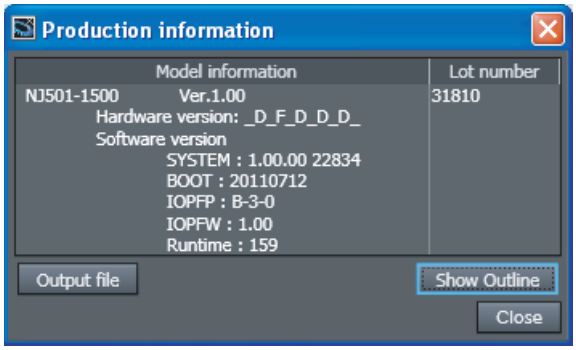
● Procedure

1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select ***Edit*** from the menu.

The EtherCAT Configuration Editing Pane is displayed for the Controller Configurations and Setup layer.

2 Right-click the master in the EtherCAT Configurations Editing Pane and select **Display Production Information**.

The Production Information Dialog Box is displayed.



● Saving EtherCAT Slave Production Information to a File

1 Click the **Output file** Button in the Production Information Dialog Box.

The Save File Dialog Box is displayed.

2 Input a file name, and then click the **Save** Button.

A file with a .csv extension is saved.

7-9 Backing Up Variables and Memory

Backing Up Variables and Memory

When you replace an NJ-series Controller, you can back up the retained memory in the Controller to a file and restore the backed up data from the file to the new Controller.

⚠ WARNING

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

Precautions for Safe Use

The absolute encoder home offset is stored in the Controller as absolute encoder information. If you replace the Controller and restore backup data that is different from the Controller data from before the Controller was replaced, do not restore the absolute encoder home offset. If data from another Controller that includes the absolute encoder home offset is accidentally restored, set home again. If you use a new Servo Drive or replace a Servo Drive, set the home. Doing either of these without confirming safety may result in injury.

Precautions for Correct Use

- The file that contains a backup of variables and memory can be used to restore Controller memory only from the project file that was used to create the backup file. It cannot be used to restore memory from another project file.
- Store and manage the backup file and the project file used to create it as a set.
- You can also use the backup file to restore memory from a copy of the project file used to create it, or even if the name of the project file is changed.
- If you change a variable, delete a variable, or otherwise edit a backed up variable in the project file used to create the backup, that variable is not restored to memory. The information on variables or memory that was not restored is recorded as errors.

7-9-1 Backup Data

You can back up or restore following retained memory.

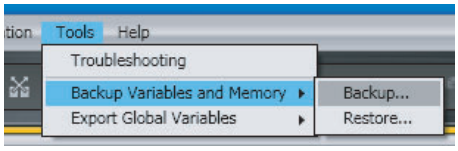
● Contents of the Retained Memory of the Connected Controller

Type of retained memory	Description	Remarks
Present values of variables with a Retain attribute	The values of retained variables defined in the Sysmac Studio	
Present values in the DM, EM, and Holding Areas of memory used for CJ-series Units	Holding, EM, and DM Area data that can be assigned to CJ-series Special Units	The entire memory areas are backed up.
Absolute encoder home offset	Compensation value that was tuned with the absolute encoder	

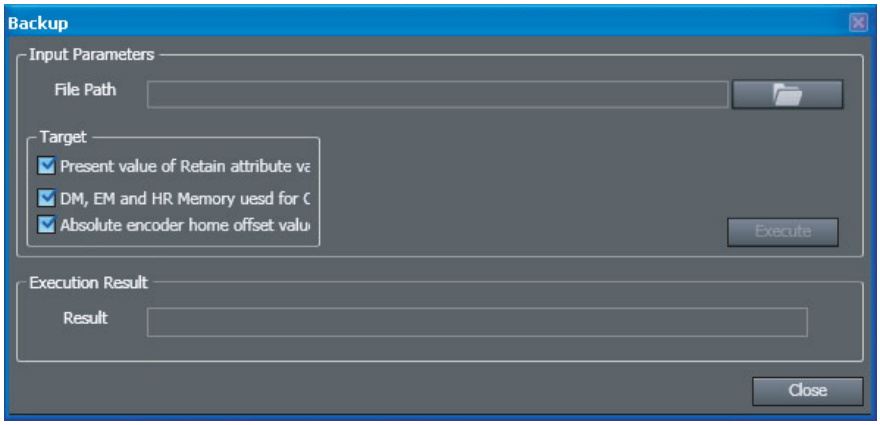
Backing Up Data

● Procedure

1 Select ***Backup Variables and Memory*** – ***Back Up*** from the Tools Menu from the Sysmac Studio.

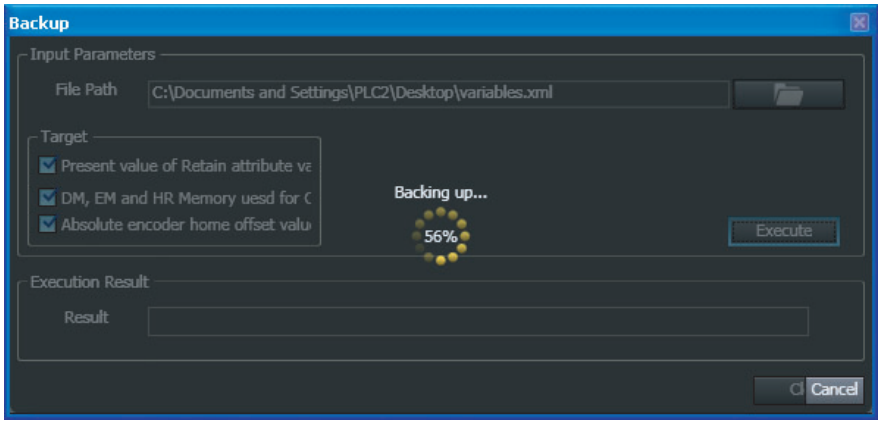


The Backup Dialog Box is displayed.



2 Click the **View File Selection Dialog** Button ( ). The Save As Dialog Box is displayed. Specify the file path name and file name.

3 Select the check boxes for the memory to back up, and then click the **Execute** Button. The data is backed up.



When the backup is completed, the results are displayed in the Execution Results Display Area.

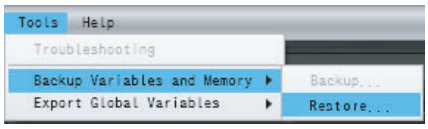
Additional Information

To back up the data, the contents of the NJ-series Controller and the project must match. If it does not match, stop the backup and synchronize the data to make it match.

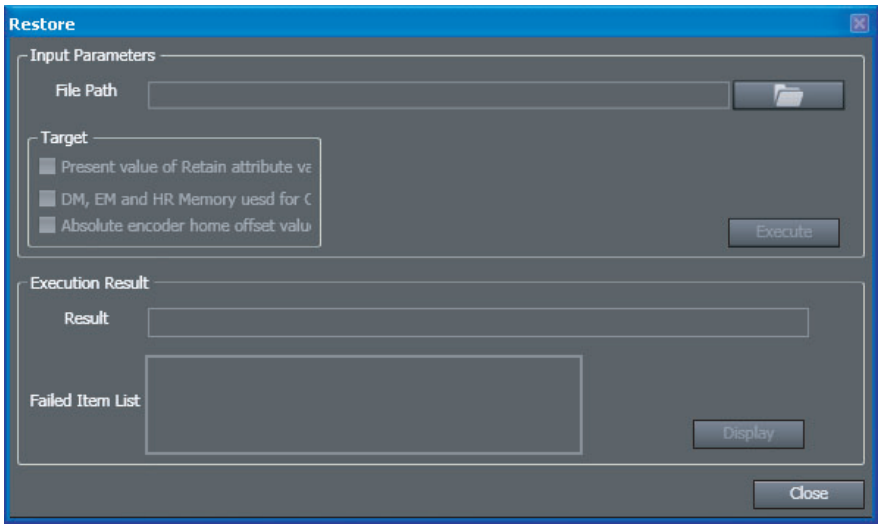
● Restoring Data

Restore Procedure

1 Select ***Backup Variables and Memory*** – ***Restore*** from the Tools Menu from the Sysmac Studio.

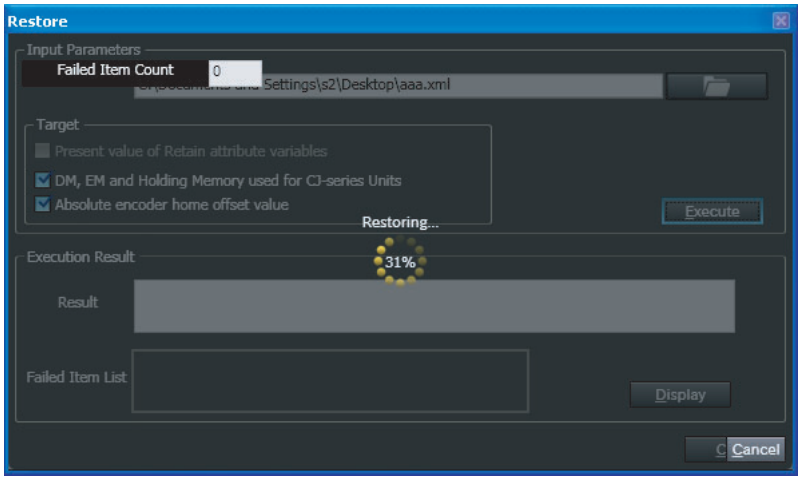


The Restore Dialog Box is displayed.

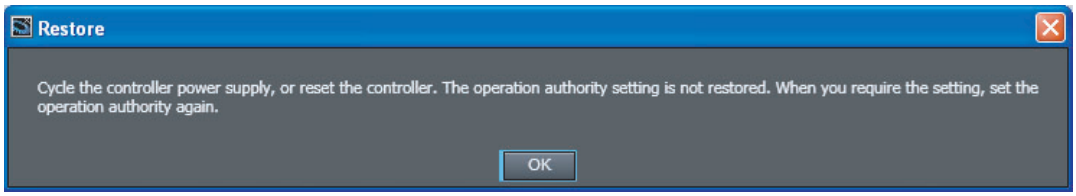


2 Click the **View File Selection** Dialog Button ( ). The File Selection Dialog Box is displayed. Specify the file path.

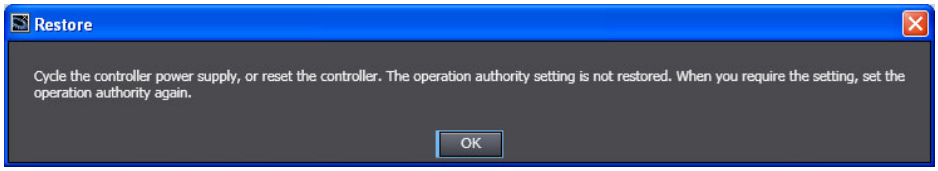
3 Select the check boxes for the memory to restore, and then click the **Execute** Button. The data is restored.



When the restore operation is completed normally, the results are displayed in the Execution Results Display Area. A dialog box for restarting the NJ-series Controller is displayed to reflect the results of the restored data.



If the restore operation fails, the number of items that were not restored is shown in the Failed Item List. Click the **Display** Button. The names of the data that were not restored are displayed in the *List of Failed Items*.



Additional Information

To restore the backup, the contents of the NJ-series Controller and the project must match. If it does not match, stop the restore process and synchronize the data to make it match.

7-10 EtherCAT Maintenance

● EtherCAT Maintenance

The following operations are used for EtherCAT maintenance.

- Disconnecting a slave from and reconnecting a slave to the network
- Packet monitoring
- Diagnostic and statistical information
- I/O wiring checks
- Checking I/O assignments

7-10-1 Disconnecting a Slave from and Reconnecting a Slave to the Network

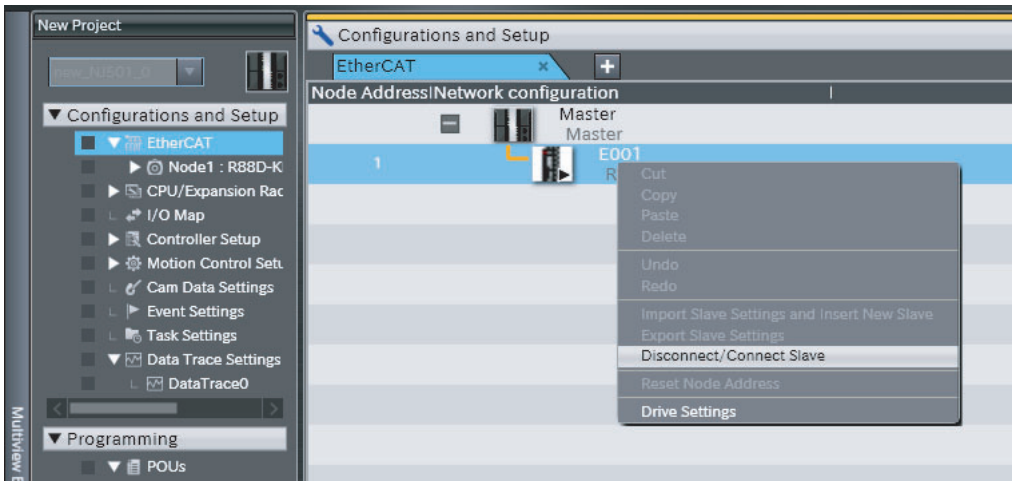
● Disconnecting a Slave from and Reconnecting a Slave to the Network

You can use this operation to disconnect a slave with active process data communications from the network without Process Data Communications Error occurring. You can then reconnect the slave to the network to start process data communications again.

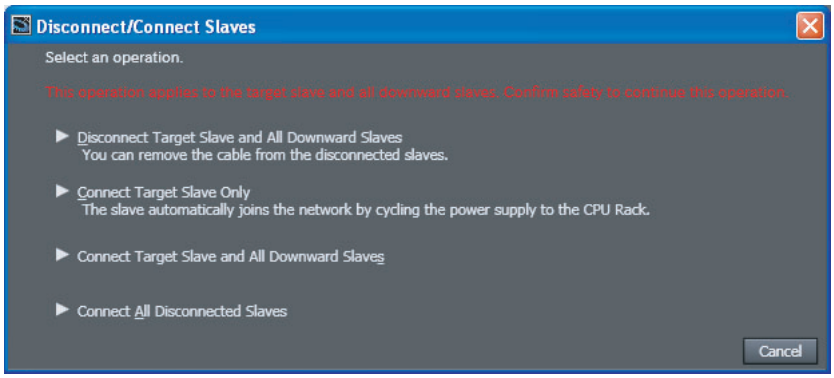
● Procedure for Disconnecting a Slave from the Network

Use the following procedure to disconnect a slave from the network.

1 Right-click the slave in the Network Configuration Display Tab Page and select ***Disconnect/Connect Slave***.

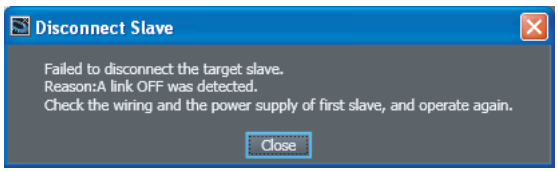


The Disconnect/Connect Slaves Dialog Box is displayed.



2 Click the **Disconnect Target Slave and All Downward Slaves** Button. The selected slave and following slaves are disconnected.

The following confirmation dialog box is displayed if disconnection failed.



Additional Information

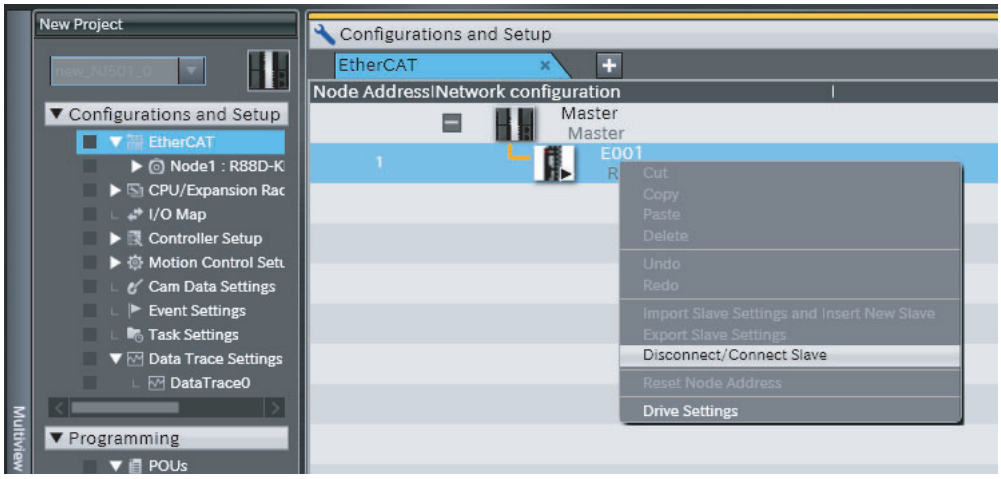
If you select a slave that has more than one output port and click the **Disconnect Target Slave and All Downward Slaves** Button, all of the slaves that are connected after all of the output ports will be disconnected. You can remove the communications cables from the disconnected slaves.

Precautions for Correct Use

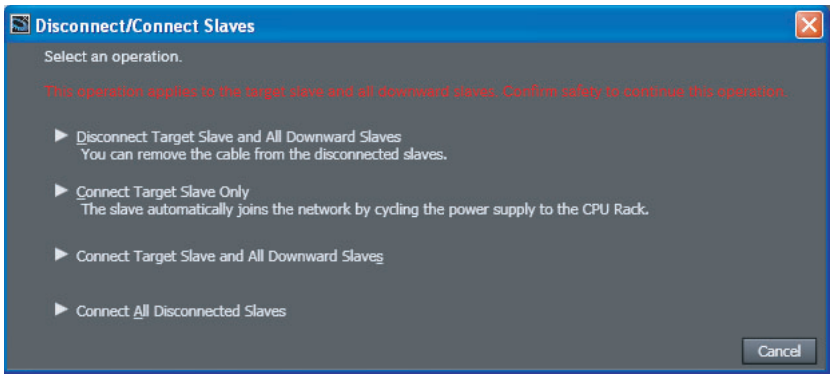
Disconnecting a slave affects not only the selected slave but all of the slaves connected after the output ports on the selected slave. When you disconnect slaves, all I/O refreshing for process data communications for the slaves is stopped. Always confirm safety before you disconnect a slave.

● Procedure for Reconnecting a Slave to the Network

1 Right-click the slave in the Network Configuration Display Tab Page and select ***Disconnect/Connect Slave***.



The Disconnect/Connect Slaves Dialog Box is displayed.



2 Click the **Connect Target Slave Only** Button.

The following dialog box is displayed and the selected slave is reconnected to the network. I/O refreshing with process data communications is restarted.

Note 1 Select the **Connect All Disconnected Slaves** Button to reconnect all slaves that are currently disconnected and to restart I/O refreshing through process data communications.

2 Select ***Connect target slave and the downward slaves*** to reconnect the specified slave and all slaves that are connected after its OUT port. I/O refreshing with process data communications is restarted.

Additional Information

When the EtherCAT configurations are synchronized, the status of the slaves are displayed in the Edit Network Configuration Tab Page with the following icons. These icons are not displayed if synchronization is lost.

Icon	Meaning
▶	The slave in the Network Configuration Tab Page exists in the actual network configuration.
❚❚	The slave in the Network Configuration Tab Page exists in the actual network configuration but it is disconnected.
❚❚✖	The slave in the Network Configuration Tab Page is not connected and does not exist (i.e., is not connected) in the actual network configuration. (This icon could also indicate a slaves that was connected in the location of a disconnected slave without the node address set.)
✖	The slave in the Network Configuration Tab Page does not exist in the actual network configuration.
■	Communications for the slave in the Network Configuration Tab Page are disabled.

7-10-2 Packet Monitoring

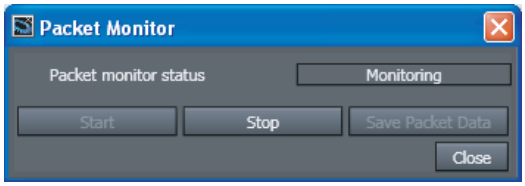
● Packet Monitoring

The master can monitor the packets that are transmitted through the network. From the Sysmac Studio, you can start and stop packet monitoring by the master, and you can get part of the packet data monitored by the master and save it in a file.

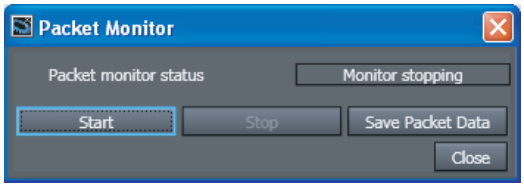
● Procedure

1 Right-click the master in the Network Configuration Display Tab Page and select ***Display Packet Monitor*** from the menu.

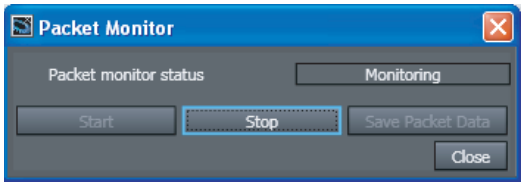
The Packet Monitor Dialog Box is displayed.



