# OMRON

# Machine Automation Controller NJ-series Robot Integrated System

### **Startup Guide**

NJ501-R

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# Introduction

Thank you for purchasing an NJ-series Robot Integrated CPU Unit.

This guide describes the startup procedure of the "Robot Integrated System" that contains NJ-series Robot Integrated CPU Unit and Omron robots and the basic operating procedure of the Sysmac Studio using a simple machine model. You can learn the basics of the Robot Integrated System in a short time while you operate the system according to this guide.

For information on wiring and operation settings of NJ-series Robot Integrated CPU Unit, IPC Application Controller, robots and their peripheral devices, refer to *Related Manuals* on page 23.

This guide does not contain safety information and other details required for actual use of the products. Thoroughly read and understand the manuals for all of the devices that are used in this guide to ensure that the system is used safely. Review the entire contents of these materials, including all safety precautions, precautions for safe use, and precautions for correct use.

For safety instruction of the robot and details on robot use, refer to the *Robot Safety Guide (Cat. No. 1590)*.

### **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.

Also, this manual is intended for the personnel, who understand the following contents.

- Personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503, for programming<sup>\*1</sup>.
- Personnel who understand the specifications of NJ-series CPU Unit and know how to use it<sup>\*1</sup>.
- Personnel who understand basic operation procedure of the Sysmac Studio<sup>\*1</sup>.
- Personnel who have attended the industrial robot seminar held by Omron or have equivalent knowledge.
- Personnel in charge of working with a robot and well knowing how to handle the robot.
- \*1. For information of the international standard IEC 61131-3 and basic operation procedure of NJ-series CPU Unit and Sysmac Studio, refer to the *Relevant Technical Guides* on page 26.

### **Applicable Products**

This manual covers the following products.

- NJ-series Robot Integrated CPU Unit NJ501-R□□□
- SCARA robot eCobra 600/800

RL4-000000

IPC Application Controller

AC1-152000

# **Relevant Manuals**

The following table provides the relevant manuals for the NJ-series CPU Units. Read all of the manuals that are relevant to your system configuration and application before you use the NJ-series CPU Unit.

Most operations are performed from the Sysmac Studio Automation Software. Refer to the Sysmac Studio Version 1 Operation Manual (Cat. No. W504) and the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for information on the Sysmac Studio.

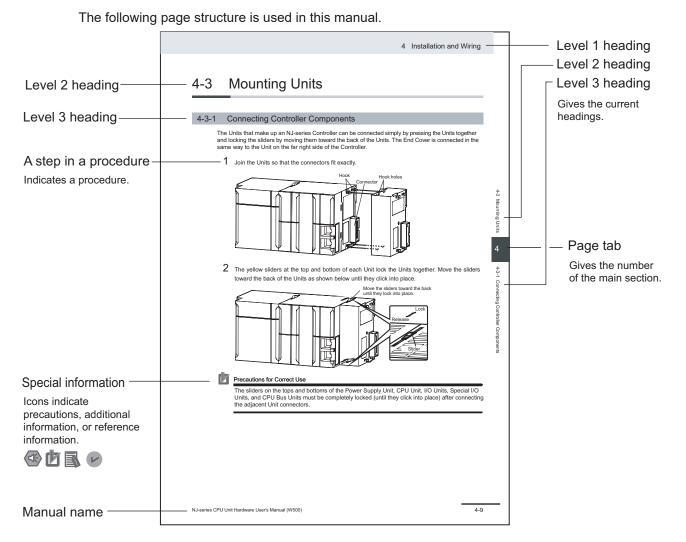
						I	Manua	I					
	Bas	ic info	rma-										
	NJ-series ( Hardware I	tion											
Purpose of use		NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series CPU Unit Motion Control User's Manual	NJ/NX-series Motion Control Instructions Reference Manua	NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual	NJ/NX-series Database Connection CPU Units User's Manual	NJ-series Robot Integrated CPU Unit User's Manual	eV+3 User's Manual	eV+3 Keyword Reference Manual	NJ-series NJ Robotics CPU Unit User's Manual	NJ/NX-series Troubleshooting Manual
Introduction to NJ-series Controllers	0							0					
Setting devices and hardware													
Using motion control	1			0									
Using EtherCAT	0					0							
Using EtherNet/IP	1						0						
Using robot control for OMRON robots	1								0				
Software settings													
Using motion control				0									
Using EtherCAT						0							
Using EtherNet/IP		0					0						
Using database connection service								0					
Using robot control for OMRON robots									0	0	0		
Using robot control with NJ Robotics function												0	
Writing the user program													
Using motion control				0	0								
Using EtherCAT		1				0							
Using EtherNet/IP							0						
Using database connection service		0	0					0					
Using robot control for OMRON robots		1							0	0	0		
Using robot control with NJ Robotics function												0	
Programming error processing									0	0	0		0