2 Click the **Start** Button to begin monitoring.



3 Click the **Stop** Button to stop monitoring.



4 Click the **Save Packet Data** Button to save the results of the monitoring.

The Save File Dialog Box is displayed.

5 Input a file name, and then click the **Save** Button.

A TCPDump packet data file with a .cap extension is saved.

7-10-3 Diagnostic and Statistical Information

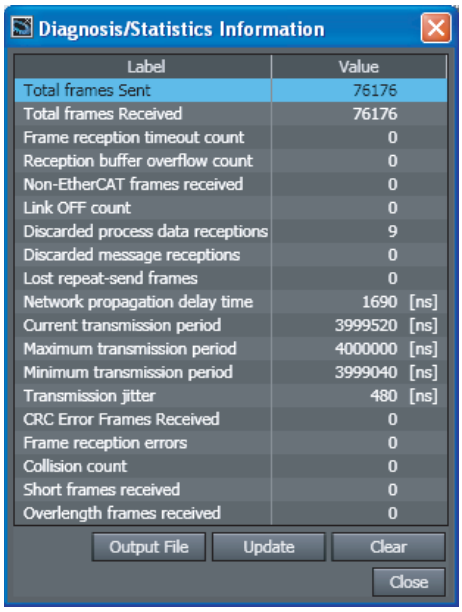
● Diagnostic and Statistical Information

Diagnostic and statistical information provides statistics on diagnosis of EtherCAT communications status, such as the number of frames that are sent and received.

● Procedure for Retrieving Diagnostic and Statistical Information

1 Right-click the master in the Network Configuration Display Tab Page and select ***Display Diagnostic/Statistics Information*** from the menu.

The Diagnostic and Statistics Information Dialog Box is displayed.



Label	Value
Total frames Sent	76176
Total frames Received	76176
Frame reception timeout count	0
Reception buffer overflow count	0
Non-EtherCAT frames received	0
Link OFF count	0
Discarded process data receptions	9
Discarded message receptions	0
Lost repeat-send frames	0
Network propagation delay time	1690 [ns]
Current transmission period	3999520 [ns]
Maximum transmission period	4000000 [ns]
Minimum transmission period	3999040 [ns]
Transmission jitter	480 [ns]
CRC Error Frames Received	0
Frame reception errors	0
Collision count	0
Short frames received	0
Overlength frames received	0

2 Click the **Update** Button to update the displayed information.

3 To clear the diagnostic and statistical information that was collected by the Controller and start collecting the information again, click the **Clear** Button.

4 To save the displayed information, click the **Output File** Button.

The Save File Dialog Box is displayed.

5 Enter a file name, and then click the **Save** Button.

A CSV file with an .csv extension is saved.

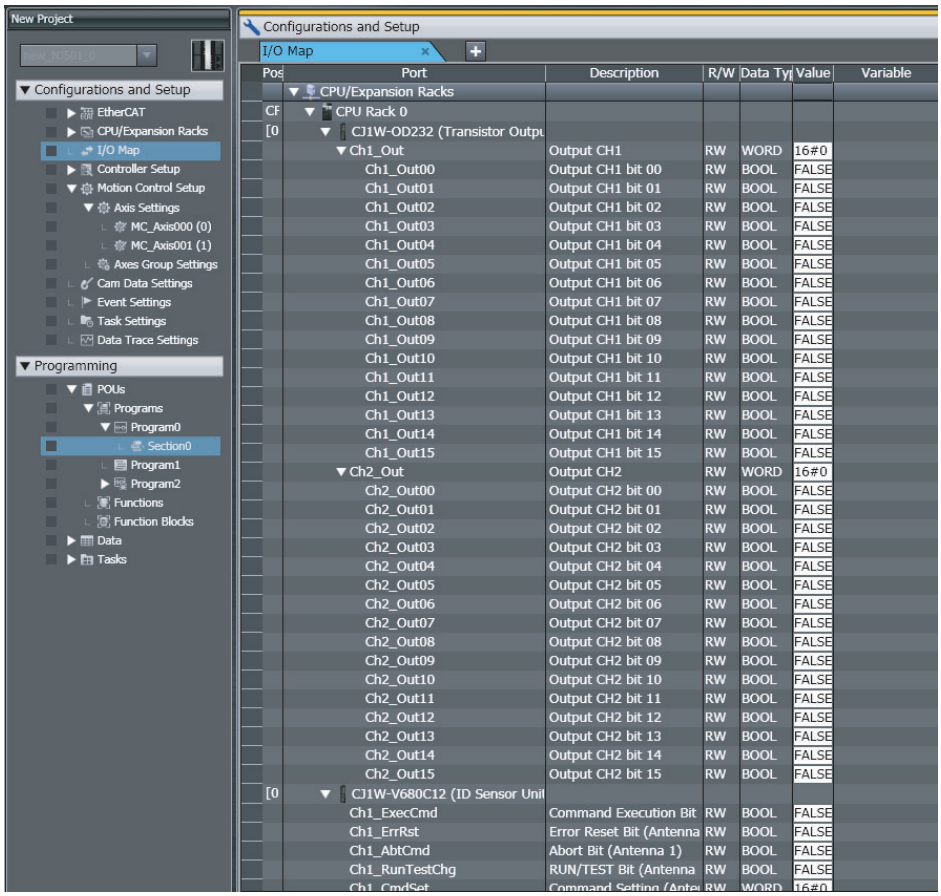
7-10-4 I/O Wiring Check

● I/O Wiring Check

You can use an I/O wiring check to check the wiring connections between Units and external devices.

● Procedure

1 Go online and then double-click **I/O Map** under **Configurations and Setup** on the Multiview Explorer. Or, right-click **I/O Map** under **Configurations and Setup** and select ***Edit*** from the menu.



2 Make sure that the results of output devices that are changed to TRUE or FALSE are being properly output to the external devices. Also, make sure that the results of forced outputs from external devices that are connected to input devices are being properly input into the I/O Map.

7-10-5 I/O Assignment Check

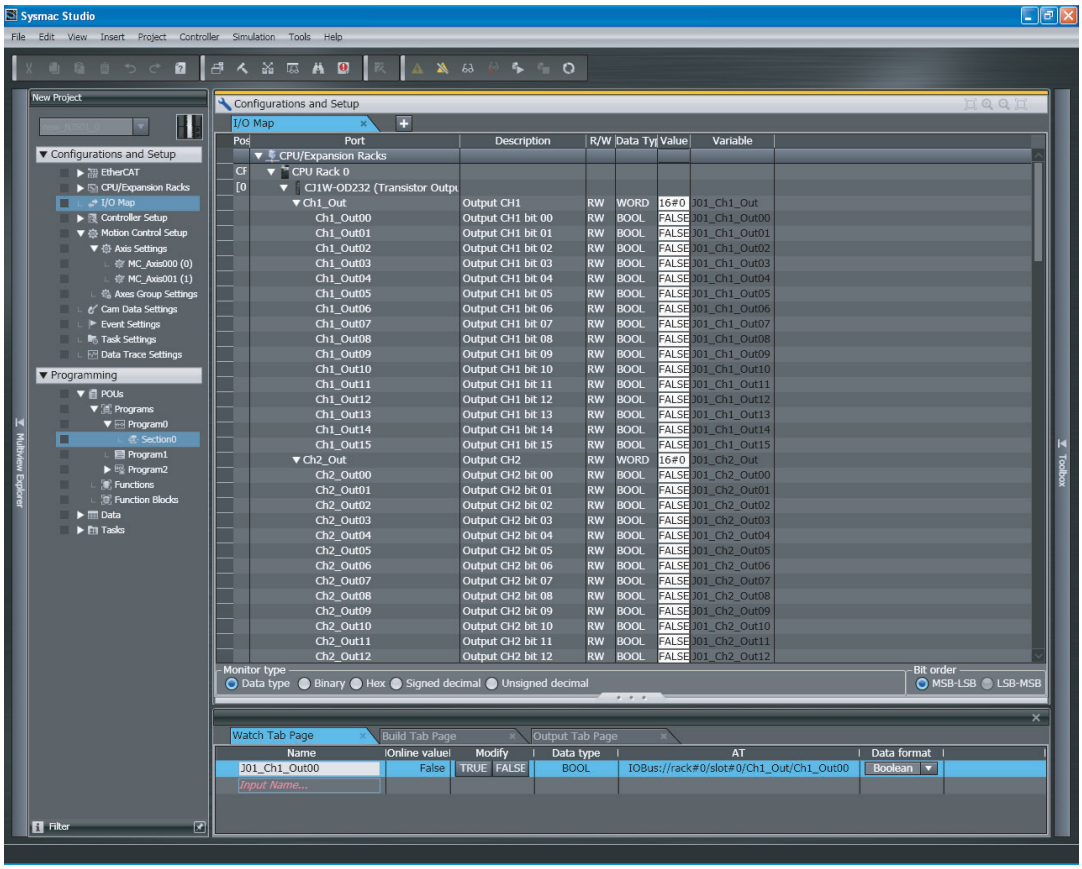
● I/O Assignment Check

You can use an I/O assignment check to check the assignments of external I/O devices and variables.

● Procedure to Check I/O Assignments

1 Execute a wiring connection check between Units and external devices.

2 Open the Watch Tab Page while online.



3 Make sure that the TRUE and FALSE values that are specified for variables assigned to output devices are being properly output to the external device. Also, make sure that the results of forced outputs from any connected external devices are being properly input into the variables assigned to input devices.

7-11 Troubleshooting

● Overview of Troubleshooting

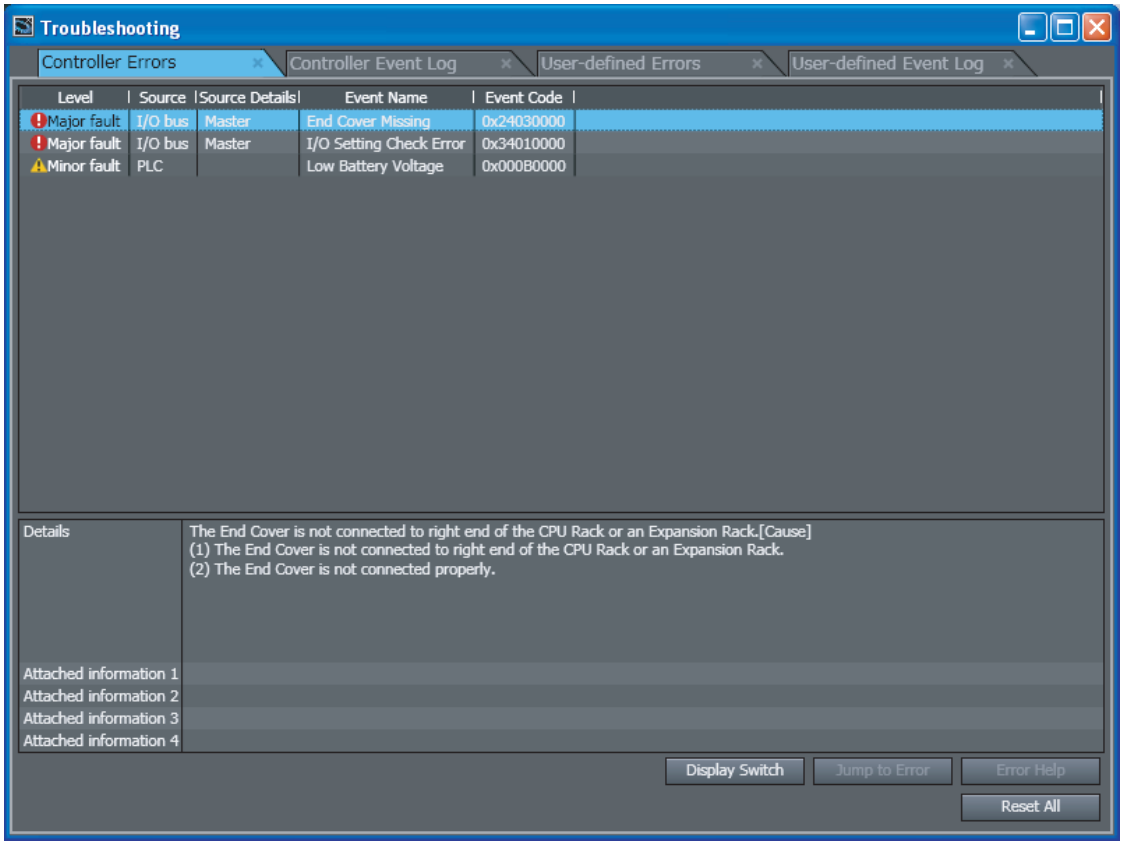
Troubleshooting is used to check the errors that occurred in the Controller, display corrections for the errors, and clear the errors.

7-11-1 Troubleshooting Dialog Box

The current errors in the online Controller and the contents of the event logs are read and displayed in the Troubleshooting and Event Logs Dialog Box.

1 Select ***Troubleshooting*** from the Tools Menu while online. You can also click the **Troubleshooting** Button in the toolbar.

The following Troubleshooting Dialog Box is displayed.

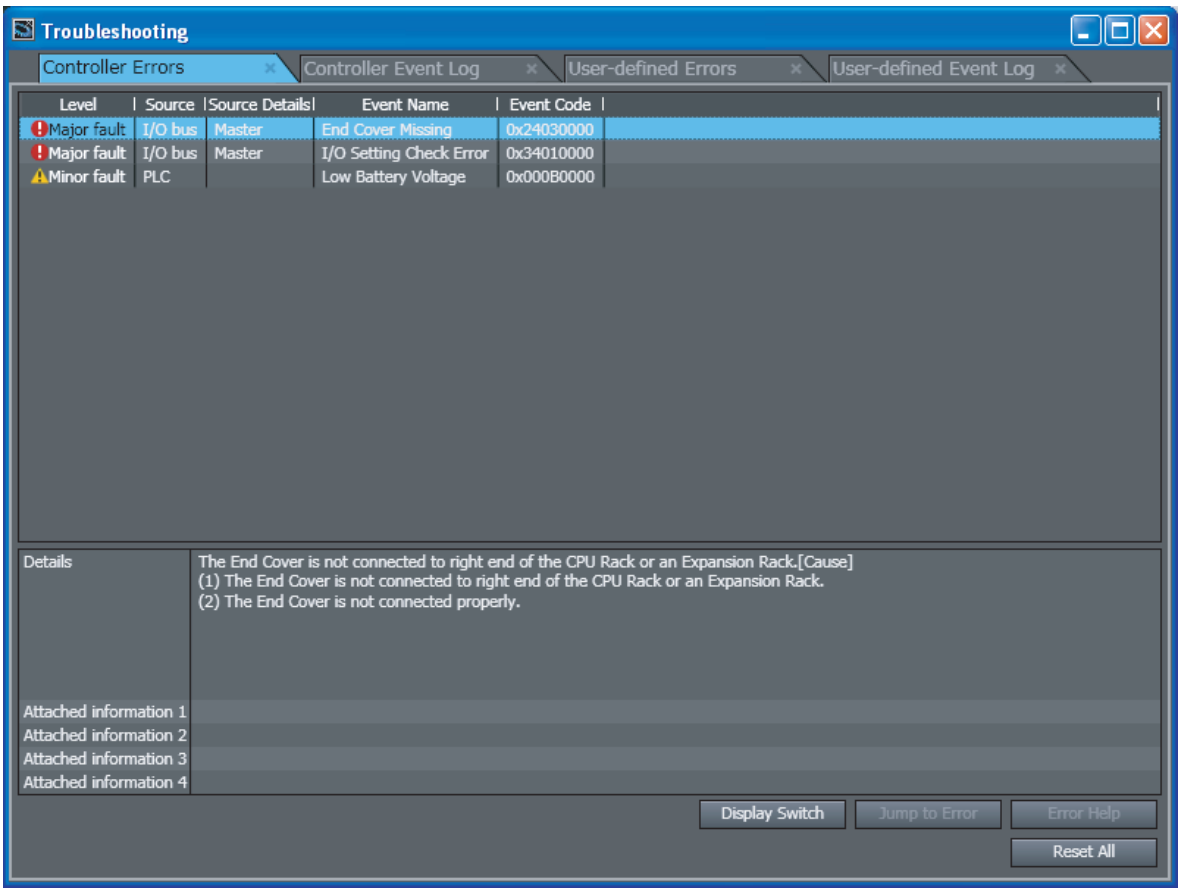


2 Click the following tabs to change the display as required.

Tab	Displayed information
Controller Errors	This tab page reports Controller errors as well as error details and corrections.
Controller Event Log	This tab page displays errors and information recorded in the event logs in the Controller.
User-defined Errors	This tab page reports user-defined errors and user-defined information that is created by execution of the SetAlarm (Create User-defined Error) instruction and the SetInfo (Create User-defined Information) instruction.
User-defined Event Log	This tab page displays user-defined errors and user-defined information recorded in the event log in the Controller.

7-11-2 Controller errors

This tab page displays any current Controller errors. (Observations and information are not displayed.)



● Information Displayed for Controller Errors and Functions

Item	Description	Remarks
Level	Displays the level of the error.	When a Controller error is displayed, this shows whether it is a major fault, a partial fault, or a minor fault. Observations and information events can be checked in the Controller log.
Source Source Details	Displays the location of the error.	
Event Name	Displays the name of the error.	
Event Code	Displays the event code of the error.	
Details	Describes the error and gives the cause of the error.	
Attached information 1 to 4	Displays supplementary information about the error. The meaning of the data is explained in the details.	
Action and correction	Gives the action and correction that are required to recover from the error.	The location to edit is displayed if you select a correction.
Display Switch	Switches the display between the details and attached information 1 to 4, and the corrections.	

Item	Description	Remarks
Jump to Error Button	Changes the display to the Correction Display in the Sysmac Studio if correcting settings are required.	You cannot jump if the data is not synchronized.
Error Help Button	Displays help if an error in a CJ-series Unit cannot be dealt with in the Sysmac Studio.	
Reset All Button	Clears all current errors. Any errors that remain are displayed again.	You cannot clear errors individually.

● Items Displayed as Sources

Displayed source	Displayed detailed event source	Location of error
PLC	Blank	The error occurred in the data processing section of the Controller.
I/O bus	Master	The error occurred between the Controller and a mounted Unit.
	Rack No. and Slot No.	The error occurred in a Unit that is mounted in the Controller. The Unit where the error occurred is identified by the rack number and slot number.
EtherNet/IP	Communications port	The error occurred in communications on the built-in EtherNet/IP port on the Controller.
	CIP	The error occurred in a CIP application on the built-in EtherNet/IP port on the Controller.
	FTP	The error occurred in an FTP application on the built-in EtherNet/IP port on the Controller.
	NTP	The error occurred in an NTP application on the built-in EtherNet/IP port on the Controller.
	SNMP	The error occurred in an SNMP application on the built-in EtherNet/IP port on the Controller.
EtherCAT	Communications port	The error occurred in communications on the built-in EtherCAT port on the Controller.
	Master	The error occurred in the master for the built-in EtherCAT port on the Controller.
	Node No.	The error occurred in a slave connected to the built-in EtherCAT port on the Controller.
Motion Control	Common items	The error occurred in the Axis Common section of the Controller's Motion Control Function Module.
	Axis No.	The error occurred in an axis in the Controller's Motion Control Function Module.
	Axes Group No.	The error occurred in the an axes group in the Controller's Motion Control Function Module.

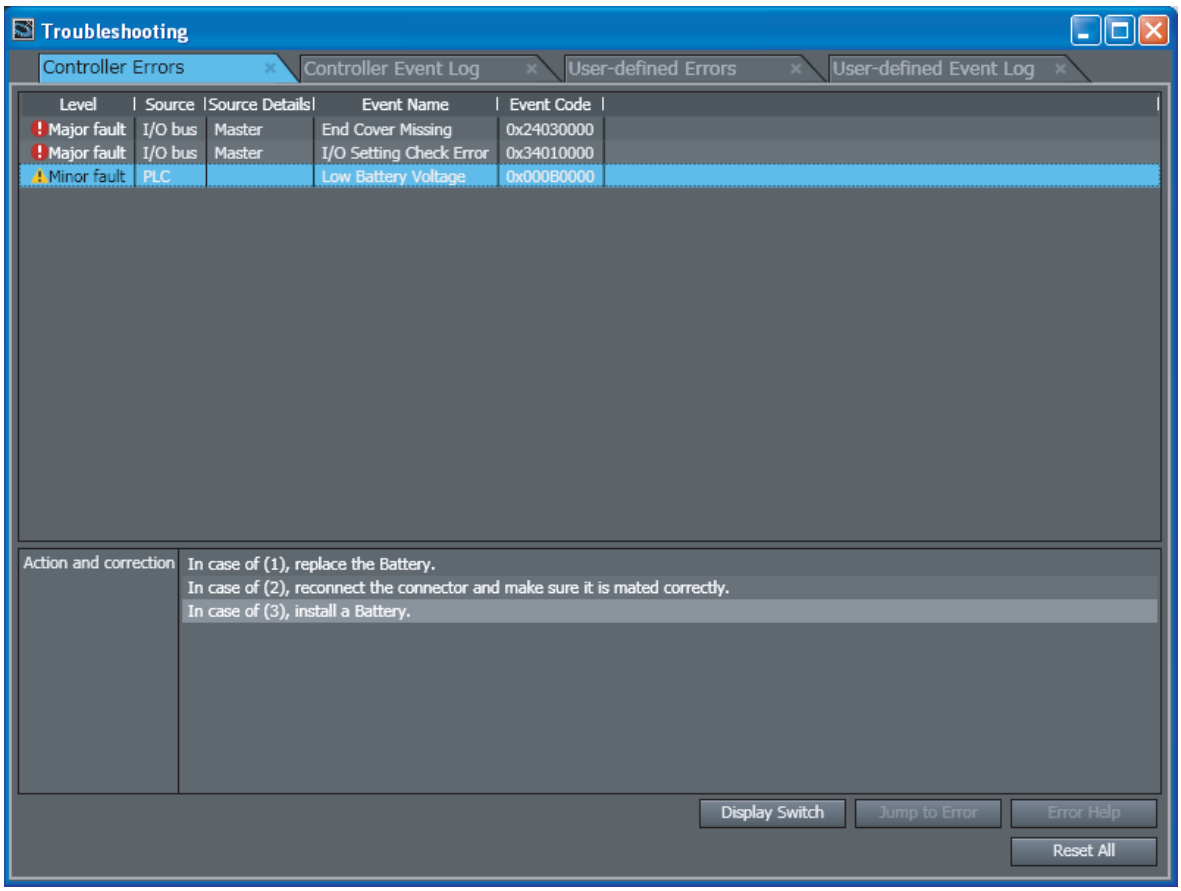
Note If the data is not synchronized, the CJ-series Unit models and the EtherCAT slave models are not displayed.