	Manual												
	Bas	ic info	rma-										
	NJ-series ( Hardware	tion											
Purpose of use		NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series CPU Unit Motion Control User's Manual	NJ/NX-series Motion Control Instructions Reference Manua	NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual	NJ/NX-series Database Connection CPU Units User's Manual	NJ-series Robot Integrated CPU Unit User's Manual	eV+3 User's Manual	eV+3 Keyword Reference Manual	NJ-series NJ Robotics CPU Unit User's Manual	NJ/NX-series Troubleshooting Manual
Testing operation and debugging													
Using motion control				0									
Using EtherCAT						0							
Using EtherNet/IP		0					0						
Using database connection service								0					
Using robot control for OMRON robots									0	0	0		
Using robot control with NJ Robotics function												0	
Learning about error management functions and corrections <sup>*1</sup>								Δ	Δ	$\bigtriangleup$	$\bigtriangleup$		0
Maintenance													
Using motion control	0			0									
Using EtherCAT						0							
Using EtherNet/IP							0						

\*1. Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for the error management concepts and the error items. However, refer to the manuals that are indicated with triangles for details on errors corresponding to the products with the manuals that are indicated with triangles.

# **Manual Structure**

### **Page Structure**



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.

### Version Information

Information on differences in specifications and functionality for Controller with different unit versions and for different versions of the Sysmac Studio is given.

### **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.

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# **Safety Precautions**

### **Definition of Precautionary Information**

The following notation is used in this manual to provide precautions required to ensure safe usage of the NJ-series Robot Integrated CPU Unit.

The safety precautions that are provided are extremely important for safety. Always read and heed the information provided in all safety precautions.

The following notation is used.

	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.

### **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 that disassembly is prohibited.
	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.
$\underline{\mathbb{N}}$	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.
0	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

# 

Refer to the following manuals for warnings.

- NJ-series CPU Unit Hardware User's Manual (Cat. No. W500)
- NJ-series Robot Integrated CPU Unit User's Manual (Cat. No. 0037)

### Cautions

# ▲ Caution

Refer to the following manuals for cautions.

- NJ-series CPU Unit Hardware User's Manual (Cat. No. W500)
- NJ-series Robot Integrated CPU Unit User's Manual (Cat. No. 0037)

# **Precautions for Safe Use**

Refer to the following manuals for precautions for safe use.

- NJ-series CPU Unit Hardware User's Manual (Cat. No. W500)
- NJ-series Robot Integrated CPU Unit User's Manual (Cat. No. 0037)

# **Precautions for Correct Use**

Refer to the following manuals for precautions for correct use.

- NJ-series CPU Unit Hardware User's Manual (Cat. No. W500)
- NJ-series Robot Integrated CPU Unit User's Manual (Cat. No. 0037)

# **Regulations and Standards**

Refer to the following manuals for regulations and standards.

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



### **Additional Information**

The Robot Integrated CPU Unit is not a robot control device that is defined in ISO 10218-1. Therefore, the Robot Integrated CPU Unit does not comply with the robot regulations and standards.

Refer to the OMRON robot manuals for information on the OMRON robot itself.

# Versions

Hardware revisions and unit versions are used to manage the hardware and software in NJ-series Units and EtherCAT slaves. The hardware revision or unit version is updated each time there is a change in hardware or software specifications. Even when two Units or EtherCAT slaves have the same model number, they will have functional or performance differences if they have different hardware revisions or unit versions.

### **Checking Versions**

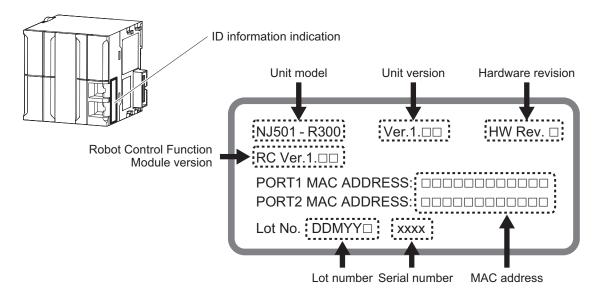
You can check versions on the ID information indications or with the Sysmac Studio.

### **Checking Unit Versions on ID Information Indications**

The unit version is given on the ID information indication on the side of the product.

● NJ501-R□00

The ID information on the NJ-series NJ501-R300 CPU Unit is shown below.



Note The hardware revision is not displayed for the Unit that the hardware revision is in blank.

### **Checking Unit Versions with the Sysmac Studio**

You can use the Sysmac Studio to check unit versions.