● Procedure

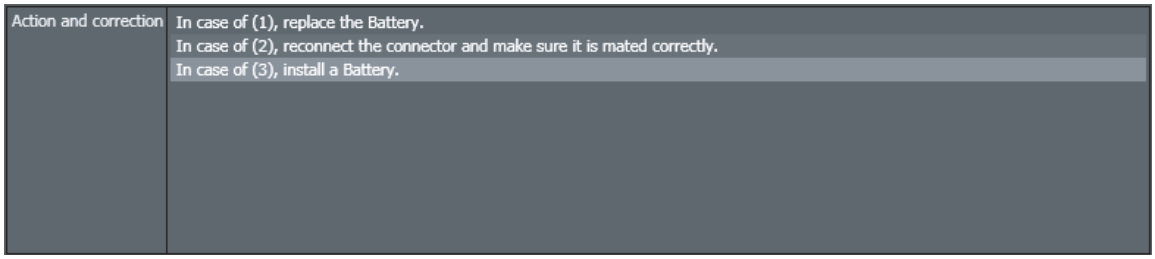
Changing to the Correction Display

1 Check the *Details* and *Attached Information* Areas to check the details and cause of an error.

2 Check the method to correct the error in the *Action and correction* Area.



3 Select the correction to make. If there is more than one correction, select one correction to actually perform.



If you select a correction that allows you to jump to the Correction View, the **Jump to Error** Button is enabled.

4 Click the **Jump to Error** Button.

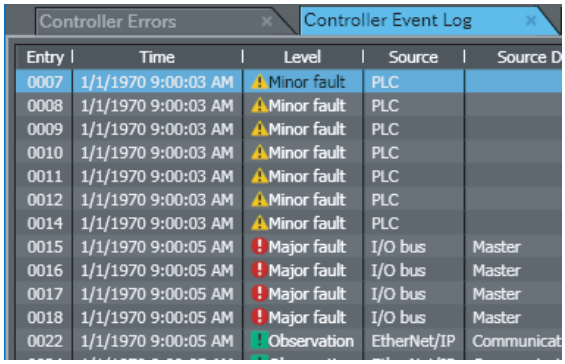
The display changes to the display for correcting the settings.

5 Correct the settings while the Sysmac Studio is offline.

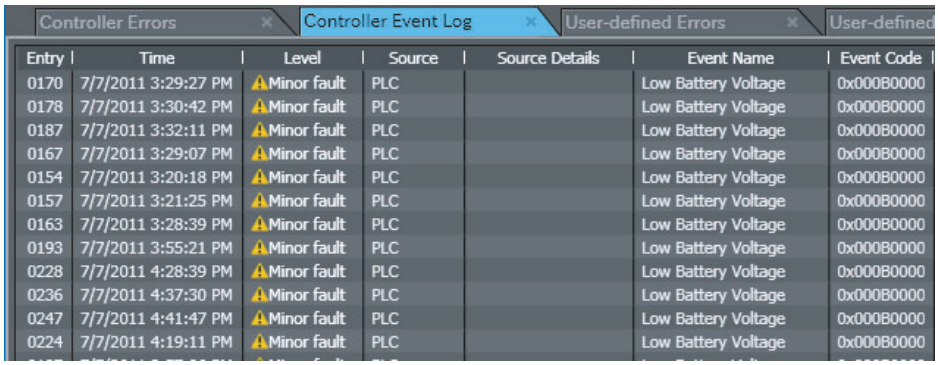
● Changing the Display Order

You can click the *Level* or *Source* heading to sort the errors by that item. The events are displayed in order of event levels by default.

Example: Changing the Display Order

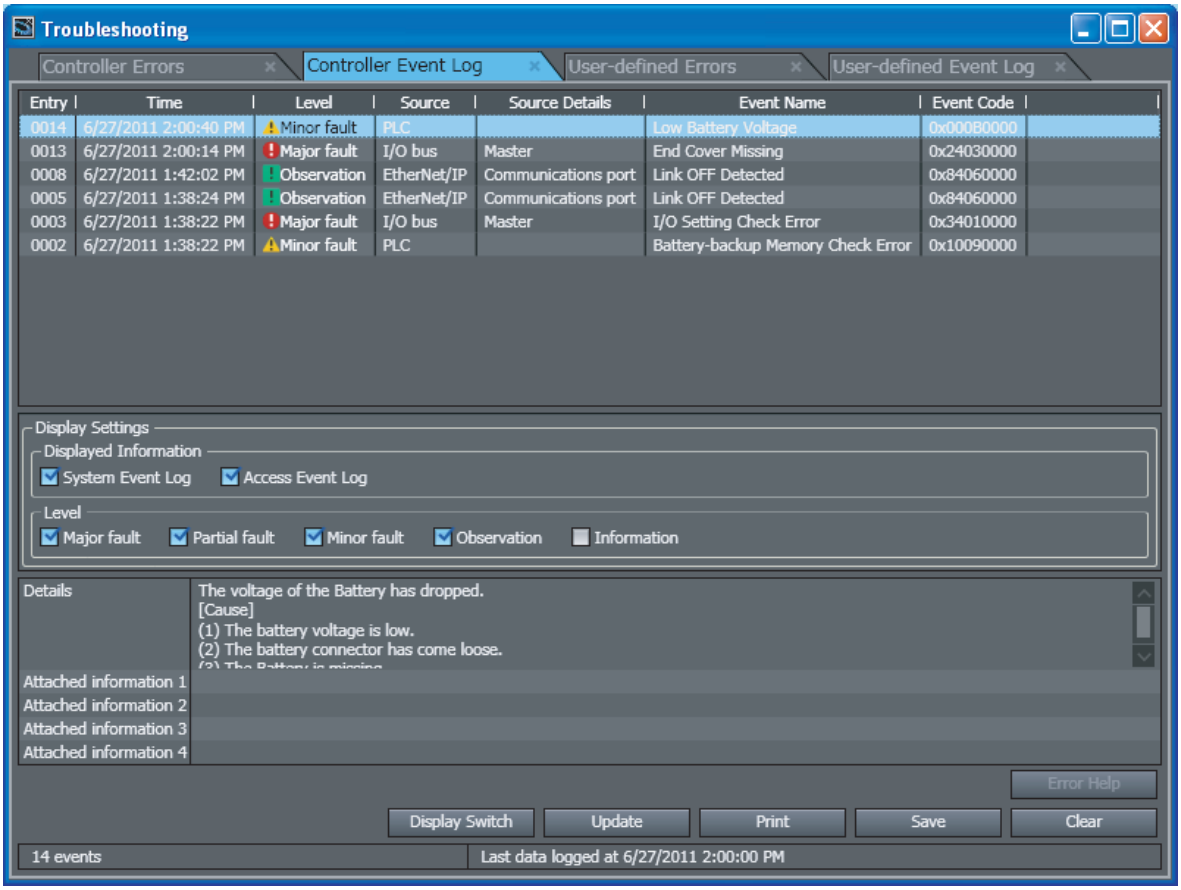


Click **Source.**



7-11-3 Controller Event Log

You can display a log of Controller events (including Controller errors and Controller information). (The logs in EtherCAT slaves are not displayed.)



● List of Controller Event Log Contents and Functions

Item	Meaning	Remarks
Entry	Displays the number of events in the log.	
Time	Displays the time and date that the event occurred.	This is time and date information stored in the Controller.
Level	Displays the event level.	Refer to *7-11-2 Controller errors* for information on the displayed contents.
Source Source Details	Displays the location of the event.	Refer to *7-11-2 Controller errors* for information on the displayed contents.
Event Name	Displays the event name.	
Event Code	Displays the event code.	
Display Settings, Displayed Information	This switches the information displayed between the system event log and the access event log.	The log contents in the CJ-series Unit is treated as a system event log.
Display Settings, Levels	Changes the information displayed according to the event levels.	
Details	Displays the contents and cause of the event log that was read.	

Item	Meaning	Remarks
Attached information 1 to 4	Displays supplementary information about the event log that was read. The meaning of the data is explained in the details.	
Action and correction	Gives the action and correction that are required to recover from the error.	The location to edit is displayed if you select a correction.
Display Switch	Switches the display between the details and attached information 1 to 4, and the corrections.	
Update Button	Reads and displays the log again.	The display is not automatically updated. The display is updated at the following times. • When you open the Troubleshooting Dialog Box • When you click the **Reload** Button.
Print Button	Prints the displayed log information.	Log information that is not displayed due to the Displayed Information selections is not printed.
Save Button	Saves the displayed log information as a CSV file.	Log information that is not displayed due to the Displayed Information selections is not saved.
Clear Button	Deletes the display log.	If the system event log is cleared, the CJ-series Unit log is also cleared.
Error Help Button	Displays the causes of and details on errors.	---

Changing the Display Order

You can click the *Time*, *Level,* or *Source* heading to sort the errors by that item. The events are displayed in order of dates by default.

Saving Controller Event Log

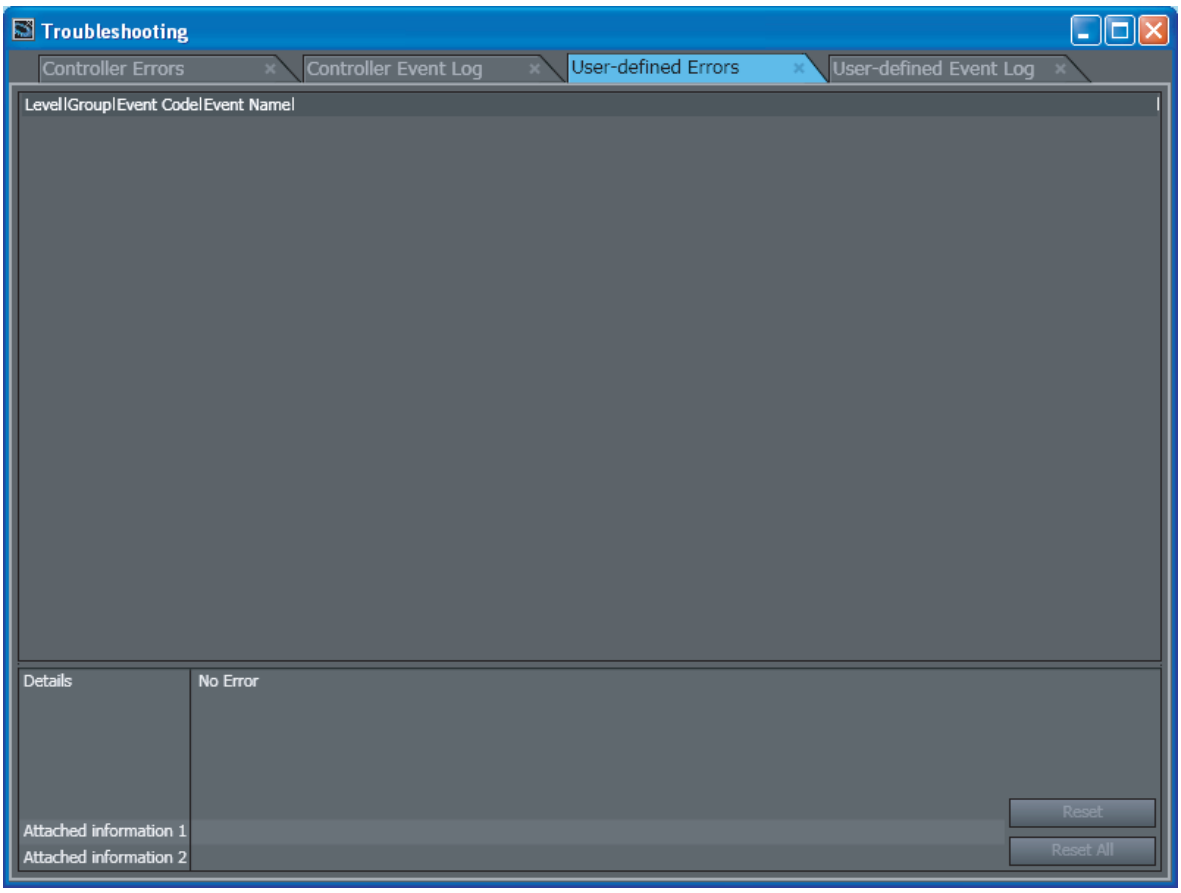
You can click the **Save** Button to save the Controller event log in a CSV file.

Precautions for Correct Use

The saved CSV file of the Controller event log is encoded in UTF-8 character codes.

7-11-4 User-defined Errors

You can display information on current errors.



Information Displayed for User-defined Errors and Functions

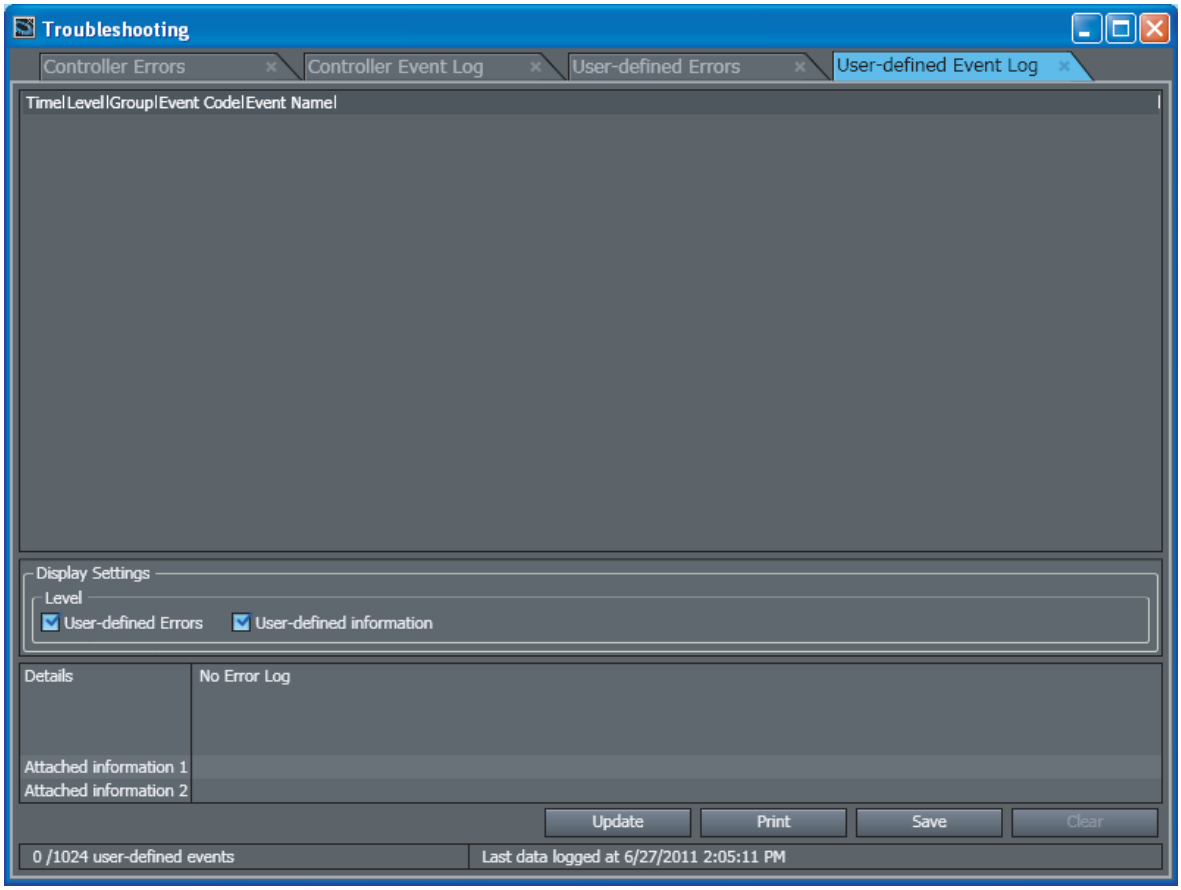
Item	Description	Remarks
Level	Displays the event level categorized by the event code.	You can change the name of the event level in the Event Setting Table.
Group	Displays the group registered in the Event Setting Table.	
Event Code	Displays the event code.	
Event Name	Displays the event title registered in the Event Setting Table.	
Details	Displays the event message registered in the Event Setting Table.	
Attached information 1 and 2	Displays the values for the *Info1* and *Info2* input parameters for the Create User-defined Error (SetAlarm) instruction and the Create User-defined Information (SetInfo) instruction.	
Reset Button	Resets the selected user-defined event.	
Reset All Button	Resets all user-defined events.	

Additional Information

Only the contents registered in the Language 1 Event Setting Table is shown in the User-defined Error Tab Page. The contents registered for Languages 2 to 9 are not displayed.

7-11-5 User-defined Event Log

The log of user-defined events that were stored for the Create User-defined Error (SetAlarm) instruction and the Create User-defined Information (SetInfo) instruction is displayed.



● Information Displayed for User-defined Event Log and Functions

Item	Contents	Remarks
Time	Displays the time and date that the user-defined event occurred.	This is time and date information stored in the Controller.
Level	Displays the event level of the user-defined event.	Refer to *7-11-4 User-defined Errors* for information on the displayed contents.
Group	Displays the group name of the user-defined event.	
Event Code	Displays the event code of the user-defined event.	
Event Name	Displays the user-defined event name.	
Display Settings, Level	Switches the view between user-defined errors (event codes 1 to 40,000) and user-defined information (event codes 40,001 to 60,000).	Only user-defined errors are displayed by default.
Details	Displays a description of the event that corresponds to the event code registered in the Event Setting Table.	Of Languages 1 to 9 in the Event Setting Table, only the contents registered for Language 1 is displayed. You cannot switch to Languages 2 to 9.

Item	Contents	Remarks
Attached Information 1 and 2	Displays the values for the Info1 and Info2 input parameters for the Create User-defined Error (SetAlarm) instruction and the Create User-defined Information (SetInfo) instruction.	
Update Button	Reads and displays the log again.	The display is not automatically updated. The display is updated at the following times. • When you open the Troubleshooting Dialog Box • When you click the **Reload** Button.
Print Button	Prints the event log.	
Save Button	Saves the event log to a CSV file.	
Clear Button	Deletes the user log.	

Changing the Display Order

You can click the *Time*, *Level, Group,* or *Event Code* heading to sort the events by that item. The events are displayed in order of dates by default.

Precautions for Correct Use

The saved CSV file of the user-defined event log is encoded in UTF-8 character codes.

7-11-6 Event Setting Table

The Event Setting Table is used to register the contents displayed on the Sysmac Studio and on NS-series PTs for user-defined events that occur for execution of the Create User-defined Error (SetAlarm) instruction and the Create User-defined Information (SetInfo) instruction.

- You can register the items that are described below (event name, level, group, and details) for each event code.
- You can register up to 5,120 events in the Event Setting Table.
- You can copy data created in Microsoft Excel and paste it into the Event Setting Table.
- You can also directly edit the Event Setting Table.

Event Name

Register the title of each user-defined event.

Level

The level of user-defined event is automatically determined according to the event code as shown in the following table. The name of the level is registered according to the level.

Event code	Level	Default title setting	Remarks
1 to 5000	High	User fault level 1	These event codes are used in the Create User-defined Error (SetAlarm) instruction.
5001 to 10000	↑	User fault level 2	
10001 to 15000	↑	User fault level 3	
15001 to 20000	↑	User fault level 4	
20001 to 25000	↑	User fault level 5	
25001 to 30000	↑	User fault level 6	
30001 to 35000	↑	User fault level 7	
35001 to 40000	↑	User fault level 8	
40001 to 60000	Low	User-defined Information	These event codes are used in the Create User-defined Information (SetInfo) instruction.

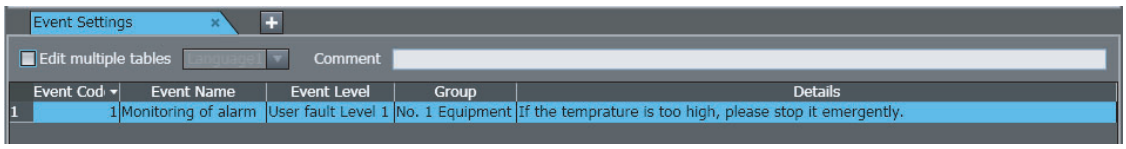
If the level name is not registered, “User Fault Level 1” to “User Fault Level 8” or “User-defined Information” is displayed.

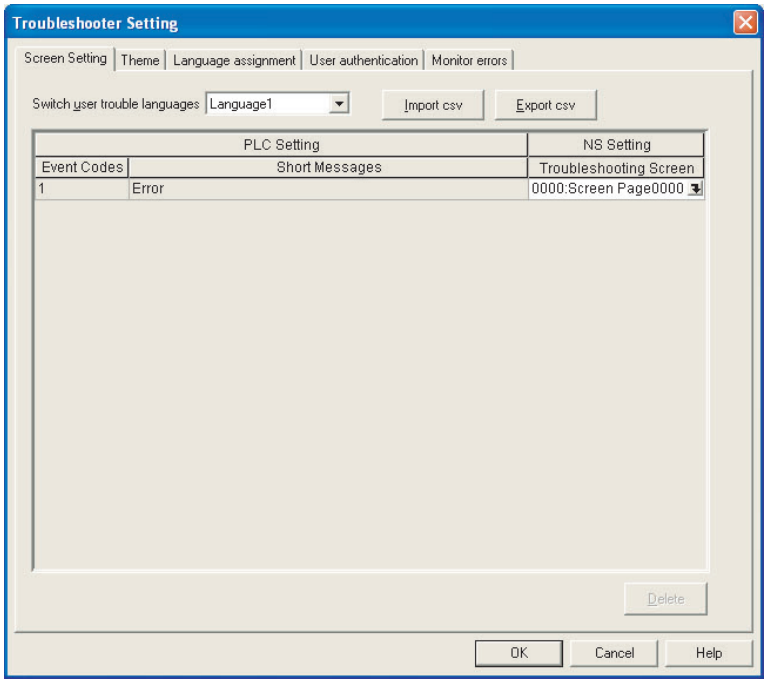
● Group

Register the group names to indicate the location and type of each user-defined event.

● Details

Register a detailed description of the user-defined event. The contents registered in the Event Setting Table and the contents displayed in the Troubleshooting Pane and on an HMI have the following relationship.





If you use more than one label on the NS-series PT, create more than one language table in the Event Setting Table. You can edit up to nine languages in the Event Setting Table.

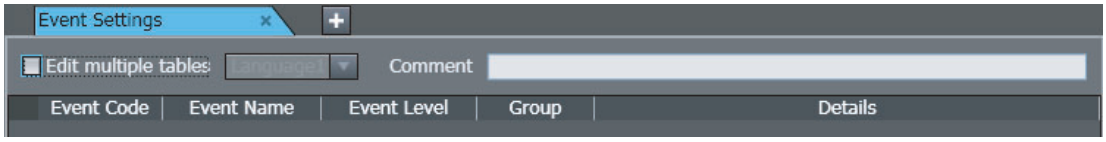
7-11-7 Displaying and Editing the Event Setting Table

This section provides the procedures for displaying and editing the Event Setting Table.

● Displaying the Event Settings Table

Double-click **Event Settings** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **Event Settings** under **Configurations and Setup** and select ***Edit*** from the menu.

The Editing Pane for the Event Setting Table is displayed.



● Displaying and Editing the Event Settings Table

Item	Description	Remarks
Event Code	You can specify a number to identify the event according to the event level.	User-defined errors: 1 to 40,000 User-defined information: 40,001 to 60,000
Event Name	You can include a title for the event.	128 characters max.
Event Level	You can specify the level of the event. The level is indicated with a number. The lower the number is, the higher the level is.	32 characters max. There are no restrictions on the characters that can be used. Case sensitive. Reserved words: None
Group	You can specify a group name to represent the location or type of the event. You can use user-defined groupings for the events.	32 characters max. There are no restrictions on the characters that can be used. Case sensitive. Reserved words: None
Details	You can include a message that describes the event. The user can enter any text string. The message is used when the event is displayed on the Sysmac Studio or an NS-series PT.	1,024 characters max. There are no restrictions on the characters that can be used. Case sensitive. Reserved words: None
Register the detailed description to display on the NS-series PT when a Controller error in the major fault level occurs.	Register the detailed description to display on the NS-series PT when a Controller error in the major fault level occurs. When a major fault occurs, the text registered here is displayed in the Troubleshooter Screen of the NS-series PT.	You can register up to 128 characters. You can enter carriage returns in the text, but each carriage return is counted as one character.
Comment	The comment is attached for each set of table entries.	

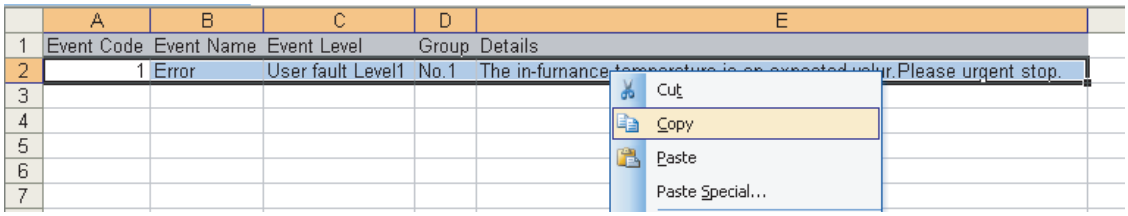
● Copying from Microsoft Excel to the Event Settings Table

This section describes the procedure to copy contents created in Microsoft Excel to the Event Setting Table. You can also directly edit information in the Event Settings Table.

1 Use the following format to create data in Microsoft Excel.

	A	B	C	D	E
1	Event Code	Event Name	Event Level	Group	Details
2	1	Error	User fault Level1	No.1	The in-furnance temperature is an expected valur.Please urgent stop.
3					
4					

2 Right-click the text in the red box and select ***Copy***.

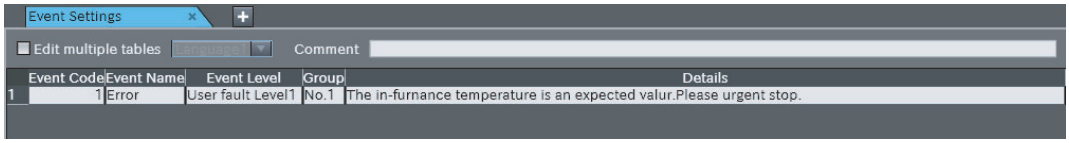


3 Right-click the Event Settings Table and select ***Paste*** to paste the data.

● Copying from the Event Setting Table to Microsoft Excel

This section describes the procedure to copy the contents of the Event Settings Table to Microsoft Excel.

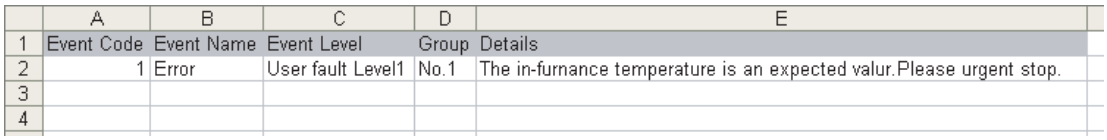
1 Select the section to copy in the Event Settings Table.



2 Right-click the Event Settings Table and select ***Copy***.

3 Paste the data in Microsoft Excel.

The data is pasted as shown below.

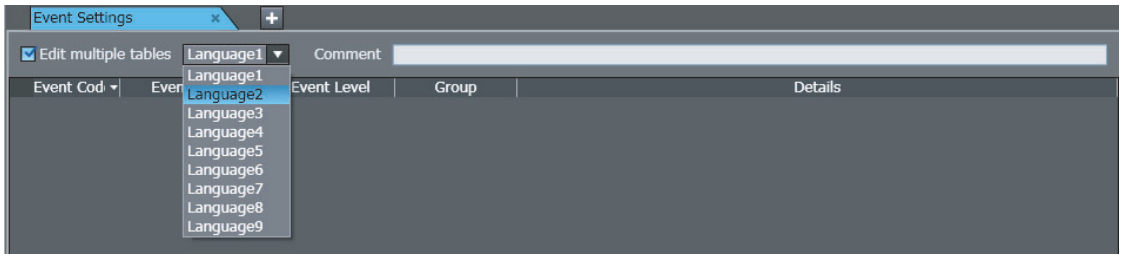


● Editing Variable Tables

You can create more than one language table in an Event Settings Table to change the contents that is displayed for different HMI labels.

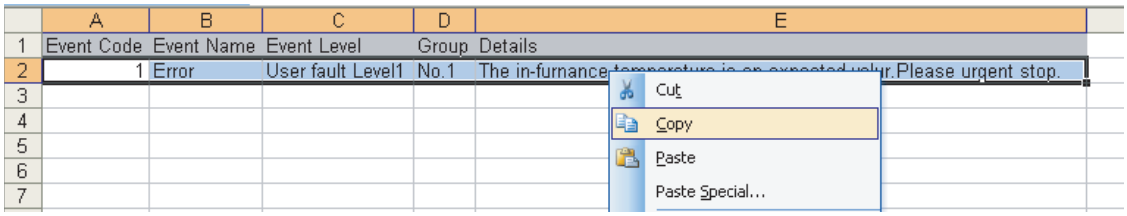
1 Select the *Edit multiple tables* Check Box in the Event Settings Table.

2 Select the language to edit from *Language 2* to *Language 9*.



3 Use the same method as in *Copying from Microsoft Excel to the Event Settings Table,* above.

Select and copy data that was created in Microsoft Excel in the red box.



4 Right-click the Event Settings Table and select ***Paste*** to paste the data.

Additional Information

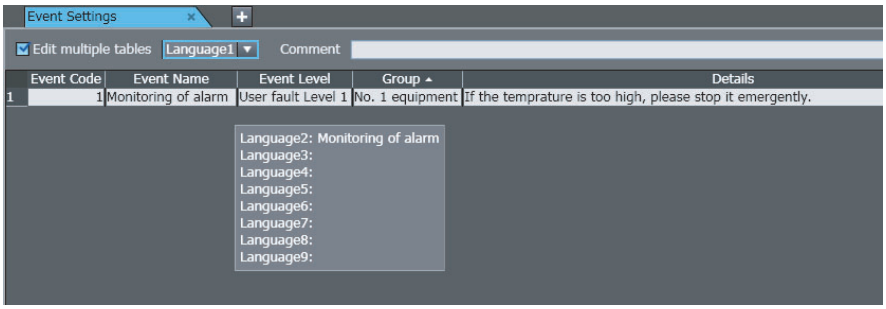
Multiple language tables in an Event Setting Table are used to add display contents for the event registered for *Language 1*. You cannot use Language 2 to Language 9 to create more events. (You cannot change the event code field.) To add an event, set the event for *Language 1* in an Event Setting Table.

● Referring to the Other Languages When Editing an Event Settings Table

The contents registered for other languages in the Event Settings Table is displayed when the mouse is placed on an event.

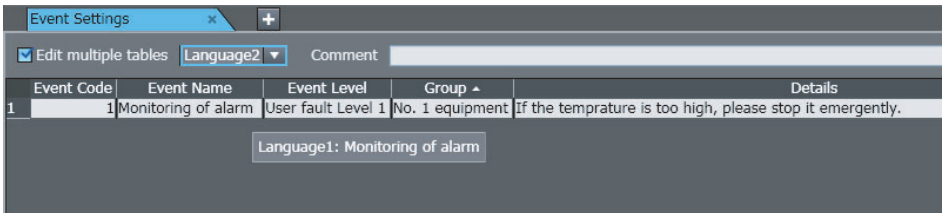
Example: When Editing the Event Settings Table for Language 1

The contents registered for Language 2 to Language 9 is displayed.



Example: When Editing the Event Settings Table for Language 2 to Language 9

The contents registered for Language 1 is displayed.



7-11-8 Event Log CSV File Format

If you click the **Save** Button in the Controller Log Tab Page or the User Log Tab Page, the contents that is registered in the log (text information) is surrounded by double quotation marks and saved in the CSV (comma separated value) format (*.csv). The format is shown below.

● Controller Log

Information on the displayed log and filtering information by level is placed at the start of the file.

```
“display target”,“system, communications, or security”
“level”, ”major, partial, minor, observation, or information”
“date”, “time”, “level”, “source”, “event”, “error code”, “attached information 1”, “attached information 2”, “attached information 3”, “attached information 4”
“2009/11/14”, “13:54:43”, “partial”, “CPU Unit (motion)”, “xx error”, “0x12345678”,,,,
“2009/10/07”, “10:56:21”, “partial”, “rack#0,slot#1(CJ1W-CRM21)”, “•• error”, “0x00011234”,,,,
```

● User-defined Event Log

```
“date”,“time”,“level”,“group name”,“event code”,“message (abbreviated)”
“2009/12/25”, “02:05:36”, “diagnostic information”, “automatic operation”, “10015”, “initialization finished”
“2009/12/25”, “02:05:37”, “minor error”, “manual operation”, “200511”, “loading error”
“2010/01/06”, “10:14:20”, “major error”, “initialized”, “255”, “recipe setting error”
```

8

Reusing Programming

This section describes how to reuse the programs that you create with the Sysmac Studio.

8-1 Overview 8-2

8-2 Example of Reusing Device and Program Assets 8-3

8-2-1 Changing I/O Assignments 8-3

8-2-2 Deleting Device Options 8-5

8-2-3 Adding Device Options 8-6

8-3 Writing Programs To Make Them More Reusable 8-7

8-3-1 Issues in Reusing Programs 8-7

8-1 Overview

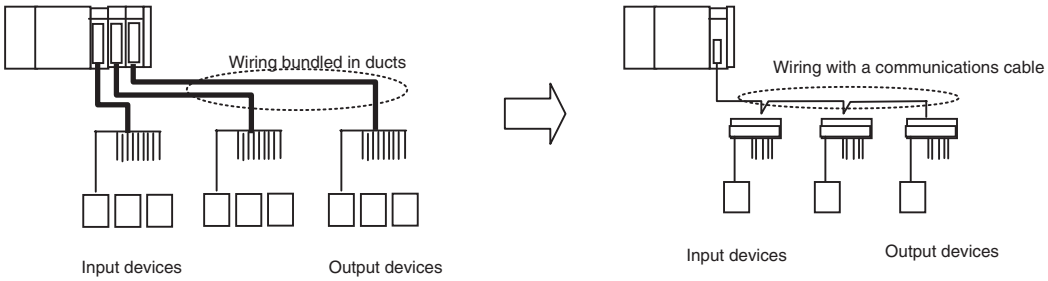
The Sysmac Studio provides an environment for programming with variables and POUs (program organization units), including functions, function blocks, and programs. Variables are assigned to manipulate external devices and I/O information in the user program. This provides a highly reusable programming style that is not system dependent. The importing and exporting features for settings enable the reuse of hardware configurations as well programming.

8-2 Example of Reusing Device and Program Assets

This section describes how design assets would be reused in a typical system upgrade example. It compares the work required for traditional programming with fixed address as opposed to programming with variables with the Sysmac Studio.

8-2-1 Changing I/O Assignments

- **In this example, the long-distance wiring from the I/O devices to Basic I/O Units is converted to a network device configuration that uses remote I/O slaves to save wiring and changing the I/O devices to remote I/O slaves to improve the maintainability of the system.**

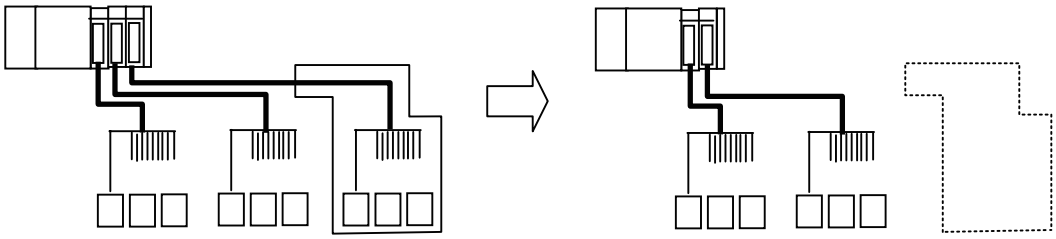


	Goal	Traditional programming	Programming with the Sysmac Studio
1	Checking the addresses assigned to the old devices	You must confirm the addresses and I/O comments assigned to the Basic I/O Units.	---
2	Checking the addresses assigned to the new devices	You must calculate the addresses assigned to the remote I/O slaves. **Note** If any of the calculated addresses are used as work bits, you must assign the work bits to new work bit addresses.	---

	Goal	Traditional programming	Programming with the Sysmac Studio
3	Replacing the addresses of the old devices with the addresses of the new devices.	You must move the I/O comment information for the previous addresses to the calculated new addresses. **Note** If any of the calculated addresses are used as work bits, you must move the I/O comments to the new work bit addresses.	You must delete the Basic I/O Units from the Unit configuration (variable assignments to I/O devices are cleared).
		You must replace the addresses of the old devices with the addresses of the new devices. **Note** If any of the calculated addresses are used as work bits, you must move the I/O comments to the new work bit addresses.	You must register the remote I/O slaves in the network configuration.
		You must register the remote I/O slaves in the network configuration.	You must assign variables to the I/O devices for remote I/O devices.
4	Changing the Unit Configuration in the project	You must delete the Basic I/O Units from the Unit Configuration.	---
		You must delete the old addresses from the variable table.	---
5	Building the devices and wiring	You must wire the I/O devices to the remote I/O device terminals according to the device configuration diagrams and wiring diagrams.	You must wire the I/O devices to the remote I/O device terminals according to the device configuration diagrams and wiring diagrams.
6	Checking wiring and addresses	You must visually confirm that wires are connected according to the wiring diagram using color codes and use a tester to check continuity.	You must visually confirm that wires are connected according to the wiring diagram using color codes and use a tester to check continuity.
		You must confirm that the output results to the new addresses are output to the remote I/O slave devices and that dummy inputs from I/O devices are reflected in the input words.	You must confirm that the output results to the variables are output to the remote I/O slave devices and that dummy inputs from I/O devices are reflected in the variables.
7	Debugging the programs	You must check for mistakes in address changes for device changes and make sure that operation timing is not affected.	You must make sure that operation timing is not affected.
8	Performing trial operation	You must perform trial operation of the device configuration and control programs after the changes are made.	You must perform trial operation of the device configuration and control programs after the changes are made.

8-2-2 Deleting Device Options

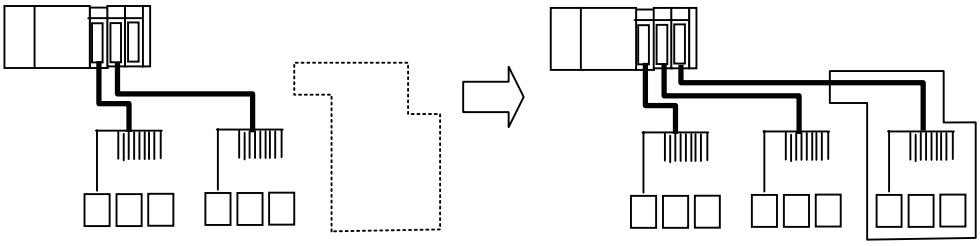
- **In this example, part of the devices is removed from the system to reduce the production scale.**



	Application	Traditional programming	Programming with the Sysmac Studio
1	Checking the addresses assigned to the devices to delete	You must check the addresses that are used by the devices to delete.	---
2	Checking the control programming for the devices to delete	You must check the programming that is used to control the devices to delete.	You must check the programs and program tasks that are used to control the devices to delete.
		You must check the programming that is used to monitor and interlock the devices to delete.	You must check the programs and program tasks that are used to monitor and interlock the devices to delete.
3	Changing the Unit Configuration in the project	You must delete the devices to delete from the Unit Configuration.	You must delete the devices to delete from the Unit configuration (variable assignments to I/O devices are cleared).
4	Deleting the control programming for the unnecessary devices	You must delete the programming that is used to control the devices to delete.	You must delete the programs and program tasks that are used to control the devices to delete.
		You must correct the programming that is used to monitor and interlock the devices to delete.	You must correct the programs that are used to monitor and interlock the devices to delete.
		You must delete the addresses that are used by the devices to delete from the variable table.	---
5	Removing Units that were used for the devices to delete	You must remove the wiring to the external devices from the Units that were used for the devices to delete.	You must remove the wiring to the external devices from the Units that were used for the devices to delete.
		You must remove the external devices and the Units that were used for the devices to delete.	You must remove the external devices and the Units that were used for the devices to delete.
6	Debugging the programs	You must check for mistakes in program changes for the devices to delete and make sure that operation timing is not affected.	You must check for mistakes in program changes for the devices to delete and make sure that operation timing is not affected.
7	Performing trial operation	You must perform trial operation of the device configuration and control programs.	You must perform trial operation of the device configuration and control programs.