### Checking the Unit Version of an NJ-series CPU Unit

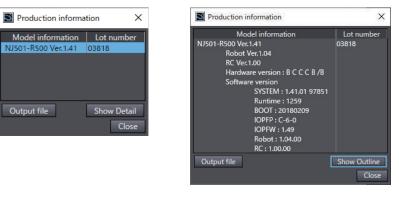
You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can do this for the CPU Unit, CJ-series Special I/O Units, and CJ-series CPU Bus Units. You cannot check the unit versions of CJ-series Basic I/O Units with the Sysmac Studio.

- 1 Double-click CPU Rack under Configurations and Setup CPU/Expansion Racks in the Multiview Explorer. Or, right-click CPU Rack under Configurations and Setup - CPU/ Expansion Racks in the Multiview Explorer and select Edit from the menu. The Unit Editor is displayed.
- **2** Right-click any open space in the Unit Editor and select **Production Information**. The Production Information Dialog Box is displayed.

### Changing Information Displayed in Production Information Dialog Box

1 Click the Show Detail or Show Outline Button at the lower right of the Production Information Dialog Box.

The view will change between the **production information** details and outline.



**Outline View** 

**Detailed View** 

The information that is displayed is different for the Outline View and Detail View. The Detail View displays the unit version, hardware revision, and various versions. The Outline View displays only the unit version.

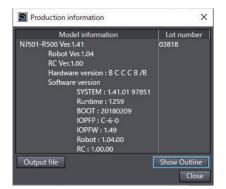
**Note** The hardware revision is separated by "/" and displayed on the right of the hardware version. The hardware revision is not displayed for the Unit that the hardware revision is in blank.

### Changing Information Displayed in Production Information Dialog Box

1 Click the Show Detail or Show Outline Button at the lower right of the Production Information Dialog Box.

The view will change between the **production information** details and outline.

Production information	ation X
Model information	Lot number
NJ501-R500 Ver.1.41	03818
Output file	Show Detail
Output file	Show Detail Close



**Outline View** 

Detailed View

# **Related Manuals**

Manual name	Cat. No.	Model numbers	Application	Description
NJ-series CPU Unit	W500	NJ501-□□□□	Learning the basic	An introduction to the entire NJ-series
Hardware User's Manual		NJ301-□□□□	specifications of the	system is provided along with the follow-
		NJ101-□□□□	NJ-series CPU Units,	ing information on the CPU Unit.
			including introductory	Features and system configuration
			information, design-	Introduction
			ing, installation, and maintenance.	Part names and functions
			Mainly hardware in-	General specifications
			formation is provided.	Installation and wiring
	14/504		-	Maintenance and inspection
NJ/NX-series CPU Unit Software User's Manual	W501		Learning how to pro-	The following information is provided on a Controller built with an NJ/NX-series CPU
Soltware User's Manual		NX502-□□□ NX102-□□□	gram and set up an NJ/NX-series CPU	Unit.
		NX1P2-000	Unit.	CPU Unit operation
		NJ501-000	Mainly software infor-	CPU Unit features
		NJ301-□□□	mation is provided.	Initial settings
		NJ101-□□□□		<ul> <li>Programming based on IEC 61131-3</li> </ul>
				language specifications
NJ/NX-series Instructions	W502	NX701-000	Learning detailed	The instructions in the instruction set (IEC
Reference Manual		NX502-000	specifications on the	61131-3 specifications) are described.
		NX102-000	basic instructions of	
		NX1P2-000	an NJ/NX-series	
		NJ501-□□□□	CPU Unit.	
		NJ301-□□□□		
		NJ101-□□□□		
NJ/NX-series CPU Unit	W507	NX701-000	Learning about mo-	The settings and operation of the CPU
Motion Control User's Manual		NX502-000	tion control settings	Unit and programming concepts for mo-
		NX102-000	and programming	tion control are described.
		NX1P2-□□□□ NJ501-□□□□	concepts.	
		NJ301-000		
		NJ101-000		
NJ/NX-series	W508	NX701-000	Learning about the	The motion control instructions are descri-
Motion Control Instructions		NX502-000	specifications of the	bed.
Reference Manual		NX102-000	motion control in-	
		NX1P2-000	structions.	
		NJ501-□□□□		
		NJ301-□□□□		
		NJ101-□□□		
NJ/NX-series	W505	NX701-□□□	Using the built-in	Information on the built-in EtherCAT port
CPU Unit		NX502-	EtherCAT port on an	is provided.
Built-in EtherCAT <sup>®</sup> Port			NJ/NX-series CPU	This manual provides an introduction and
User's Manual		NX1P2-□□□□ NJ501-□□□□	Unit.	provides information on the configuration, features, and setup.
		NJ301-000		
		NJ101-000		
NJ/NX-series	W506	NX701-000	Using the built-in	Information on the built-in EtherNet/IP port
CPU Unit		NX502-000	EtherNet/IP port on	is provided.
Built-in EtherNet/IP <sup>™</sup> Port		NX102-□□□	an NJ/NX-series	Information is provided on the basic setup,
User's Manual		NX1P2-000	CPU Unit.	tag data links, and other features.
		NJ501-□□□□		
		NJ301-□□□□		
		NJ101-□□□□		

The following are the manuals related to this manual. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
NJ-series Robot Integrated CPU Unit User's Manual	0037	NJ501-R□□□	Using the NJ-series Robot Integrated CPU Unit.	Describes the settings and operation of the CPU Unit and programming concepts for OMRON robot control.
Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Opera- tion Manual	W595	SYSMAC-SE2□□□ SYSMAC- SE200D-64	Learning about the operating procedures and functions of the Sysmac Studio to configure Robot Inte- grated System using Robot Integrated CPU Unit.	Describes the operating procedures of the Sysmac Studio for Robot Integrated CPU Unit.
Sysmac Studio Robot Integrated System Building Function with IPC Application Controller Opera- tion Manual	W621	SYSMAC-SE2 SYSMAC- SE200D-64	Learning about the operating procedures and functions of the Sysmac Studio to configure Robot Inte- grated System using IPC Application Con- troller.	Describes the operating procedures of the Sysmac Studio for IPC Application Con- troller.
Sysmac Studio 3D Simulation Function Oper- ation Manual	W618	SYSMAC-SE2□□□ SYSMAC-SA4□□ □-64	Learning about an outline of the 3D sim- ulation function of the Sysmac Studio and how to use the func- tion.	Describes an outline, execution proce- dures, and operating procedures for the 3D simulation function of the Sysmac Stu- dio.
eV+3 User's Manual	1651	NJ501-R□□□	Operating the OM- RON robot with the V + program.	Describes the V+ language to control the OMRON robots.
eV+3 Keyword Reference Manual	1652	NJ501-R□□	Operating the OM- RON robot with the V + program.	Describes V+ keywords that are used in the V+ language.
eCobra 600 and 800 Robot with EtherCAT User's Guide	1653	RL4-116□□□ RL4-216□□□	Using the eCobra.	Describes the eCobra.
i4L Robots with EtherCAT Us- er's Manual	1659	RS4-2063□□□ RS4-2064□□□ RS4-2065□□□	Using the i4L.	Describes the i4L.
i4H Robots with EtherCAT Us- er's Manual	1661	RS4-2066□□□ RS4-2067□□□ RS4-2068□□□	Using the i4H.	Describes the i4H.
Viper 650 and 850 Robot with EtherCAT User's Guide	1654	RL6-206	Using the Viper.	Describes the Viper.
iX3 565 Robot with EtherCAT User's Guide	1655	RX3-206□□□	Using the iX3.	Describes the iX3.
iX4 650 H/HS and 800 H/HS Robot with EtherCAT User's Guide	1656	RX4-216	Using the iX4.	Describes the iX4.
Robot Safety Guide	1590	RL4-000000 RS4-000000 RL6-000000 RX3-000000 RX4-000000	Learning how to use the OMRON robot safely.	Describes how to use the OMRON robot safely.
Teaching Pendant T20 User's Manual	1601	10046-010	Operating the OM- RON robot with a teaching pendant.	Describes the setup, operation, and user maintenance for the Teaching Pendant T20.
IPC Application Controller User's Manual	1632	AC1-152000	Using the IPC Appli- cation Controller.	Describes the IPC Application Controller.