8-2-3 Adding Device Options

- **In this example, part of the devices is expanded on the device copy line to increase the production scale.**



	Application	Traditional programming	Programming with the Sysmac Studio
1	Checking the addresses assigned to the devices to add	You must check the addresses to assign to the Units to use for the devices to add. **Note** If any of the assigned addresses are used as work bits, you must assign the work bits to unused work bits.	---
		You must add variables and comments for the work bits to use in the programming.	You must register the Units to use for the devices to add in the Unit Configuration.
		You must register the Units to use for the devices to add in the Unit Configuration.	You must register the variables to use in the programs.
		---	You must assign the variables to use to the I/O devices.
2	Writing the control programming for the devices to add	You must write the control programming. **Note** If any of the assigned addresses are used as work bits, you must change the work bits to unused addresses.	You must write the control programming.
		You must understand the operation and affects of interlocks and improve the programming.	You must understand the operation and affects of interlocks and improve the programming.
3	Building the devices to add and wiring	You must add and wire devices according to the device configuration diagrams and wiring diagrams.	You must add and wire devices according to the device configuration diagrams and wiring diagrams.
4	Checking wiring and addresses	You must visually confirm that wires are connected according to the wiring diagram using color codes and use a tester to check continuity.	You must visually confirm that wires are connected according to the wiring diagram using color codes and use a tester to check continuity.
		You must confirm that the output results to the addresses are output to the devices and that inputs from I/O devices are reflected in the input words.	You must confirm that the output results to the variables are output to the devices and that inputs from I/O devices are reflected in the variables.
5	Debugging the programs	You must debug the programs.	You must debug the programs.
6	Performing trial operation	You must perform trial operation of the device configuration and control programs after the changes are made.	You must perform trial operation of the device configuration and control programs after the changes are made.

8-3 Writing Programs To Make Them More Reusable

8-3-1 Issues in Reusing Programs

The ability to reuse development assets is necessary to reduce development costs, shorten development time, and reduce maintenance costs for production facilities. As shown in *8-2 Example of Reusing Device and Program Assets*, minimizing the size of the function modules that build the hardware and software is important to enable the reuse of programs with the Sysmac Studio. That means that the structure of modules and development stages are important issues.

With previous PLCs, information was exchanged with I/O devices through addresses that were assigned to the hardwired devices. These addresses were used to write the program. As a result, changing the addresses for device changes involved complex procedures to obtain new addresses, move comments to new addresses, change addresses in the program, etc. This was inevitably accompanied by mistakes. The relationship between hardware and software was strong and the function modules were large, so the affects of changes could not be absorbed by the modules.

With the NJ-series Controllers, information for hardwired I/O devices is handled in I/O devices that are defined within the system. The programs are created based on these I/O devices and the variables that are assigned to them by the user. Even if devices are changed, it is often not necessary to change the programs when the I/O devices that are defined within the system are changed, i.e., it is only necessary to change the variable assignments to I/O devices. The hardware-software function modules separate the I/O devices and variables, and the affects of changes can be absorbed by the function modules. This reduces the corrections that require complex procedures, which in turn reduces mistakes. Confirmation and correction work are also reduced to reduce the cost of development and development time.

9

Support Software Provided with the Sysmac Studio

This section describes the Support Software that is provided with the Sysmac Studio.

9-1 Support Software Provided with the Sysmac Studio 9-2

9-1-1 Introduction 9-2

9-2 Starting the Support Software 9-3

9-2-1 Starting and Exiting 9-3

9-1 Support Software Provided with the Sysmac Studio

9-1-1 Introduction

● Support Software Provided with the Sysmac Studio

The following Support Software can be installed from the Sysmac Studio Package.

Product	Model number	Included Support Software		Enclosed data
Sysmac Studio Version 1.0	SYSMAC-SE2□□□	Sysmac Studio	Ver.1.□	• CPS • Manuals (PDF files)
		CX-Integrator	Ver.2.□	
		CX-Designer	Ver.3.□	
		CX-Protocol	Ver.1.□	
		Network Configurator	Ver.3.□	
		CX-Server	Ver.5.□	
		Communications Middleware	Ver.1.□	

● Units Supported by the Sysmac Studio and Applicable Support Software

CPU Bus Units

Model	Unit name	Applicable Support Software	Relevant Manuals	Cat. No.
CJ1W-DRM21	DeviceNet Unit	CX-Integrator	CX-Integrator Operation Manual	W464
CJ1W-EIP21	EtherNet/IP Unit	CX-Integrator		
		Network Configurator	NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual	W506
CJ1W-SCU22	Serial Communications Units	CX-Protocol	CX-Protocol Operation Manual	W344
CJ1W-SCU32				
CJ1W-SCU42				

Programmable Terminals (HMIs)

Model number	Unit name	Applicable Support Software	Manual	Cat. No.
NS Series	Programmable Terminals	CX-Designer	CX-Designer User's Manual	V099

9-2 Starting the Support Software

9-2-1 Starting and Exiting

This section describes how to start and exit the Support Software that is provided with the Sysmac Studio.

Precautions for Correct Use

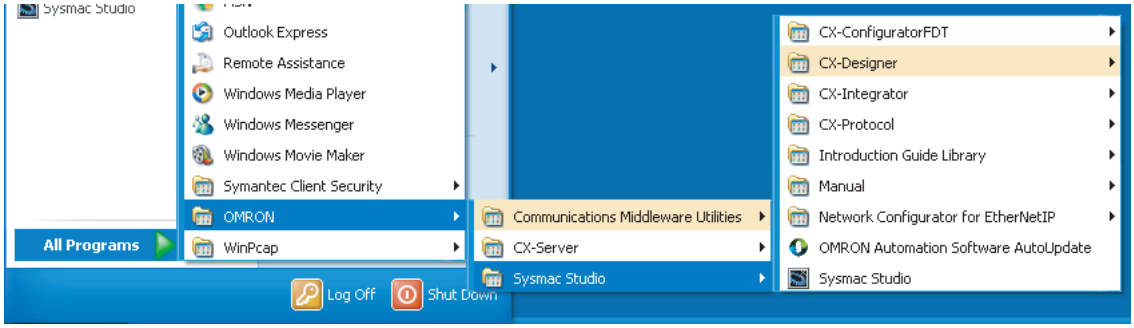
Observe the following precautions when you start the Sysmac Studio or any of the Support Software that is provided with it.

- Exit all applications that are not directly related to the Sysmac Studio. Always stop all screen savers, virus checkers, email applications, other communications applications, schedule management software, and applications that are started periodically or for events.
- If any hard disks or printers that are connected to the computer are shared with other computers on a network, isolate them so that they are no longer shared.
- With some notebook computers, the default settings assign the USB port to a modem or infrared communications. Refer to the user documentation for your computer and set the USB port as a normal serial port.
- With some notebook computers, the default settings do not supply power (5 V) to the USB port to save energy. There are energy-saving settings in Windows, and also sometimes in utilities or the BIOS of the computer. Refer to the user documentation for your computer and disable all energy-saving features.

Starting the Support Software Provided with Sysmac Studio

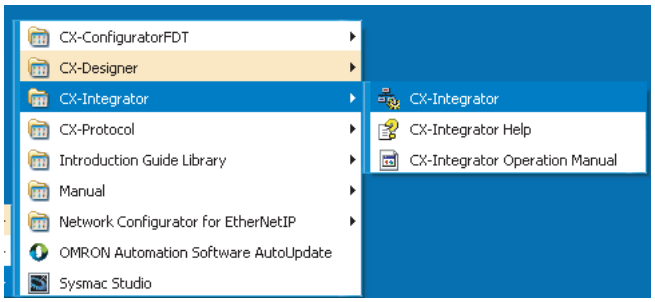
Use the following procedure to start the Support Software that is provided with the Sysmac Studio.

1 Select ***All Programs - OMRON - Sysmac Studio*** from the Windows Start Menu as shown below.



A list of the Support Software is displayed.

2 Select the icon of the Support Software to start. (Example: CX-Integrator)

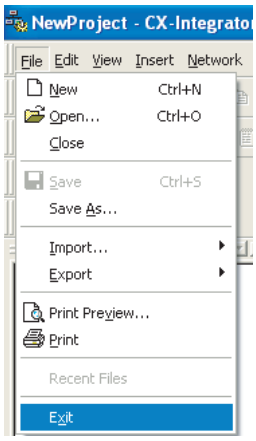


The main window for the Support Software is displayed.

Exiting the Support Software Provided with Sysmac Studio

Use the following procedure to exit the Support Software that is provided with the Sysmac Studio.

1 Select ***Exit*** from the File Menu.



The Support Software provided with Sysmac Studio is exited.

Additional Information

If there is unsaved data when you select ***Exit*** from the menu, a dialog box will prompt saving the data before the Support Software is exited. Save the data if it is required. Refer to the relevant manual for details.

10

Troubleshooting

This section describes the error messages that are displayed when you check a program on the Sysmac Studio and how to correct those errors.

10-1 Error Messages for Ladder Program Checks 10-2
10-2 Error Messages for Structured Text Checks 10-7
10-3 Error Messages for Sysmac Studio Operation 10-10

10-1 Error Messages for Ladder Program Checks

The following table lists the ladder program error messages that are displayed in the Output Tab Page when detected during a program check on the Sysmac Studio.

Error message	Error level	Cause	Correction
A parameter is not entered for the input.	Error	Refer to the error message.	Enter a parameter for the input.
A parameter is not entered for the output.	Error	Refer to the error message.	Enter a parameter for the output.
A parameter of the MC instruction is invalid. Execute the program check to correct the parameter.	Error	The MC or MCR number argument does not match the MC or MCR level number.	Correct the MC or MCR instruction parameter.
A variable that is not registered in the variable table is used.	Error	Refer to the error message.	Define the variable in the variable table or enter the correct variable name.
A variable whose data type is not defined is used.	Error	Refer to the error message.	Define the data type or enter the correct variable name.
Any item other than output cannot be connected after an output.	Error	Refer to the error message.	Remove any connections other than outputs after the output.
An exception such as memory shortage has occurred.	Error	An object file could not be created due to insufficient memory.	Reduce the sizes of the individual POUs as given below, e.g., by separating individual POUs into two or more POUs. POUs that are ladder programs: Separate the programs into two or more sections. Global variables: Use structures or arrays to combine variables or use local variables instead of global variables whenever possible.
Any parameters other than WORD data may result in an unexpected operation.	Warning	Unintended operation may occur if you use a parameter that is not WORD data.	Correct the usage of parameter data types.
Be careful not to make the scan time too long when moving upward on the program.	Warning	Refer to the error message.	Correct the usage of nesting.
Cannot jump into inside the FOR-NEXT loop.	Error	You attempted to jump to a location inside a FOR ... NEXT construct from outside the FOR ... NEXT construct.	Correct the usage of the FOR and NEXT instructions.
Contacts must not be connected to the right bus bar.	Error	The input is connected to the right bus bar.	Correct the rung.
Data may be lost during conversion.	Warning	Some data may be lost in the conversion.	Correct how the data is converted.
data_type_name cannot be converted to *data_type_name*.	Error	You cannot convert the data to the specified data type.	Correct how the data is converted.

Error message	Error level	Cause	Correction
Inline ST can contain up to 1,000 rows.	Error	The Inline ST box contains more than 1,000 lines.	Reduce the number of lines in the Inline ST box.
Invalid pair of data types. Execution result may be lost.	Error	You cannot specify a combination of data types that may result in the loss of execution results.	Correct the usage of the data types.
Invalid pair of input parameters.	Error	The specified combination of input parameter data types is incorrect.	Correct the usage of input parameter data types.
It is not recommended to use global variables in a function.	Warning	You used a global variable in a function.	Correct the usage of global variables in functions.
instruction_name requires a variable with the range specified.	Error	You specified a variable that does not have a range specification.	Correct the usage of the instruction, or specify the variable with a range specification.
Literal cannot be used in an input parameter of a in-out variable.	Error	A literal was specified for the parameter on the input side for an in-out variable.	Correct the parameter on the input side for the in-out variable.
Literal format is wrong or the data type is not available.	Error	The format of the literal is incorrect, or you attempted to use a text string literal as a different data type.	Correct the usage of literals, including the format.
member_name is not a member of the *data_type_name* data type.	Error	You specified an undefined member name after the period.	Define the member or correct the member specification.
No JUMP instruction specifies the label in the same section.	Warning	This warning is displayed when only a label is defined in a section.	Correct the usage of jumps and labels.
No need to round integer type variables.	Warning	Execution is not required for integer variables.	Correct the usage of the integer variables.
No value can be written to a literal.	Error	You attempted to output to a literal.	Correct the output.
No value can be written to a variable with Read Only attribute set in the task setting.	Error	You specified a variable that can be accessed in the task as an output parameter.	Correct the usage of the accessing tasks.
No value can be written to a variable with the Constant attribute.	Error	You specified a variable with the Constant attribute as an output parameter.	Correct the usage of the Constant attribute for the variable.
No value can be written to an input variable.	Error	You attempted to write a value to an input variable inside a function or function block.	Correct the usage of input variables in functions and function blocks.
No value can be written to input, output, or in-out variables of a function block instance.	Error	You attempted to write a value to the output variable, input variable, or in-out variable of an instance variable.	Correct the usage of variables of function block instances.
No value can be written to the enumerated type of variables.	Error	You attempted to output a value to an enumeration.	Correct the enumeration.
One rung can contain only one inline ST.	Error	There is more than one Inline ST box on the rung.	Correct the usage of inline ST.
One rung can contain up to 1,000 instructions.	Error	Refer to the error message.	Reduce the number of instructions on the rung.
One section can contain up to 1,000 rungs.	Error	You attempted to use more than 1,000 rungs in one section.	Reduce the number of rungs in the section.

Error message	Error level	Cause	Correction
Output parameter type does not match output variable type.	Error	The data type of the output parameter does not match the data type of the output variable.	Correct the output parameter or output variable.
Same name is already used for a variable.	Error	Refer to the error message.	Rename the variable or the label.
The BREAK instruction is used outside the FOR-NEXT loop.	Error	Refer to the error message.	Correct the usage of the BREAK instruction.
The BREAK instruction must be connected to the right bus bar.	Error	Refer to the error message.	Correct the usage of the BREAK instruction.
The END instruction cannot be used in a function or function block.	Error	Refer to the error message.	Remove the END instruction from the function or function block.
The END instruction must be used alone on a rung. The rung cannot contain any other elements.	Error	Refer to the error message.	Correct the usage of the END instruction.
The FOR instruction must be used alone on a rung. The rung cannot contain any other elements.	Error	Refer to the error message.	Correct the usage of the FOR instruction.
The MC instruction must be connected to the right bus bar.	Error	Refer to the error message.	Correct the output of the MC instruction.
The MCR instruction must be used alone on a rung. The rung cannot contain any other elements.	Error	Refer to the error message.	Correct the usage of the MCR instruction.
The NEXT instruction must be used alone on a rung. The rung cannot contain any other elements.	Error	Refer to the error message.	Correct the usage of the NEXT instruction.
The RETURN instruction cannot be used in a program POU.	Error	The RETURN instruction was used in a program.	Remove the RETURN instruction from the program.
The RETURN instruction must be used alone on a rung. The rung cannot contain any other elements.	Error	Refer to the error message.	Correct the usage of the RETURN instruction.
The array dimension is not correctly specified.	Error	The array dimensions used do not match the array definition.	Correct the array definition or correct the array dimensions.
The array expression is invalid.	Error	The array expression is incorrect, there is no right bracket, or there is a character after the right bracket.	Correct the array expression.
The array index is out of range.	Error	The literal used for the array subscript is outside of the range of the array.	Correct the array definition or correct the array subscript.
The data type range is decreased in the conversion from *data_type_name* to *data_type_name*.	Error	You cannot convert the variable to the specified data type.	Correct how the data is converted.
The *data_type_name* data type is not defined.	Error	You attempted to use a variable with an undefined data type.	Define the data type or enter the correct variable name.

Error message	Error level	Cause	Correction
The downward differentiation condition cannot be specified for the *instruction_name* instruction.	Error	The instruction does not support the ~ condition.	Correct the usage of the *instruction_name* instruction.
The function block definition name is empty.	Error	Refer to the error message.	Enter a function block definition name.
The function block name is not defined.	Error	Refer to the error message.	Define the function block or enter the correct function name.
The function name is empty.	Error	Refer to the error message.	Enter a function definition name.
The function name is not defined.	Error	Refer to the error message.	Define the function or enter the correct function name.
The inline ST box must be connected to the right bus bar.	Error	Refer to the error message.	Correct the usage of inline ST.
The input parameter cannot be omitted for an in-out variable.	Error	The in-out variable does not have a parameter on the input side.	Enter a parameter on the input size for the in-out variable.
The input parameter types cannot be converted to the output parameter types.	Error	Refer to the error message.	Correct how the data is converted.
The input used as an internal bit is not written from others.	Warning	Refer to the error message.	Check the access relationships of the work bit input.
The instance is doubly used, which may cause an unintentional operation.	Warning	Refer to the error message.	Correct the usage of the instance.
The instance variable is empty.	Error	Refer to the error message.	Enter an instance variable.
The label is empty.	Error	No label was entered for a Jump instruction (->>) or Label instruction.	Enter a label.
The label specified for the jump destination does not exist in the same section.	Error	A label for the jump target does not exist in the same section.	Correct the usage of jumps and labels.
The label specified for the jump destination is used more than once.	Error	Refer to the error message.	Correct the usage of jumps and labels.
The member expression is invalid.	Error	The member expression is incorrect (e.g., “(a..b)”).	Correct the member expression.
The output is doubly used, which may cause unintentional operation.	Warning	Refer to the error message.	Correct the usage of outputs.
The output used as an internal bit is not referenced from others.	Warning	Refer to the error message.	Check the access relationships of the work bit output.
The rung cannot be branched before the MC instruction.	Error	Refer to the error message.	Correct the rung before the MC instruction.
The rung cannot be branched or converged after an output.	Error	Refer to the error message.	Remove any branches or joins after outputs.
The rung is disjunct.	Error	There is a disconnection within a rung.	Correct the rung.
The upper limit of nesting levels (15) was exceeded.	Error	Refer to the error message.	Correct the usage of nesting.

Error message	Error level	Cause	Correction
The upward differentiation condition cannot be specified for the *instruction_name* instruction.	Error	The instruction does not support the @ condition.	Correct the usage of the *instruction_name* instruction.
There is no corresponding FOR instruction in the same section.	Error	A FOR instruction was not found in the same section as a NEXT instruction.	Correct the usage of the FOR and NEXT instructions.
There is no corresponding MC instruction.	Error	You did not include the MC instruction that corresponds to the MCR instruction.	Correct the usage of the MC and MCR instructions.
There is no corresponding MCR instruction inside the FOR-NEXT loop.	Error	There is an MC instruction without an MCR instruction between the FOR and NEXT instructions.	Correct the MC structure between the FOR and NEXT instructions.
There is no corresponding MCR instruction.	Error	You did not include the MCR instruction that corresponds to the MC instruction.	Correct the usage of the MC and MCR instructions.
There is no corresponding NEXT instruction in the same section.	Error	A NEXT instruction was not found in the same section as a FOR instruction.	Correct the usage of the FOR and NEXT instructions.
There is no corresponding NEXT instruction inside the MC-MCR region.	Error	There is a FOR instruction without a NEXT instruction between the MC and MCR instructions.	Correct the FOR structure between the MC and MCR instructions.
Unsigned integers cannot be used together with signed integers.	Error	You cannot use an unsigned integer with a signed integer or a real number.	Correct the usage of unsigned integers, signed integers, and real numbers.
When specifying an output parameter of an in-out variable, it must be same as input parameter.	Error	The parameter on the output side for the in-out variable is not the same as the parameter on the input side.	Use the same parameter on both the input and output sides for an in-out variable.
When using the union data type, specify a member.	Error	You attempted to use a union variable without a period.	Correct the usage of unions.
You can only use the following types for the input parameter.	Error	You specified a data type that cannot be used for an input.	Correct the usage of inputs.

10-2 Error Messages for Structured Text Checks

The following table lists the ST program error messages that are displayed in the Output Tab Page when detected during a program check on the Sysmac Studio.