Manual name	Cat. No.	Model numbers	Application	Description
NJ/NX-series Database Connection CPU Units User's Manual	W527	NX701-20 NX502-20 NX102-20 NJ501-20 NJ101-20	Using the database connection service with NJ/NX-series Controllers.	Describes the database connection serv- ice.
NJ-series NJ Robotics CPU Unit User's Manual	W539	NJ501-4□□ NJ501-R□□	Controlling robots with NJ-series CPU Units.	Describes the functionality to control ro- bots.
NJ/NX-series Troubleshooting Manual	W503	NX701-000 NX502-000 NX102-000 NX1P2-000 NJ501-000 NJ301-000 NJ101-000	Learning about the errors that may be detected in an NJ/NX-series Con- troller.	Concepts on managing errors that may be detected in an NJ/NX-series Controller and information on individual errors are described.
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC -SE2□□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
NX-series Position Interface Units User's Manual	W524	NX-EC0 NX-ECS NX-PG0	Learning how to use NX-series Position Interface Units.	The hardware, setup, and functions for the NX-series Incremental Encoder Input Units, SSI Input Units, and Pulse Output Unit are described.
AC Servomotors/Servo Drives 1S-series with	1586	R88M-1□ R88D-1SN□-ECT	Learning how to use the Servomotors/	Describes the hardware, setup methods and functions of the Servomotors/Servo
Built-in EtherCAT <sup>®</sup> Communi- cations User's Manual	1621	R88M-1AL□/ -1AM□ R88D-1SAN□-ECT	Servo Drives with built-in EtherCAT Communications.	Drives with built-in EtherCAT Communica- tions.
AC Servomotors/Servo Drives G5 Series with	1576	R88M-K□ R88D-KN□-ECT	Learning how to use the AC Servomotors/	Describes the hardware, setup methods and functions of the AC Servomotors/
Built-in EtherCAT <sup>®</sup> Communi- cations User's Manual	1577	R88L-EC-⊡ R88D-KN□-ECT-L	Servo Drives with built-in EtherCAT Communications.	Servo Drives with built-in EtherCAT Com- munications. The Linear Motor Type models and dedi- cated models for position control are avail- able in G5-series.

# **Relevant Technical Guides**

The following table lists the relevant technical guides for the NJ-series CPU Units. Use these manuals for reference.

Manual name	Cat. No.	Application	Description
Machine Automation Controller Startup Guide for CPU Unit	W513	Learning about outline and op- eration procedure of the NJ- series CPU Unit and Sysmac Studio.	Describes the startup procedure of the NJ-series CPU Unit and the basic operating procedure of the Sysmac Studio on an example of simple sequence control.
Machine Automation Controller Startup Guide for Motion Con- trol	W514	Learning about the basics of the motion control functions of the NJ-series CPU Unit.	Describes the startup procedures and Sysmac Studio operating procedures for someone that will use NJ-series motion control func- tions for the first time. The procedures are explained in simple ex- amples of one-axis positioning and two-axis linear interpolation.

# Terminology

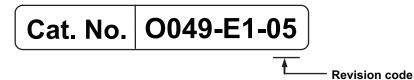
Term	Description
continuous-path mo-	A motion to move continuous operations smoothly without stopping motion of the OM-
tion	RON robot.
IEC 61131-3 lan-	A programming language to write a sequence control program.
guage	
robots controllable	Specify the controllable robots by the data processing for robot in the Motion Control
by NJ Robotics func-	Function Module of the NJ-series CPU Unit. The controllable robot consists of the 1S-series or G5-series Servomotor/Servo Drive
tion	with built-in EtherCAT communications and the robot arm that is prepared by the cus-
	tomer.
ТСР	A tip (Tool Center Point) defined in each OMRON robot.
	The target position or path can be specified based on the TCP.
TIO	Refers to digital input and output signals to use arm tip tools for OMRON SCARA robots
	(i4H, i4L).
V+	An operating system that controls OMRON robots. V+ programs run on it.
V+ keyword	A generic term for instructions that are used during a V+ program and monitoring com-
	mand.
V+ language	A programming language for OMRON robot control.
V+ task	A task that can execute a V+ program.
V+ version	Version of the V+ operating system that runs on a Robot Integrated CPU Unit or OM-
	RON robot.
V+ program	A control program written in the V+ language.
OMRON robot	Specifies the OMRON robot controllable from the Robot Integrated CPU Unit.
	The robot consists of the robot amplifier and the robot arm connected to the robot ampli- fier.
shared variable	A variable that can be shared between the sequence control program and V+ program.
sequence control	A control program written in IEC 61131-3 language including the motion control.
program	
configured V+ ver-	A V+ version that is set by the V+ version configuration function.
sion	It is set for both the Robot Integrated CPU Unit and an OMRON robot.
hardware servo	A servo system built into the robot amplifier.
user program	A generic term for the collection of programs written in the ladder diagram, ST, and V+
	languages.
remote encoder	Specifies the encoder which sets the motion control axis as the external encoder for ro-
	bot control.
recipe	A set of product type data in the customer's system.
recipe change	Specifies that the product data and information (recipe) related to the production process
	are changed.
	The target recipe for the Robot Integrated CPU Unit is a property from the present val- ues of variables and a vision sensor.
local encoder	Specifies the encoder connected to the encoder input port on the OMRON robot.
Robot Control Func-	Software to perform robot control that is installed in the Robot Integrated CPU Unit.
tion Module	
robot control instruc-	FB instructions written in the sequence control program to control the OMRON robots.
tions	They include an instruction to directly control the OMRON robots and an instruction to
	execute or abort V+ programs assigned to the V+ tasks.

This section describes the terms that are used in this manual.

Term	Description
Robot Integrated	A CPU Unit that supports control function for the OMRON robot with the NJ-series CPU
CPU Unit	Unit.

# **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	August 2020	Original production
02	December 2020	<ul> <li>Added description on dynamic pick-and-place equipment.</li> </ul>
		Corrected mistakes.
03	October 2021	Corrected mistakes.
04	March 2022	Corrected mistakes.
05	July 2024	Made changes accompanying the upgrade to Sysmac Studio version 1.54.

# 1

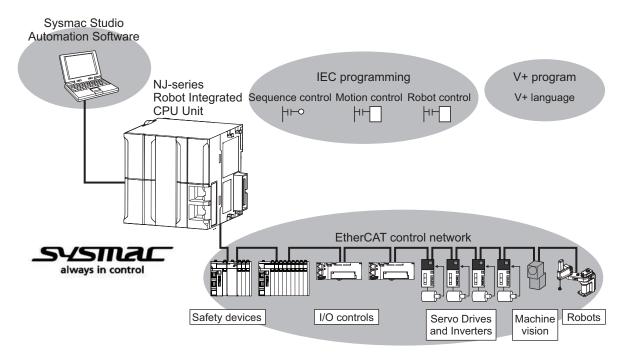
# **Overview**

This section describes the overview of robot integrated system.

1-1	Featu	res of Robot Integrated System	1-2
	1-1-1	Features of the NJ-series Robot Integrated CPU Unit	1-2
	1-1-2	Features of the EtherCAT-compatible OMRON robots	
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	1-6-2 Hardv Softw	Operating Modes for Equipment	1-11 <b>1-12</b> <b>1-14</b> 1-14
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# 1-1 Features of Robot Integrated System

The robot integrated system is a system to integrate the sequence control and robot control into a Controller, network, and software.



The system consists of the NJ-series Robot Integrated CPU Unit, the OMRON robots that support EtherCAT communications, and the Sysmac Studio Automation Software.

### 1-1-1 Features of the NJ-series Robot Integrated CPU Unit

The sequence control and the robot control can be executed with a CPU Unit. This allows you to design interface easily between the sequence control and robot control and reduce the design time and the adjustment time at startup.

### **1-1-2** Features of the EtherCAT-compatible OMRON robots

The robots and peripheral devices can connect to the same EtherCAT network. The operations for the robots and the peripheral devices can be handled in the same time axis with the synchronization function of the EtherCAT, so wait time for asynchronous operation or variations of timing are reduced. This enables you to reduce the tact time, identify an error cause during operation, and make predictive control for the operations of peripheral devices.

### **1-1-3** Features of the Sysmac Studio Automation Software

The sequence control and the robot control can be developed with a software. It is easy to perform the advance verification on paper because the system operations to use with the sequence control and robot control can be simulated with the 3D model.

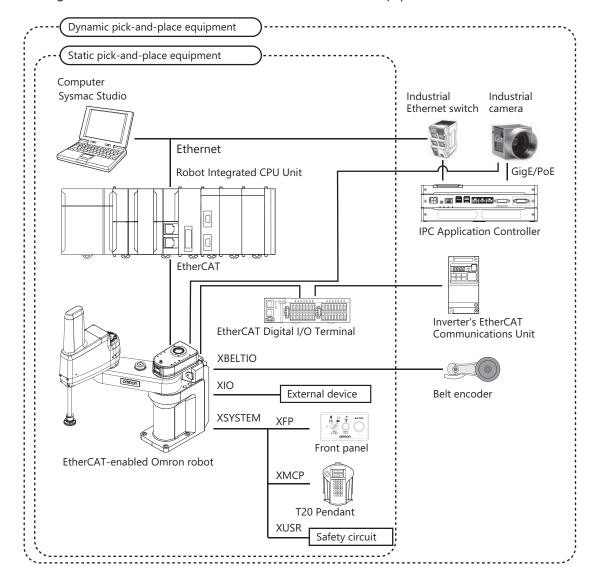
# 1-2 System configuration to build in this guide

*NJ-series Robot Integrated System Startup Guide* (hereinafter referred to as "this guide") describes examples of building a static pick-and-place equipment and a dynamic pick-and-place equipment.

An equipment to move a workpiece that is placed at the specified position to the target position is called a static pick-and-place equipment in this guide.

An equipment that picks up a workpiece being moved on the conveyor and places it at the specified position is called a dynamic pick-and-place equipment. The pickup position is automatically determined from the position detected by the camera and encoder.

To control multiple Omron robots and manage the recipes, IPC Application Controller is connected to the equipment via Ethernet. Select and use the IPC Application Controller, industrial cameras, and belt encoders required for the functions explained in *1-8-2 Application Manager* on page 1-14.



The figure below illustrates the devices to be used for each equipment.