Error message	Error level	Cause	Correction
"(" is missing.	Error	Refer to the error message.	Insert a left parenthesis.
")" is missing.	Error	Refer to the error message.	Insert a right parenthesis.
"." is missing.	Error	Refer to the error message.	Insert a period.
":" is missing.	Error	Refer to the error message.	Insert a colon.
":=" is missing.	Error	Refer to the error message.	Insert a colon and equals sign (:=).
";" is missing.	Error	Refer to the error message.	Insert a semicolon.
"[" is missing.	Error	Refer to the error message.	Insert a left bracket.
"]" is missing.	Error	Refer to the error message.	Insert a right bracket.
A constant cannot be written.	Error	Refer to the error message.	Correct the usage of constants.
A variable with Constant attribute cannot be written.	Error	Refer to the error message.	Correct the usage of variables with a Constant attribute.
Address cannot be allocated for the variable *variable_name*. Check the auto allocation option.	Error	Refer to the error message.	Refer to the error message.
An I/O parameter is missing. All I/O parameters must be set.	Error	Refer to the error message.	Set the I/O parameter.
Array dimension or size does not match.	Error	Refer to the error message.	Correct the usage of arrays.
Array index is out of range.	Error	Refer to the error message.	Correct the array index.
Bad Parameter - Variable is not found.	Error	Refer to the error message.	Correct the parameter.
Constant is missing.	Error	Refer to the error message.	Insert a constant.
Conversion from *source_data* to *destination_data* may cause data loss.	Error	Refer to the error message.	Correct how the data is converted.
Conversion from *source_data* to *destination_data* is impossible.	Error	Refer to the error message.	Correct how the data is converted.
"DO" is missing.	Error	Refer to the error message.	Insert DO.
Definition of the function block *definition_name* is missing.	Error	Refer to the error message.	Correct the function block definitions.
Definition of the function *function_definition_name* is missing.	Error	Refer to the error message.	Use the function definition *function_definition_name*.
Division by zero	Error	Refer to the error message.	Correct the division operation.
Duplicate variable is specified for the function.	Error	Refer to the error message.	Correct the usage of the variables.
Duplicate variable is specified.	Error	Refer to the error message.	Correct the variable.
"EN' or 'ENO' cannot be used as an input/output variable.	Error	Refer to the error message.	Correct the usage of the *EN* and *ENO* variables.

Error message	Error level	Cause	Correction
"END_CASE" is missing.	Error	Refer to the error message.	Insert END CASE.
"END_FOR" is missing.	Error	Refer to the error message.	Insert END FOR.
"END_IF" is missing.	Error	Refer to the error message.	Insert END IF.
"END_REPEAT" is missing.	Error	Refer to the error message.	Insert END REPEAT.
"END_WHILE" is missing.	Error	Refer to the error message.	Insert END WHILE.
End of the comment is not found.	Error	Refer to the error message.	Define the end of the comment.
End of the string is not found.	Error	Refer to the error message.	Define the end of the text string.
Enumerated type identifiers are read only.	Error	Refer to the error message.	Correct the usage of ENUM enumerators.
Failed to retrieve the information of variable *variable_name* from function block variable table.	Error	Refer to the error message.	Correct the variable name.
Field specifier is missing.	Error	Refer to the error message.	Correct the field specifier.
Function block I/O variable is read only.	Error	Refer to the error message.	Correct the function block I/O variable.
Global variable *variable_name* is used.	Warning	Refer to the error message.	Correct the usage of the variables.
Identifier is missing.	Error	Refer to the error message.	Insert an identifier.
Invalid format.	Error	Refer to the error message.	Correct the format.
Invalid value	Error	Refer to the error message.	Correct the value.
Missing parameter.	Error	Refer to the error message.	Correct the number of parameter specifications.
member_name is not a member of *data_type_variable_name*.	Error	Refer to the error message.	Correct the m*ember_name* member of *data_type_variable*.
Negation is not supported by *data_type_variable_name* data type.	Error	Refer to the error message.	Correct the value or the data type.
Numbers cannot be specified for the NOT operation.	Error	Refer to the error message.	Correct the usage of the NOT expression.
"OF" is missing.	Error	Refer to the error message.	Insert OF.
Output variable of the function is invalid.	Error	Refer to the error message.	Correct the output variable.
Read-only memory is specified as the AT address of the variable *variable_name*. No value can be assigned to the variable.	Error	Refer to the error message.	Correct the AT specification.
String literal is too long.	Error	Refer to the error message.	Correct the text string.
Strings are not currently supported.	Error	Refer to the error message.	Correct the text string.
Structure variables are not supported.	Error	Refer to the error message.	Correct the usage method.
"THEN" is missing.	Error	Refer to the error message.	Insert THEN.
"TO" is missing.	Error	Refer to the error message.	Insert TO.
The AT address specified for the variable *variable_name* is invalid.	Error	Refer to the error message.	Correct the AT specification.

Error message	Error level	Cause	Correction
The FOR loop declaration contains an invalid parameter.	Error	Refer to the error message.	Correct the parameter in the FOR loop declaration.
The array index is invalid.	Error	Refer to the error message.	Correct the array index.
The array is short of dimensions.	Error	Refer to the error message.	Correct the array variable.
The constant is invalid.	Error	Refer to the error message.	Correct the constant.
The expression is invalid.	Error	Refer to the error message.	Correct the expression.
The function block parameter is mixed data types.	Error	Refer to the error message.	Correct the function block parameter.
The in-out variable is invalid.	Error	Refer to the error message.	Correct the in-out variable.
The input variable *variable_name* cannot be assigned a value.	Error	Refer to the error message.	Correct the usage of the input variables.
The operation is invalid.	Error	Refer to the error message.	Correct the operation.
The *operator_name* operator is not supported by *data_type_name* data type.	Error	Refer to the error message.	Correct the usage of the operator.
The output variable is invalid.	Error	Refer to the error message.	Correct the output variable.
The output variable *variable_name* cannot be assigned a value.	Error	Refer to the error message.	Correct the usage of the output variables.
The statement is invalid.	Error	Refer to the error message.	Correct the instruction.
The variable does not have enough size.	Error	Refer to the error message.	Correct the variable size.
The variable *variable_name* is not a parameter of the function.	Error	Refer to the error message.	Correct the *variable_name* variable.
The variable *variable_name* is not an in-out variable.	Error	Refer to the error message.	Correct the usage of the variable attributes.
There are too many keywords.	Error	Refer to the error message.	Reduce the number of keywords.
There must be at least one line of valid code (excluding comments).	Error	Refer to the error message.	Insert at least one line of valid code.
Too many dimensions for an array.	Error	Refer to the error message.	Correct the array variable.
Too many parameters are specified.	Error	Refer to the error message.	Correct the variable.
Too many variables are specified for the function.	Error	Refer to the error message.	Correct the variable specifications.
Two variable formats are mixed.	Error	Refer to the error message.	Correct the variable notation.
"UNTIL" is missing.	Error	Refer to the error message.	Insert UNTIL.
Usage mismatch in a variable of the function	Error	Refer to the error message.	Correct the usage of the variables.
Usage mismatch in function block variable	Error	Refer to the error message.	Correct usage of the function block variables.
Usage mismatch. ':=' cannot be used for an output parameter.	Error	Refer to the error message.	Correct the usage.
Usage mismatch. '=>' cannot be used for an I/O parameter.	Error	Refer to the error message.	Correct the usage.
Usage mismatch. '=>' cannot be used for an input parameter.	Error	Refer to the error message.	Correct the usage.

10-3 Error Messages for Sysmac Studio Operation

The following table lists the error messages that are displayed in the Output Tab Page when you perform operations on the Sysmac Studio.

Error message	Error level	Cause	Correction
A communications error has occurred.	Error	There was a communications error between the Sysmac Studio and the Controller. (For example, a cable is disconnected.)	Check the Communications Setup, and then try again.
		There was an error in a communications message.	• Check the cable connections and go offline, then go online and try again. • Increase the response monitoring time in the communications settings. • Wait for a while and then try again (e.g., wait until downloads from other Support Software are completed).
		An unexpected error occurred during exclusive control of commands.	
		An unexpected error occurred (including inconsistent communications format).	
		A timeout occurred during the Communications Setup test.	Check the following items: • Cable connections • The specified IP address • The network connection and the IP address setting for the local area network in the Control Panel on the computer
		There was no response from the Controller.	• Make sure the cables are connected correctly. • Increase the response monitoring time in the Communications Setup. • Cycle the power supply to the Controller.
		There was a request header error (no content-length header).	
		There was a request header error (no cookie header, no cookie that represents the session ID, or the session ID is incorrect).	
		There was a request header error (no host header).	

Error message	Error level	Cause	Correction
A communications error has occurred.	Error	There was a request command error (no command was specified, or the specified command does not exist).	
		There was a request command error (no argument specification).	
		An unexpected error occurred when the session was created or discarded.	
		An unexpected error occurred during file management.	
		The file could not be locked.	
An error occurred when exporting the project.	Error	The file system is write protected, or some other write error occurred.	Make sure the write attribute of the file system is set correctly.
A project could not be found in the archive file.	Error	The export file was not found.	Specify the correct export file.
An error has occurred in the MC Test Run. The MC Test Run is forced to end.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
An error occurred while the Special Unit parameters were transfered.	Error	The transfer operation for all parameters timed out.	Check the power supply and wiring, and then try again.
An error occurred during backup parameter transfer of EtherCAT slaves.	Error	Refer to the error message.	Try again.
An error occurred when importing the project.	Error	The file system is read protected, or some other read error occurred.	Make sure the read attribute of the file system is set correctly.
An unexpected error has occurred. Transfer was aborted.	Error	Refer to the error message.	Try again.
Cannot be executed.	Error	• A cable is disconnected. • You used prohibited characters in the volume label. • You used prohibited characters when you created or renamed a file or folder. • The SD Memory Card does not have enough available space for the copy operation. • There is no SD Memory Card. • Power is not supplied to the SD Memory Card. • The protection switch on the SD Memory Card is turned ON. • A format operation is in progress. • Other Support Software is currently accessing the SD Memory Card.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Correct the volume label. • Correct the name of the file or folder. • Check the amount of available space required to copy the data, and the amount of available space left on the SD Memory Card. • Insert the SD Memory Card. • Insert the SD Memory Card again. • Turn OFF the protection switch on the SD Memory Card. • Wait until the format operation is completed, and then try again. • Wait until the other Support Software is finished, and then try again.

Error message	Error level	Cause	Correction
Cannot change to the MC Test Run.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Cannot execute the test run.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Cannot read the axis variable *variable_name*.	Error	There was a communications error between the Sysmac Studio and the Controller.	Check the Communications Setup, and then try again.
Cannot start monitoring the axis status.	Error	There was a communications error between the Sysmac Studio and the Controller.	Check the Communications Setup, and then try again.
Data is broken.	Error	The data you attempted to read or write is corrupted.	
Error occurred when exporting project	Error	The export failed due to some problem.	Make sure the contents of the file and the write attribute of the file system are correct.
Error occurred when importing project	Error	The import failed due to some problem.	Make sure the contents of the file and the read attribute of the file system are correct.
Error while loading file	Error	The file could not be loaded.	Check the file to see if it is corrupted.
Error while writing file	Error	The file could not be written to.	Make sure that the file is not open for any other application, and then try again.
Export Failed	Error	You cannot write to the save location. You do not have write rights for the save location. The file you are trying to overwrite may be in use by another application.	Save the data to a folder that you can write to. Save the file under another file name.
Failed to add a Rack.	Error	You have reached the maximum number of Racks.	Delete a Rack, and then try again.
Failed to add a Unit.	Error	You have reached the maximum number of Units that you can add to the Rack.	Add the Unit to another Rack, or delete a Unit and try again.
Failed to clear the error.	Error	A timeout occurred or an error response was received when you attempted to reset a Controller error or user-defined error during troubleshooting. • A cable is disconnected. • You do not have the required access rights. • A download is in progress for other Support Software.	• Check the cable connections. Go offline and then go online again, and then try again. • Reset the access rights, and then try again. • Wait until the download for the other Support Software is finished, and then try again.
Failed to clear diagnosis/statistics information.	Error	The system is busy.	Try again.
		The communications timed out.	Check the power supply and wiring, and then try again.
Failed to clear the event log.	Error	A timeout occurred or an error response was received when you attempted to clear the troubleshooting event log or user-defined event log or when you attempted to clear all memory to clear the error log. • A cable is disconnected. • You do not have the required access rights. • Write protection is enabled. • A download is in progress for other Support Software.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Reset the access rights, and then try again. • Disable write protection, and then try again. • Wait until the download for the other Support Software is finished, and then try again.

Error message	Error level	Cause	Correction
Failed to compare.	Error	The communications timed out.	Check the power supply and wiring, and then try again.
		The system is busy.	Try again.
		The loads are OFF.	Enable the loads, and then try again.
		A major fault level Controller error occurred.	Correct the error, and then try again.
		A Link OFF Error occurred.	Check the power supply and wiring of the first slave and then try again.
		Communications are not possible with the target slave.	Check the power supply, wiring, and slave's node address, and then try again.
		The target slave is disabled.	Enable the slave and perform synchronization, and then try again.
		The slave cannot be identified.	Use the Compare and Merge with Actual Network Configuration menu command to make the configurations match, synchronize the data, and then try again.
		Synchronization has not been performed.	Synchronize, and then perform the operation.
		A slave status change was detected.	Make sure you are not performing any operations in other Support Software, and then try again.
		A change in the configuration was detected.	Try again.
Failed to delete a Rack.	Error	You cannot delete this Rack.	
Failed to execute the command.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to extend the session.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to get a session.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to get actual Unit configuration.	Error	A change in the configuration was detected.	Try again.
		The limit to the number of slaves was exceeded.	Correct the wiring to reduce the number of slaves to 192 or less, and then try again.
		The wiring is incorrect.	Correct the wiring so that the input and output ports are connected, and then try again.
		The system is busy.	Try again.
		The communications timed out.	Check the power supply and wiring, and then try again.
		A Link OFF Error occurred.	Check the power supply of the first slave. Check the wiring. Try again after you have solved the problem.
		A system error occurred.	Contact your OMRON representative.
		A change in the configuration was detected.	Try again.
Failed to get diagnosis/statistics information.	Error	The communications timed out.	Check the power supply and wiring, and then try again.

Error message	Error level	Cause	Correction
Failed to get packet data.	Error	The communications timed out.	Check the power supply and wiring, and then try again.
		The system is busy.	Try again.
		The packet monitor was started already.	Stop the packet monitor, and then try again.
		The file could not be obtained.	Make sure that you are not saving the packet monitor results with an instruction or from another tool, and then try again.
Failed to get serial numbers.	Error	A change in the configuration was detected.	Try again.
		The limit to the number of slaves was exceeded.	Correct the wiring to reduce the number of slaves to 192 or less, and then try again.
		The wiring is incorrect.	Correct the wiring so that the input and output ports are connected, and then try again.
		The system is busy.	Try again.
		The communications timed out.	Check the power supply and wiring, and then try again.
		A Link OFF Error occurred.	Check the power supply of the first slave. Check the wiring. Try again after you have solved the problem.
		The actual device configuration and the device configuration in the project do not match.	Make sure that the device configurations match, and then try again.
Failed to get the production information.	Error	A change in the configuration was detected.	Try again.
		The limit to the number of slaves was exceeded.	Correct the wiring to reduce the number of slaves to 192 or less, and then try again.
		The communications timed out.	Check the power supply and wiring, and then try again.
		The wiring is incorrect.	Correct the wiring so that the input and output ports are connected, and then try again.
		The system is busy.	Try again.
		A Link OFF Error occurred.	Check the power supply of the first slave. Check the wiring. Try again after you have solved the problem.
		Check that the following slave information is provided in the ESI file library.	Vendor ID=0x{0,0:X8}, Product Code=0x{1,0:X8}, Revision Number=0x{2,0:X8}
		There are two or more slaves with the same node address in the actual device configuration.	Write a new slave node address to correct the problem.
		There is a slave with an out-of-range node address in the actual device configuration.	Write a new slave node address to correct the problem.
		Communications failed.	Check the power supply and wiring, and then try again.

Error message	Error level	Cause	Correction
Failed to judge the condition. Simulation will stop at the breakpoint.	Error	This error is displayed when the condition for a breakpoint cannot be evaluated due to an internal communications error. **Note** This does not mean that the result of the evaluation is FALSE.	Execution pauses at the breakpoint where the error occurred, and this error message is displayed. Stop the simulation, and then execute the simulation again.
Failed to load the event log.	Error	A timeout occurred or an error response was received when reading the event log for troubleshooting. • A cable is disconnected. • A download is in progress for other Support Software. • An I/O Bus Check Error occurred, and reading the error log of the CJ-series Unit was not possible.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Wait until the download for the other Support Software is finished, and then try again. • Eliminate all high level errors, perform an error reset, and then try to read the event log again.
Failed to lock the servo.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to monitor the status.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to read Controller Clock Information.	Error	A timeout occurred when the Clock Dialog Box was displayed. (For example, a cable is disconnected.)	• Check the cable connections. Go offline and then go online again, and then try again.
Failed to read the file.	Error	You specified a file that is not a Unit Parameters File.	Specify a Unit Parameters File.
Failed to read the list of Controller variables and memory addresses for which forced refreshing is active.	Error	A timeout occurred or an error response was received when you attempted to read forced refreshing values after going offline, or when all forced refreshing was completed. • A cable is disconnected. • A download is in progress for other Support Software.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Wait until the download for the other Support Software is finished, and then try again.
Failed to read the serial ID.	Error	The serial ID could not be obtained from the CPU Unit when online.	There is no correction to be taken. (For example, noise caused the error.)
Failed to read the status.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to cancel the forced refreshings for all of the specified variables/memory in the Controller.	Error	A timeout occurred or an error response was received when you attempted to cancel forced refreshing after going offline, or when all forced refreshing was completed. • A cable is disconnected. • A download is in progress for other Support Software.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Wait until the download for the other Support Software is finished, and then try again.
Failed to reset all axis errors.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to restore EtherCAT configuration.	Error	Add an ESI file that contains the device (ID) information.	Make sure that the device configurations match, and then try again.
Failed to save file.	Error	You do not have the rights that are required to load the file.	
Failed to start absolute positioning.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to start homing.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.

Error message	Error level	Cause	Correction
Failed to start jogging.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to start packet monitoring.	Error	The communications timed out.	Check the power supply and wiring, and then try again.
	Error	The system is busy.	Try again.
Failed to start relative positioning.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to start the MC Test Run.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to stop jogging.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to stop packet monitoring.	Error	The communications timed out.	Check the power supply and wiring, and then try again.
	Error	The system is busy.	Try again.
Failed to stop the axis.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.
Failed to transfer from the controller.	Error	The upload failed (the specified file does not exist).	
Failed to transfer the parameters.	Error	There was a communications error between the Sysmac Studio and the Controller.	Check the Communications Setup, and then try again.
Failed to transfer to the controller.	Error	The download failed.	
Failed to transfer.	Error	The communications timed out.	Check the power supply and wiring, and then try again.
		The system is busy.	Try again.
		The loads are OFF.	Enable the loads, and then try again.
		A major fault level Controller error occurred.	Correct the error, and then try again.
		A Link OFF Error occurred.	Check the power supply and wiring of the first slave and then try again.
		Communications are not possible with the target slave.	Check the power supply, wiring, and slave's node address, and then try again.
		The target slave is disabled.	Enable the slave and perform synchronization, and then try again.
		The slave cannot be identified.	Use the Compare and Merge with Actual Network Configuration menu command to make the configurations match, synchronize the data, and then try again.
		Synchronization has not been performed.	Synchronize, and then perform the operation.
		A slave status change was detected.	Make sure you are not performing any operations in other Support Software, and then try again.
		A change in the configuration was detected.	Try again.
		Communications failed.	Check the power supply and wiring, and then try again.
Failed to unlock the servo.	Error	You cannot execute the operation because of a Controller error.	Identify and remove the Controller error, and then try again.

Error message	Error level	Cause	Correction
Failed to write Controller Clock Information.	Error	A timeout occurred when you clicked the button to apply the time zone and clock settings in the Clock Dialog Box. (For example, a cable is disconnected.)	• Check the cable connections. Go offline and then go online again, and then try again.
Failed to write the Controller name.	Error	A timeout occurred or an error response was received when you attempted to write the name of the Controller while online. • A cable is disconnected. • Write protection is enabled. • A download is in progress for other Support Software.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Disable write protection, and then try again. • Wait until the download for the other Support Software is finished, and then try again.
Failed to write the ID to the Controller.	Error	A timeout occurred or an error response was received when you attempted to write the online user program execution ID to the Controller. • A cable is disconnected. • RUN mode • Write protection is enabled. • A download is in progress for other Support Software.	• Check the cable connections. Go offline and then go online again, and then try again. • Increase the response monitoring time in the Communications Setup. • Change to PROGRAM mode, and then try again. • Disable write protection, and then try again. • Wait until the download for the other Support Software is finished, and then try again.
File operation failed.	Error	Refer to the error message.	
Import Failed	Error	The CSV file is corrupted. Another application is using the CSV file.	If another application is using the CSV file, close that application, and then try again.
Incorrect CSV format on line *line_number*.	Error	The CSV file format is incorrect.	Specify a valid CSV file.
Insufficient permissions.	Error	You do not have the read rights required to read the file system stored in the project file.	Make sure the read attribute of the file system is set correctly.
Problem while reading CSV File	Error	The CSV file could not be loaded.	Make sure that the file is not open for any other application, and then try again.
The command is not supported by the controller and device.	Error	The command does not exist.	
The content of the archive file is invalid.	Error	The contents of the export file are incorrect (format error).	Specify the correct export file.
The Controller was not found.	Error	A node at the specified IP address was not found during the Communications Setup test. (A response was received, but the specified IP address was not found.)	• Check the remote IP address in the Communications Setup.
The entered value has an error.	Error	The value that was entered in one or more of the text boxes in the current window is out of range. The text boxes that caused this error are designated by an exclamation mark.	You can view the tooltip of any text box with an exclamation mark to see how to correct the problem. Follow the instructions to correct the value as appropriate.
The file format is illegal.	Error	Refer to the error message.	