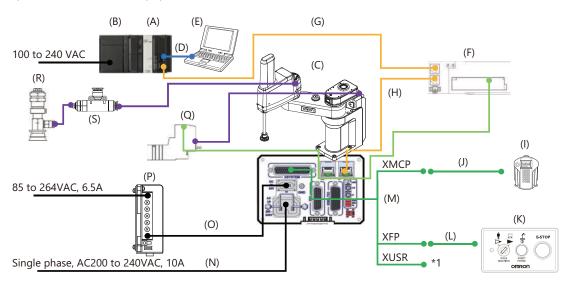
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# 1-3 System Configuration for Static Pickand-place Equipment

This section describes the system configuration for the static pick-and-place equipment that is explained in this guide.

An equipment to move a workpiece that is not moved at the specified position to the target position is called a static pick-and-place equipment in this guide.

"XUSR" in the following figure is a wiring to the safety circuits. Refer to A-1 Designing Example of the Safety Functions for the Pick-and-place Equipment on page A-2, and design the safety circuits required for the actual equipments.



The parts that are used in the system configuration are given below.

Letter	Name	Model	Version
А	Robot Integrated CPU Unit	NJ501-R300	Ver.1.41
В	Power Supply Unit	NJ-PA3001	
С	SCARA Robot eCobra 600 Pro	RL4-2166000	3.0 0-0 Edit A1
D	Ethernet cable <sup>*1</sup>		
E	Computer (Sysmac Studio)		
F	EtherCAT Digital I/O Terminal	GX-MD3218	
G	Ethernet cable <sup>*1</sup>		
Н	Ethernet cable <sup>*1</sup>		
I	T20 Pendant	10046-010	3.0.0.1
J	T20 Adapter Cable		
К	Front Panel	90356-10358	
L	Front Panel Cable		
Μ	XSYSTEM Cable Assembly	Incudes in the RL4-2166000.	
N	AC Power Cable	04118-000	
0	DC Power Cable	04120-000	
Р	24 VDC Power Supply 150 W	S8FS-G15024CD	
Q	Solenoid valve	Selects depending on the workpiece.	
R	Vacuum pad		
S	Vacuum ejector		

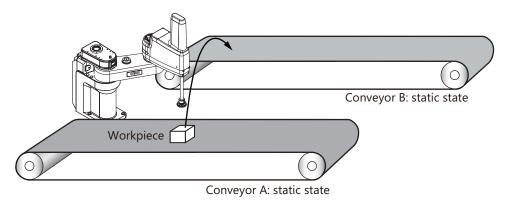
\*1. Use a twisted-pair cable (double shielding with aluminum tape and braiding) of category 5 (100BASE-TX) or higher.

# 1-4 Operations of Static Pick-and-place Equipment

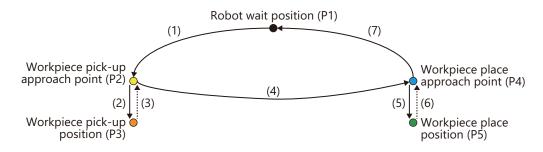
This section describes the operating specifications and procedures for the static pick-and-place equipment.

# 1-4-1 Operating Specifications

This equipment picks up a workpiece that is not moving on the conveyor A and transfers it to the specified position on the conveyor B.



The following figure shows a specific operation for a robot.



Number	Description of operation
(1)	Move from the robot wait position (P1) to the workpiece pick-up approach point (P2) in joint interpola- tion operation.
(2)	Move from the workpiece pick-up approach point (P2) to the workpiece pick-up position (P3) in linear interpolation operation.
(3)	Move from the workpiece pick-up position (P3) to workpiece pick-up approach point (P2) in linear in- terpolation operation.
(4)	Move from the workpiece pick-up approach point (P2) to the workpiece place approach point (P4) in joint interpolation operation.
(5)	Move from the workpiece place approach point (P4) to the workpiece place position (P5) in linear in- terpolation operation.
(6)	Move from the workpiece place position (P5) to the workpiece place approach point (P4) in linear in- terpolation operation.
(7)	Move from the workpiece place approach point (P4) to the robot wait position (P1) in joint interpola- tion operation.

1

# 1-4-2 Operating Modes for Equipment



#### Additional Information

The operations for conveyor A and B are not described in this guide. Program it by the customer according to the operating specifications of actual equipments.

# 1-4-2 Operating Modes for Equipment

Assume that this equipment have two operating modes, manual operation and automatic operation modes.

Perform teaching in manual operation, and execute the actual pick-and-place operations in automatic operation.