Error message	Error level	Cause	Correction
The name has already been used.	Error	A data type with that name is already defined.	Use a different name to define the data type.
The operation cannot be executed because it is invalid.	Error	Refer to the error message.	
The predefined keywords cannot be used for data type name.	Error	This error is displayed when you attempt to use a reserved word (such as IF) for a data type name.	Do not use reserved words for data types.

App

Appendices

App

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A-1 Driver Installation for Direct USB Cable Connection

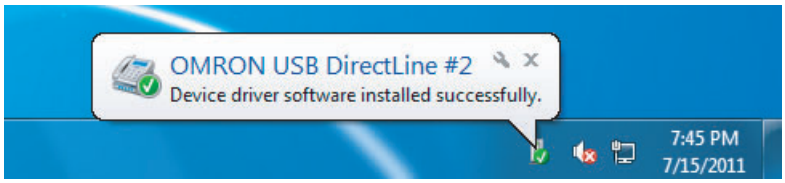
Use one of the following procedures the first time you connect the computer to the USB port on the Controller. These procedures assume that the Sysmac Studio is already installed on the computer.

A-1-1 Installing the USB Driver

Windows Vista or Windows 7

1 Turn ON the power supply to the Controller and connect the USB port on the Controller to the computer with a USB cable.

The USB driver is installed automatically after you connect the cable.



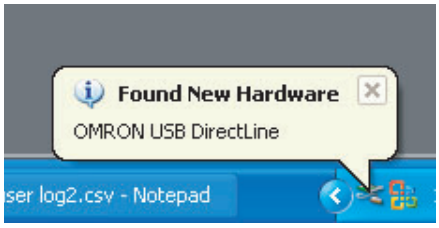
Additional Information

You may need to restart Windows after you install the USB driver. Restart Windows as instructed on the display.

Windows XP

1 Turn ON the power supply to the Controller and connect the USB port on the Controller to the computer with a USB cable.

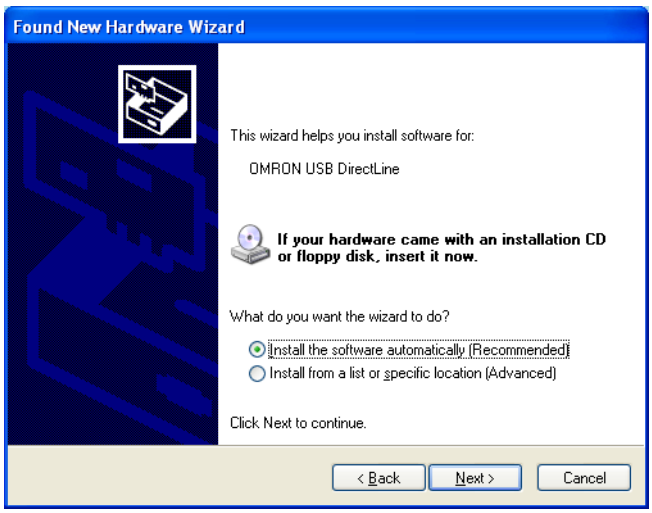
The device is detected automatically after you connect the cable, and the following message is displayed.



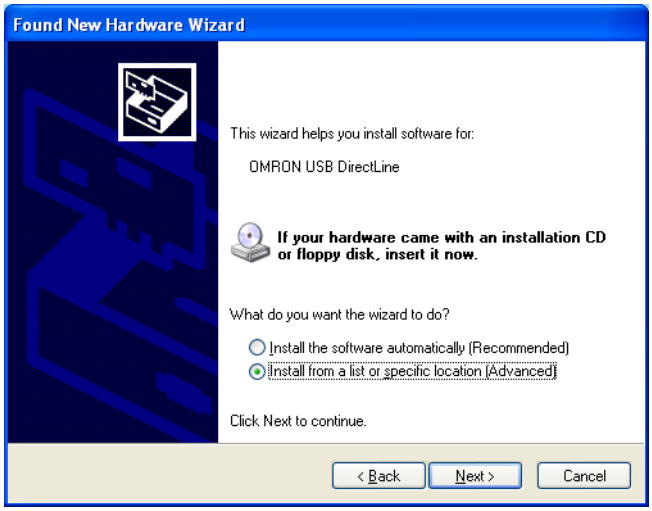
The following dialog box is displayed.

- Connect to Windows Update?

Select an option and click the **Next** Button.



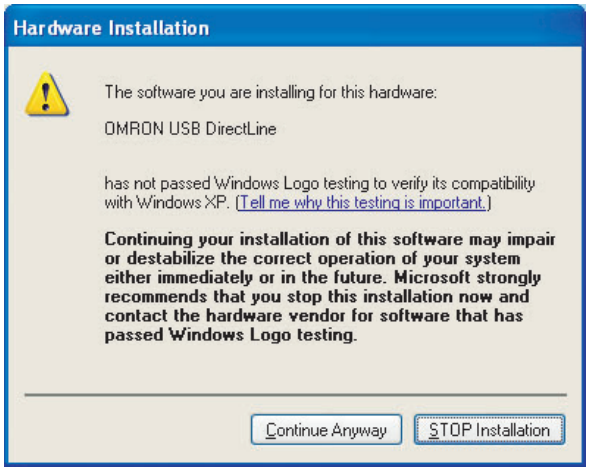
2 Select one of the options, and then click the **Next** Button.



Note 1 If the software is not installed automatically, refer to the procedure to specify the USB driver that is given later in this section.

2 If the installation media is already inserted or if a USB device driver was previously installed for another port, a list of drivers is displayed after you click the **Next** Button in step 2, select the *Don't search, I will select the driver to install Option*, and then click the **Next** Button again. Make sure that the most recent driver is selected, and then click the **Next** Button.

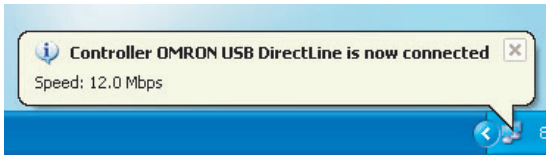
3 If the following dialog box is displayed, click the **Continue Anyway** Button.



The following dialog box is displayed if the driver is installed normally.

4 Click the **Finish** Button.

The following icon is displayed in the task bar.

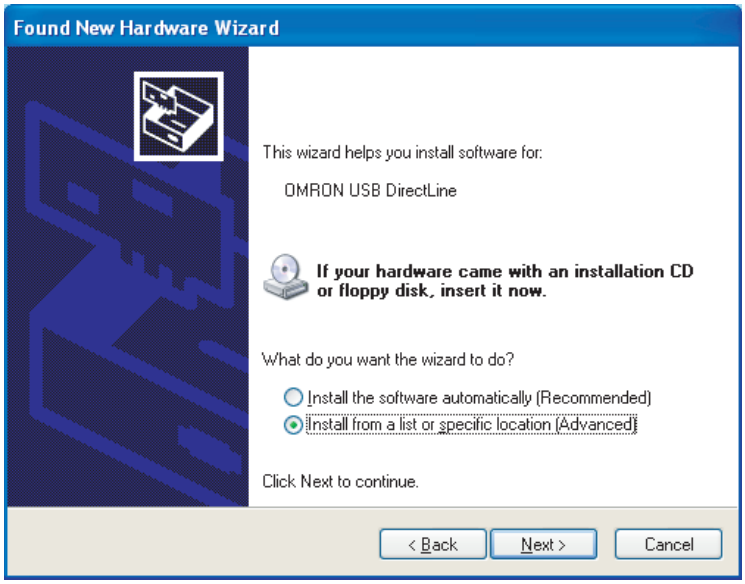


A-1-2 Installing a Specified USB Driver

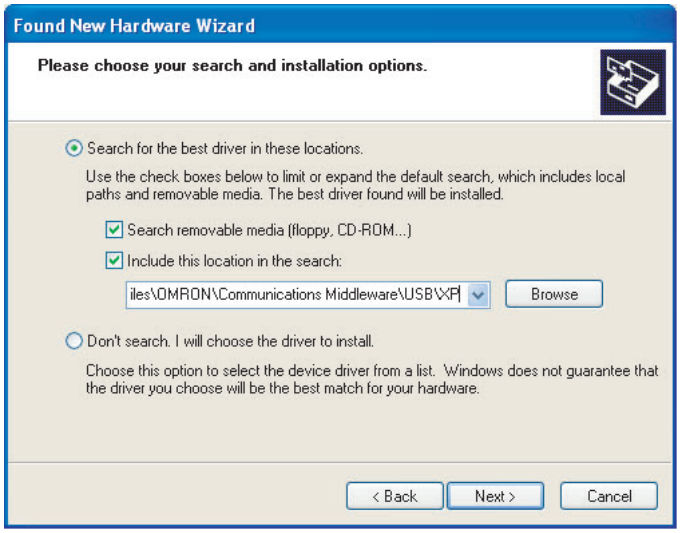
If you cannot install the USB driver automatically, use the following procedure to specify the driver to install.

Windows XP

1 On the Found New Hardware Wizard Dialog Box that is shown below, select the *Install from a list or specific location (Advanced)* Option and click the **Next** Button.



The following dialog box is displayed.

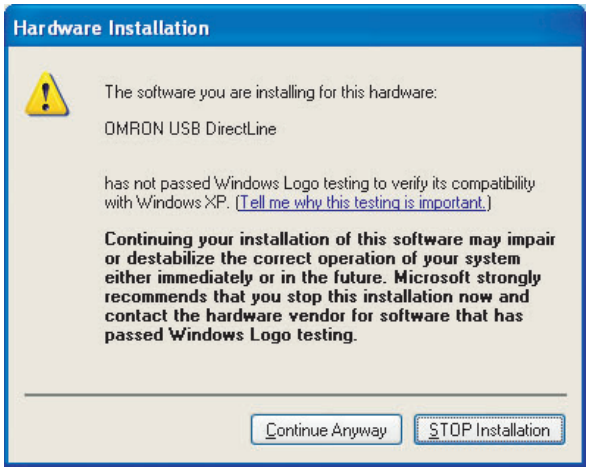


2 Make sure that the following location is shown for the *Include this location in the search* Option, and then click the **Next** Button.

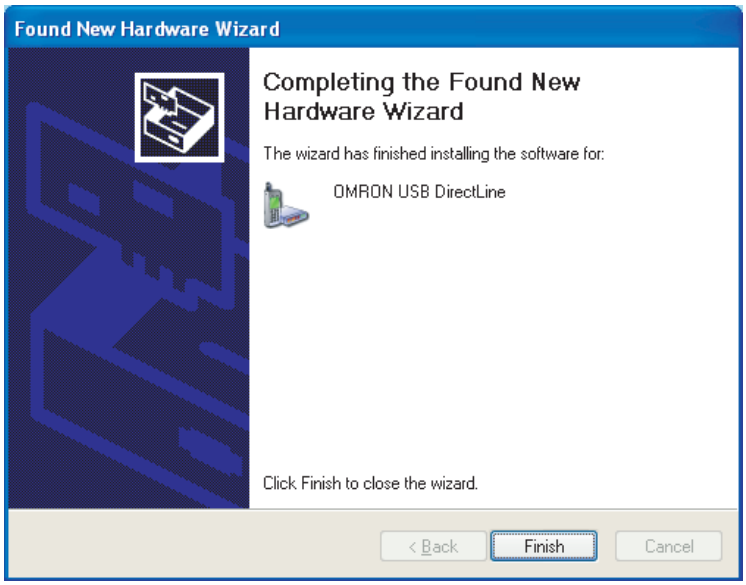
C:\Program Files\OMRON\Communications Middleware\USB\XP

The USB driver is installed.

3 If the following dialog box is displayed, click the **Continue Anyway** Button.



The following dialog box is displayed if the driver is installed normally.



4 Click the **Finish** Button.

Additional Information

With Windows Vista or Windows 7, the following folders are specified for the location of the USB driver.

- Windows Vista 32-bit edition
  C:\Program Files\OMRON\Communications Middleware\USB\Vista\32bit
- Windows 7 32-bit edition
  C:\Program Files\OMRON\Communications Middleware\USB\7\32bit
- Windows 7 64-bit edition
  C:\Program Files (x86)\OMRON\Communications Middleware\USB\7\64bit

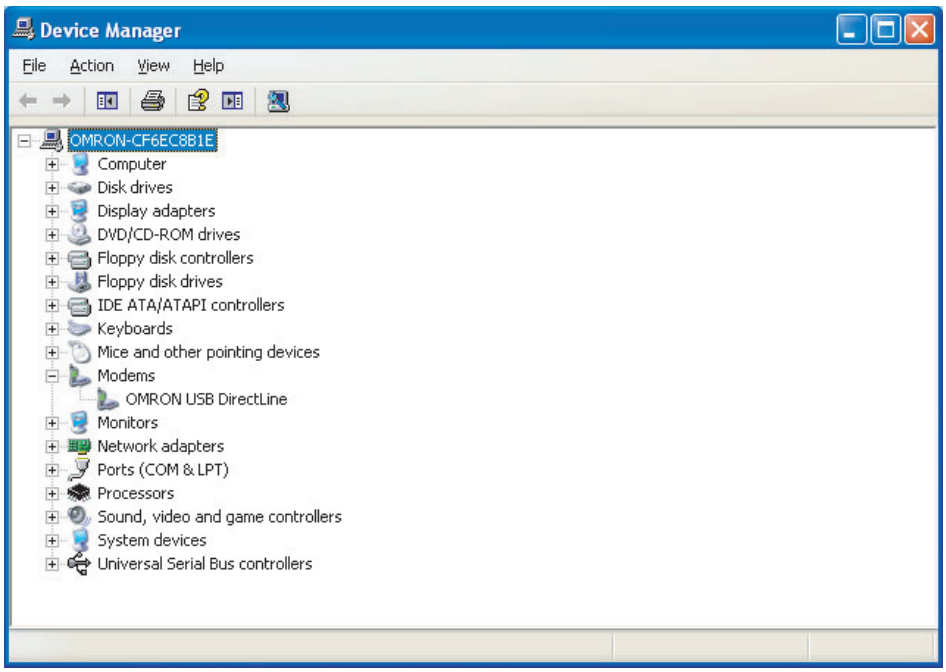
A-1-3 Confirmation Procedure after Installation

Procedure

1 Connect the computer to the Controller with a USB cable.

2 Start the Device Manager on the computer.

3 Click the *Modems* Icon in the Device Manager and make sure that *OMRON USB DirectLine* is displayed.



A-2 Specifying One of Multiple Ethernet Interface Cards

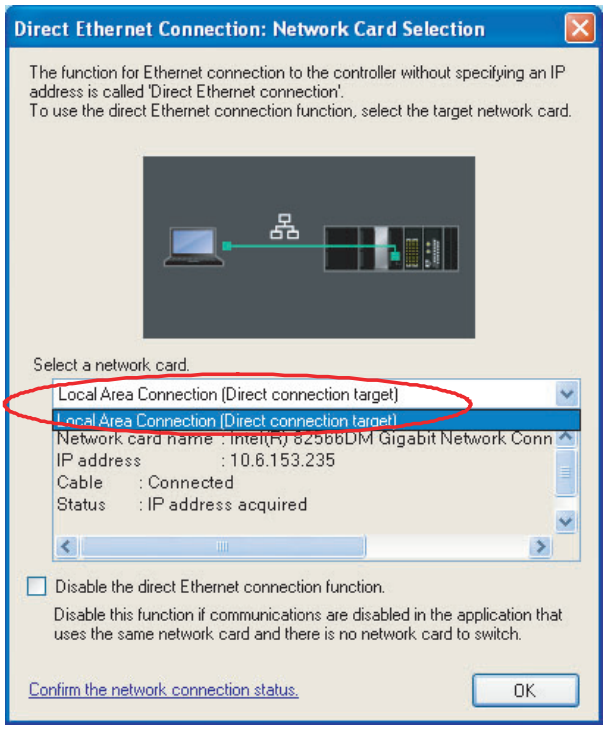
If more than one Ethernet interface card is mounted in the computer that runs the Sysmac Studio, you must specify the Ethernet interface card that is connected to the NJ-series Controller to connect directly through Ethernet. The Ethernet interface card is specified when the Sysmac Studio is installed. You can use a special utility shown below to change the specification after installation.

Specifying the Ethernet Interface Card

1 Select ***All Programs - OMRON - Communications Middleware Utilities - Direct Ethernet Utility*** from the Windows Start Menu.

The Direct Ethernet Utility Dialog Box is displayed.

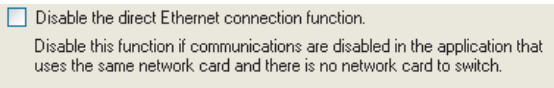
2 Select the Ethernet interface card to use to connect the NJ-series Controller in the Direct Ethernet Utility Dialog Box.



3 Click the **OK** Button. The dialog box is closed.

Precautions for Correct Use

If any other application that uses the same network becomes unable to communicate and there is no network card to switch, select the *Disable the direct Ethernet connection function* Check Box and disable this feature.



Precautions for Correct Use

The settings that you make with the Direct Ethernet Utility are used for Ethernet connections for other OMRON software as well, not just for the Sysmac Studio. Make sure that you do not unintentionally change the connected Controller when you change the Ethernet interface card.

Examples of other OMRON software: Network Configurator and CX-Integrator

A-3 Differences between the Simulator and the Physical Controller

The Simulator has the following functional differences in comparison with the physical Controller.

Item		Differences between Simulator and physical Controller
Tasks	Starting	You start the Simulator from the Simulation Menu or the Simulation Pane. (You cannot start it from the Controller Menu.)
	Synchronization	The data in the Simulator is synchronized when you go online with the Simulator. (There is no need to perform synchronization after you start the Simulator.)
	Exiting	You exist the Simulator from the Simulation Menu or the Simulation Pane. (When you exist, the online connection is broken and the programs and other data are deleted from the Simulator.)
	Scheduling	On the Simulator, tasks are executed according to the Windows scheduling policy. Task priority and timing are ignored, so operation is not necessarily the same as on the physical Controller. The Simulator continues to execute programs even if they are not completed within the control cycle or even if the programs do not end.
	Clock	The clock in the Simulator does not use the computer clock directly. The time is advanced by adding the control cycle time each time the primary periodic task is executed. Although the time advances in increments of the control cycle, timing will still be correct even if execution is paused or if step execution is performed frequently.
	Monitoring	The Simulator displays the estimated execution times for operation on the physical Controller, and not the execution times on the computer.
	Resetting	You also cannot reset when connected to the Simulator. Exit the Simulator and then go online with the Simulator again to reset operation.
	Operating mode	The Simulator always starts in RUN mode. (You cannot change the operating mode.)
Variables and memory	Monitoring present values	The Simulator uses non-synchronized operation to read and write data. This creates the following functional differences in comparison with the physical Controller. • Changes to the present values of variables on the I/O Map are not always possible on the physical Controller, but they are always possible on the Simulator. • If program inputs for which forced refreshing is specified are changed in the user program, they may flicker on the monitor displays on thy Simulator.
	Data on the Simulator	Variable data is valid only while the Simulator is running. The user program and all other data in the Simulator are cleared when you exist the Simulator.
	Retain attribute	When you stop the Simulator, user program execution is stopped and data is discarded. Therefore, the values of variables are not retained even if the Retain attribute is set.
	Clear All Memory	This function is not supported by the Simulator. (Exit the Simulator and then go online with the Simulator again to clear memory.)
Debugging	Using the debugger	You can user debugger functions, such as step execution and breakpoints, on the Simulator.
	Changing the execution speed	You can change the apparent program execution times on the Simulator. (You change the program execution interval on the computer to change the apparent execution speed.) Time passage on the Simulator is not affected by changes in the execution speed.
	Debug programs	You can load and execute programs that are set as debug programs only on the Simulator. (You cannot load debug programs on the physical Controller.)
	Partial execution of user program	On the Simulator, you can specify to execute only the selected programs. (This is not possible on the physical Controller.)

Item		Differences between Simulator and physical Controller
Motion control	Axis control	If a Servo axis is specified on the Simulator, Servo operation is emulated. If an encoder axis is specified on the Simulator, encoder operation is not emulated and the same operation as for a virtual encoder axis is performed instead.
	Position and velocity control	On the Simulator, command values for the axes are used directly as the actual positions and actual velocities.
	Torque control	The Simulator does not have mechanical composition information and cannot calculate velocities for torque control. A velocity of 0 is used as the actual velocity.
	Touch probe function	With the Simulator, you can use Simulator instructions in the debug program to generate external triggers. On the Simulator, the Z phase is generated once for each 2,048 pulses that are input.
	MC Test Run	You cannot perform an MC Test Run when connected to the Simulator.
	Cam data	The cam data file transfer commands to transfer cam data from the Controller to files or from files to the Controller are not supported on the Simulator.
Networks	Setting communications addresses	Network communications are not performed by the Simulator, so communications address settings are ignored.
	Routing tables	Network communications are not performed by the Simulator, so routing table settings are ignored.
CJ-series Unit management	Unit configuration	The Simulator uses registered I/O directly as real I/O.
	First addresses for slots	The Simulator ignores the first address settings for slots.
	CJ-series Unit settings	CJ-series Unit emulation is not performed by the Simulator, so CJ-series Unit settings are ignored.
Instructions	Communications instructions	Instruction processing ends normally on the Simulator, but communications processing is not performed.
	SD Memory Card instructions	You can use the SD Memory Card instructions on the Simulator in the same way as you can on the physical Controller. The Simulator uses c:\OMRON\Data\SimulatorData\CARD\Memory001 as a virtual SD Memory Card.
	Real data and conversion instructions	You can use the instructions on the Simulator in the same way as you can on the physical Controller. Rounding error for calculations on the Simulator may produce somewhat different calculation results. Expressions for infinity and nonnumeric data are sometimes different for the results of the Natural Exponential Operation (EXP) instruction or calculation results on the Simulator.
	Clock instructions	Processing ends normally on the Simulator for clock and time instructions, but time change processing is not performed.
Maintenance	ID information	The Simulator does not have production information (i.e., ID information, such as lot numbers).
	Programming by multiple programmers	It is assumed that the Simulator is used on one computer by a single programmer. (It is not possible for more than one programmer to connect to the same Simulator at the same time.)
	Clock information	The time that is read from the computer when the Simulator is started is incremented each time the primary periodic task is executed to generate a virtual clock.
	SD Memory Cards	You cannot use SD Memory Cards when connected to the Simulator.
	Backing up variables and memory	You cannot backup and restore variables when connected to the Simulator.
	Peripheral devices	You cannot connect peripheral devices when connected to the Simulator.

A-4 Online Help

Online Help

You can access online help from a Sysmac Studio menu to see instruction descriptions or to check shortcut keys. There are four types of help.

Sysmac Studio help: Contents

Instruction Reference

Keyboard Mapping Reference

System-defined Variable Reference

A-4-1 Sysmac Studio Help Contents

Sysmac Studio Help Contents

This help feature provides operating procedures for the Sysmac Studio.

A-4-2 Instruction Reference

Instruction Reference

The Instructions Reference describes the basic instructions and motion control instructions that you can use with an NJ-series Controller. The contents are the same as the contents of the *NJ-series Instructions Reference Manual* and the *NJ-series Motion Control Instructions Reference Manual*.

● Displaying the Instructions Reference

There are two ways to display the Instructions Reference.

Method (1) From the main menus

Method (2) From the Ladder Editor, ST Editor, or Instruction Navigator

Method (1) From the main menus

Select ***Instruction Reference*** from the Help Menu.

The Sysmac Studio Instruction Reference Help is displayed.

Method (2) Displaying the Instructions Reference from the Ladder Editor or ST Editor

In the Ladder Editor or ST Editor, select an instruction that was previously entered or select an instruction in the Instruction Navigator in the Toolbox, and then press the **F1** Key.

The Sysmac Studio Instruction Reference Help is displayed for the selected instruction.

A-4-3 Keyboard Mapping Reference

Keyboard Mapping Reference

You can display a list of convenient shortcut keys that you can use on the Sysmac Studio.

● Displaying the Keyboard Mapping Reference

Select ***Keyboard Mapping Reference*** from the Help Menu.

The Keyboard Mapping Reference is displayed.

Refer to *A-5 Keyboard Mapping* for details.

A-4-4 System Defined Variable Reference

System Defined Variable Reference

You can display a list of descriptions of the system-defined variables that you can use on the Sysmac Studio.

● Procedure to Display the System Defined Variable Reference

Select ***System-defined Variable Reference*** from the Help Menu.

Tables of the system-defined variables are displayed.

A-5 Keyboard Mapping

The following tables list the shortcut keys that you can use in the Main Window of the Sysmac Studio.

A-5-1 Basic Operations

Operation	Shortcut keys	Menu command
Displaying help information	F1	Help – Help Contents
Inserting	Insert	None
Deleting	Delete	Edit – Delete
Moving the cursor up one cell	↑	None
Moving the cursor down one cell	↓	None
Moving the cursor right one cell	→	None
Moving the cursor left one cell	←	None
Moving the cursor to the beginning of the row	Home	None
Moving the cursor to the end of the row	End	None
Moving the cursor to the Toolbox	Insert	None
Placing the cursor in Edit Mode	F2	None
Confirming Edit Mode	Enter	None
Moving the cursor to and from the menus	Alt	None
Moving the cursor to the next category	Tab	None
Moving the cursor to the previous category	Shift + Tab	None
Moving the cursor to the next lower level at an expanded item	→	None
Expanding the lower level at a collapsed item	→	None
Collapsing the lower level at an expanded item	←	None
Moving the cursor to the next higher level at a collapsed item	←	None
Displaying/hiding the Output Tab Page	Alt + 3	View – Output Tab Page
Displaying/hiding the Watch Tab Page	Alt + 4	View – Watch Tab Page
Displaying/hiding the Cross Reference Tab Page	Alt + 5	View – Cross Reference Tab Page
Displaying/hiding the Build Tab Page	Alt + 6	View – Build Tab Page
Displaying/hiding the Search and Replace Results Tab Page	Alt + 7	View – Search and Replace Results Tab Page
Displaying/hiding the Simulation Pane	Alt + 8	View – Simulation Page
Enlarging the display	Alt + →	View – Zoom – Zoom In
Reducing the display	Alt + ←	View – Zoom – Zoom Out
Zooming the display to fit the window width	Alt + ↑	View – Zoom – Zoom to Fit
Restoring the default zoom setting	Alt + ↓	View – Zoom – Zoom Reset
Moving to the next page	PageDown	None
Moving to previous page	PageUp	None
Selecting a menu command	Alt + First underlined letter of the command	None
Saving a project	Ctrl + S	File – Save
Printing	Ctrl + P	File – Print

Operation	Shortcut keys	Menu command
Undoing	Ctrl + Z	Edit – Undo
Redoing	Ctrl + Y	Edit – Redo
Cutting	Ctrl + X	Edit – Cut
Copying	Ctrl + C	Edit – Copy
Pasting	Ctrl + V	Edit – Paste
Selecting everything	Ctrl + A	Edit – Select All
Deleting to the left of the cursor	BackSpace	None
Inverting an input or output to a NOT input or NOT output	/	None

A-5-2 Editing Programs

Operation	Shortcut keys	Menu command
Inserting a line below the cursor	R	None
Inserting a line above the cursor	Shift + R	None
Entering an N.O. input	C	None
Entering an N.C. input	/	None
Entering an OR with an N.O. input	W	None
Entering an OR with an N.C. input	X	None
Entering an output	O	None
Entering a NOT output	Q	None
Calling a function block	F	None
Calling a function	I	None
Checking all programs	F7	Project – Check All Programs
Checking the selected programs	Shift + F7	Project – Check Selected Programs
Building the project file	F8	Project – Build
Aborting building	Shift + F8	Project – Abort Build
Displaying the Jump Dialog Box	L	Edit – Jump

A-5-3 Searching and Replacing

Operation	Shortcut keys	Menu command
Searching and replacing	Ctrl + F	Edit – Search and Replace
Searching for the variable at the cursor	N	None
Returning to the previous search result	B	None
Searching for the next occurrence	Alt + N	None

A-5-4 Online

Operation	Shortcut keys	Menu command
Going online	Ctrl + W	Controller – Online
Going offline	Ctrl + Shift + W	Controller – Offline
Changing to PROGRAM mode	Ctrl + 1	Controller – Mode – PROGRAM
Changing to RUN mode	Ctrl + 3	Controller – Mode – RUN
Synchronizing	Ctrl + M	Controller – Synchronize
Changing the selected program input or output to TRUE	Ctrl + Shift + J	Controller – Set/Reset – Set
Changing the selected program input or output to FALSE	Ctrl + Shift + K	Controller – Set/Reset – Reset
Forcing a selected input or output to TRUE	Ctrl + J	Controller – Forced Refreshing – TRUE
Forcing a selected input or output to FALSE	Ctrl + K	Controller – Forced Refreshing – FALSE
Canceling a selected input or output that was forced to TRUE or FALSE	Ctrl + L	Controller – Forced Refreshing – Cancel
Starting online editing	Ctrl + E	Project – Online Edit – Start
Transferring changes made during online editing	Ctrl + Shift + E	Project – Online Edit – Transfer
Canceling online editing	Ctrl + U	Project – Online Edit – Cancel

A-5-5 Simulation

Operation	Shortcut keys	Menu command
Executing a simulation	F5	Simulation – Run
Pausing	Ctrl + Alt + Break	Simulation – Pause
Stopping	Shift + F5	Simulation – Stop
Stepping in	F11	Simulation – Step In
Step execution	F10	Simulation – Step Execution
Stepping out	Shift + F11	Simulation – Step Out
Displaying the Breakpoint Window	Alt + F9	Simulation – Breakpoint Window
Setting/clearing a breakpoint at the cursor position	F9	Simulation – Set/Clear Breakpoints
Clearing all breakpoints	Ctrl + Shift + F9	Simulation – Clear All Breakpoints

A-5-6 SD Memory Card

Operation	Shortcut keys	Menu command
Going back	Alt + ←	None
Going forward	Alt + →	None
Moving up	Backspace	None
Refreshing	F5	None
Displaying properties	Alt + Enter	None
Formatting	Ctrl + Alt + A	None
Deleting	Delete	None

Operation	Shortcut keys	Menu command
Copying	Ctrl + C	None
Pasting	Ctrl + V	None
Creating a folder	Ctrl + Alt + F	None
Renaming	F2	None
Ending	Alt + F4	None

A-6 Simulation Instructions

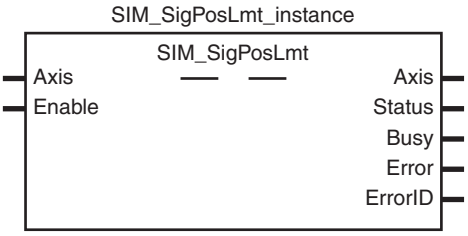
To simulate motion control instructions, you must create virtual external signals, such as the home proximity input signal and limit input signals. Use the simulation instructions to create virtual external signals. There are seven simulation instructions

- Simulate Positive Limit Input Signal Instruction
- Simulate Negative Limit Input Signal Instruction
- Simulate Home Proximity Signal Instruction
- Simulate Immediate Stop Input Signal Instruction
- Simulate External Latch Input Signal Instruction
- Simulate Drive Alarm Instruction
- Simulate Drive Warning Instruction

This section describes the simulation instructions.

A-6-1 Simulate Positive Limit Input Signal Instruction

This instruction creates a virtual positive limit input signal.

Instruction	Name	FB/ FUN	Graphic expression	ST expression
SIM_SigPosLmt	Simulate Positive Limit Input Signal	FB		SIM_SigPosLmt_instance (Axis :=*Parameter*, Enable :=*Parameter*, Status =>*Parameter*, Busy =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The positive limit input signal turns ON when *Enable* changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Status	Input signal ON	BOOL	TRUE or FALSE	TRUE when the input signal is ON.
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-18 for information on error codes.

● In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Enable* changes to TRUE, a virtual positive limit input signal is created for the axis specified by *Axis*.
- When *Enable* changes to FALSE, the positive limit input signal turns OFF for the axis specified by *Axis*.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

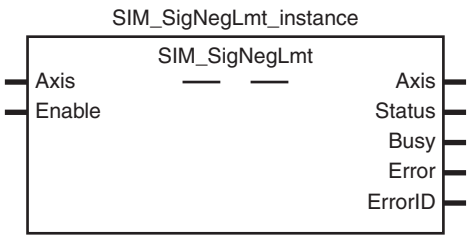
Errors

An error occurs if there is no slave for the axis specified by *Axis*. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and specify a correct value for *Axis*.	Make sure you set the I/O variables for the instruction correctly.
Precautions/Remarks	None			

A-6-2 Simulate Negative Limit Input Signal Instruction

This instruction creates a virtual negative limit input signal.

Instruction	Name	FB/ FUN	Graphic expression	ST expression
SIM_SigNegLmt	Negative Limit Input Signal	FB		SIM_SigNegLmt_instance (Axis :=*Parameter*, Enable :=*Parameter*, Status =>*Parameter*, Busy =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

● Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The negative limit input signal turns ON when *Enable* changes to TRUE.

● Output Variables

Name	Meaning	Data type	Valid range	Description
Status	Input signal ON	BOOL	TRUE or FALSE	TRUE when the input signal is ON.
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-20 for information on error codes.

● In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Enable* changes to TRUE, a virtual positive limit input signal is created for the axis specified by *Axis*.
- When *Enable* changes to FALSE, the negative limit input signal turns OFF for the axis specified by *Axis*.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

Errors

An error occurs if there is no slave for the axis specified by *Axis*. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and specify a correct value for Axis.	Make sure you set the I/O variables for the instruction correctly.
Precautions/Remarks	None			

A-6-3 Simulate Home Proximity Signal Instruction

This instruction creates a virtual home proximity signal.

Instruction	Name	FB/FUN	Graphic expression	ST expression
SIM_SigOrgProx	Simulate Home Proximity Signal	FB	SIM_SigOrgProx_instance SIM_SigOrgProx Axis — — Axis Enable — Status Busy Error ErrorID	SIM_SigOrgProx_instance (Axis :=*Parameter*, Enable :=*Parameter*, Status =>*Parameter*, Busy =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The home proximity signal turns ON when *Enable* changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Status	Input signal ON	BOOL	TRUE or FALSE	TRUE when the input signal is ON.

Name	Meaning	Data type	Valid range	Description
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-21 for information on error codes.

● In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Enable* changes to TRUE, a virtual home proximity signal is created for the axis specified by *Axis*.
- When *Enable* changes to FALSE, the home proximity signal turns OFF for the axis specified by *Axis*.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

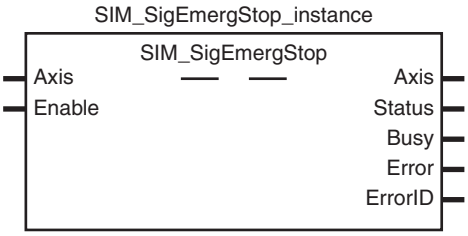
Errors

An error occurs if there is no slave for the axis specified by Axis. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**	**Data type**	**Name**	
	None	---	---	
Cause and correction	**Assumed cause**	**Correction**	**Prevention**	
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.	Check the range of the I/O variable for the instruction and specify a correct value for Axis.	Make sure you set the I/O variables for the instruction correctly.	
Precautions/Remarks	None			

A-6-4 Simulate Immediate Stop Input Signal Instruction

This instruction creates a virtual immediate stop input signal.

Instruction	Name	FB/ FUN	Graphic expression	ST expression
SIM_SigEmergStop	Simulate Immediate Stop Input Signal	FB		SIM_SigEmergStop_instance (Axis :=*Parameter*, Enable :=*Parameter*, Status =>*Parameter*, Busy =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

● Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The immediate stop input signal turns ON when *Enable* changes to TRUE.

● Output Variables

Name	Meaning	Data type	Valid range	Description
Status	Input signal ON	BOOL	TRUE or FALSE	TRUE when the input signal is ON.
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-23 for information on error codes.

● In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Enable* changes to TRUE, a virtual immediate stop input signal is created for the axis specified by *Axis*.
- When *Enable* changes to FALSE, the immediate stop input signal turns OFF for the axis specified by *Axis*.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

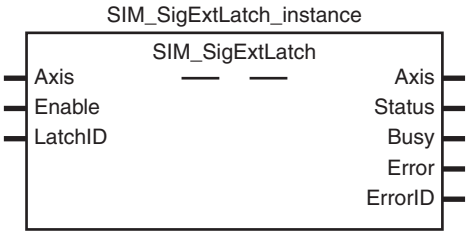
Errors

An error occurs if there is no slave for the axis specified by *Axis*. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and specify a correct value for Axis.	Make sure you set the I/O variables for the instruction correctly.
Precautions/Remarks	None			

A-6-5 Simulate External Latch Input Signal Instruction

This instruction creates a virtual external latch input signal.

Instruction	Name	FB/FUN	Graphic expression	ST expression
SIM_SigExtLatch	Simulate External Latch Input Signal	FB		SIM_SigExtLatch_instance (Axis :=*Parameter*, Enable :=*Parameter*, LatchID :=*Parameter*, Status =>*Parameter*, Busy =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

● Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The external latch input signal turns ON when Enable changes to TRUE.
LatchID(*)	Latch ID selection	UINT	1, 2	1	Specify which of the two latch functions to use. 1: Latch 1 2: Latch 2

* For information on the latch IDs, refer to the *NJ-series CPU Unit Motion Control User's Manual* (Cat. No. W507.

● Output Variables

Name	Meaning	Data type	Valid range	Description
Status	Input signal ON	BOOL	TRUE or FALSE	TRUE when the input signal is ON.
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-24 for information on error codes.

● In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Enable* changes to TRUE, a virtual external latch input signal is created for the axis specified by *Axis*.
- When *Enable* changes to FALSE, the virtual external latch input signal turns OFF for the axis specified by *Axis*.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

Errors

An error occurs in the following case.

- An error occurs if latch ID selection *LatchID* is not 1 or 2. The error code (0400 hex) is output to *ErrorID*.

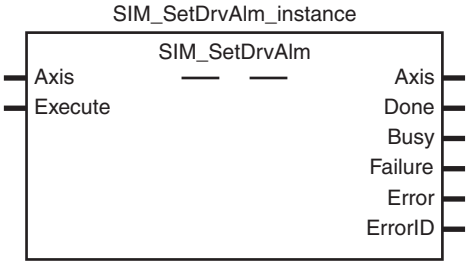
Name	Input Value Out of Range		**Event code**	04000000 hex
Meaning	The latch ID selection input parameter for the instruction exceeded the valid range of the input value.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The latch ID selection input parameter for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and do not allow the input parameter to exceed the range.	Do not allow the input parameter to the instruction to exceed the range.
Precautions/Remarks	None			

- An error occurs if there is no slave for the axis specified by *Axis*. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and specify a correct value for Axis.	Make sure you set the I/O variables for the instruction correctly.
Precautions/Remarks	None			

A-6-6 Simulate Drive Alarm Instruction

This instruction creates a virtual Drive alarm.

Instruction	Name	FB/FUN	Graphic expression	ST expression
SIM_SetDrvAlm	Simulate Drive Alarm	FB		SIM_SetDrvAlm_instance (Axis :=*Parameter*, Execute :=*Parameter*, Done =>*Parameter*, Busy =>*Parameter*, Failure =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when instruction execution is completed normally.
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Failure	Error end	BOOL	TRUE or FALSE	TRUE when instruction execution is not completed normally.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-26 for information on error codes.

● In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Execute* changes to TRUE, a virtual Drive alarm is created for the axis specified by *Axis*.
- Execute the MC_Reset (Reset Axis Error) instruction to reset the Drive alarm.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

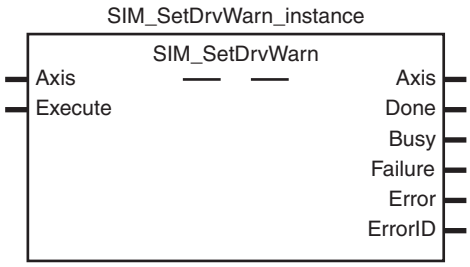
Errors

An error occurs if there is no slave for the axis specified by *Axis*. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and specify a correct value for Axis.	Make sure you set the I/O variables for the instruction correctly.
Precautions/Remarks	None			

A-6-7 Simulate Drive Warning Instruction

This instruction creates a virtual Drive warning.

Instruction	Name	FB/FUN	Graphic expression	ST expression
SIM_SetDrvWarn	Simulate Drive Warning	FB		SIM_SetDrvWarn_instance (Axis :=*Parameter*, Execute :=*Parameter*, Done =>*Parameter*, Busy =>*Parameter*, Failure =>*Parameter*, Error =>*Parameter*, ErrorID =>*Parameter*,);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE, FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when instruction execution is completed normally.
Busy	Busy	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Failure	Error end	BOOL	TRUE or FALSE	TRUE when instruction execution is not completed normally.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error code	WORD	---	Contains the error code when an error occurs.* A value of 16#0000 indicates normal execution.

* Refer to *Errors* on page A-28 for information on error codes.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Axis	Axis	_sAXIS_REF	---	Specifies the axis.*

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

Function

- When *Execute* changes to TRUE, a virtual Drive warning is created for the axis specified by *Axis*.
- Execute the MC_Reset (Reset Axis Error) instruction to reset the Drive warning.

Precautions for Correct Use

This instruction is used only for simulation. It is used to create a virtual input signal. Use it in a debug program so that it is not executed for the actual system. If this instruction is mistakenly used in a normal program, it is not executed in the actual system.

Errors

An error occurs if there is no slave for the axis specified by *Axis*. The error code (0406 hex) is output to *ErrorID*.

Name	Illegal Data Position Specified		**Event code**	04060000 hex
Meaning	The *Axis* I/O variable for the instruction exceeded the valid range.			
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.
System-defined variables	**Variable**		**Data type**	**Name**
	None		---	---
Cause and correction	**Assumed cause**		**Correction**	**Prevention**
	The *Axis* I/O variable for the instruction exceeded the valid range of the input value.		Check the range of the I/O variable for the instruction and specify a correct value for Axis.	Make sure you set the I/O variables for the instruction correctly.
Precautions/Remarks	None			

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