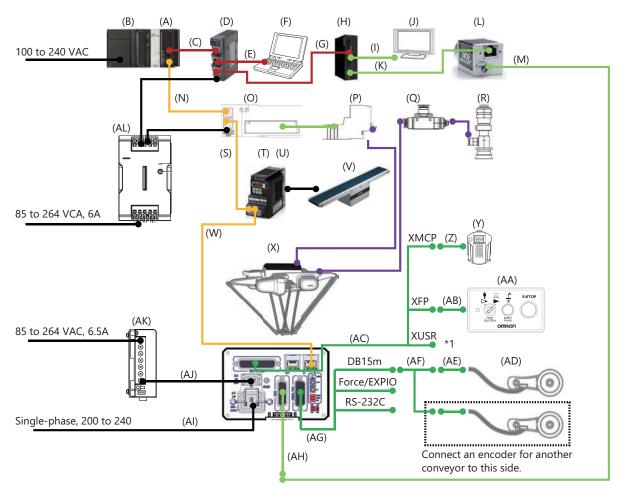
# 1-5 System Configuration for Dynamic Pick-and-place Equipment

This section describes the system configuration for the dynamic pick-and-place equipment to build in this guide.

In this guide, an equipment that picks up a workpiece being moved on the conveyor and places it at the specified position is called a dynamic pick-and-place equipment. The pickup position is automatically determined from the position detected by the camera and encoder.

"XUSR" in the following figure is a wiring to the safety circuits. Design the safety circuits required for the actual equipments.

The Y-adapter cable in the figure below is a cable to connect with the encoders. Since there is only one encoder used in this equipment, connect the encoder extension cable to one side only. No encoder is connected to the other side.



The parts that are used in the system configuration are given below.

Letter	Name	Model	Version
A	Robot Integrated CPU Unit	NJ501-R300	Ver.1.43
В	Power Supply Unit	NJ-PA3001	
С	Ethernet cable <sup>*1</sup>		
D	Industrial Ethernet switch	W4S1-03B	
E	Ethernet cable <sup>*1</sup>		
F	Computer (Sysmac Studio)		
G	Ethernet cable <sup>*1</sup>		
Н	IPC Application Controller	AC1-152000	Ver.2.00
<u> </u>	DVI Cable		
<u>ן</u>	Display		
ĸ	Camera Cable (GigE Cat.6) 10m	24114 <sup>*2</sup>	
L	Camera	24114 -	
M	Power I/O Cable		
N	Ethernet cable <sup>*1</sup>		
0	EtherCAT Digital I/O Terminal	GX-MD3218	
<u>Р</u>	Solenoid valve	Select a bellow-shape valve with suitable vacuum pres-	
Q	Vacuum ejector	sure to the workpiece.	
R	Vacuum pad		
S	Ethernet cable <sup>*1</sup>		
<u>т</u>	EtherCAT Communications Unit	3G3AX-MX2-ECT	
U		Select an applicable model from the Multi-function Com-	
0	Inverter <sup>*3</sup>	pact Inverter MX2-series V1 type.	
V	Belt conveyor <sup>*3</sup>		
W	Ethernet cable <sup>*1</sup>		
Х	Parallel Robot	RX4-2166020	4.0.C1
	iX4 650H, IP65, P30		
Y	T20 Pendant	10046-010	3.0.0.1
Z	T20 Adapter Cable		
AA	Front Panel	90356-10358	
AB	Front Panel Cable		
AC	XSYSTEM Cable Assembly	Included in the RL4-2166000.	
AD	Encoder IP65	09742-001	
AE	Encoder extension cable 5m		
AF	Y-Adapter Cable 3m	09443-000	
AG	XBELT IO Cable 0.6m	13463-000	
AH	XIO Breakout Cable	04465-000	
AI	AC Power Cable	04118-000	
AJ	DC Power Cable	04120-000	
AK	24 VDC Power Supply 150 W	S8FS-G15024CD	
AL	24 VDC Power Supply 120W	S8VK-S12024	

\*1. Use a twisted-pair cable (double shielding with aluminum tape and braiding) of category 5 (100BASE-TX) or higher.

\*2. Select a camera with the appropriate imaging range and resolution for the belt width and the workpiece.

\*3. Refer to the *Multifunction Compact Inverter User's Manual (Cat. No. 1585)* for the circuits around the inverter and connection to the belt conveyor.

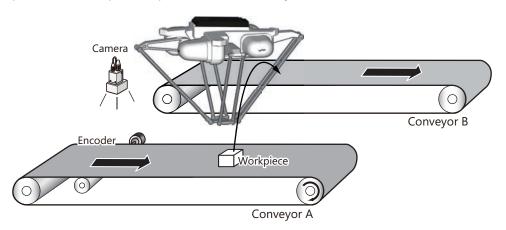
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# 1-6 Operations of Dynamic Pick-andplace Equipment

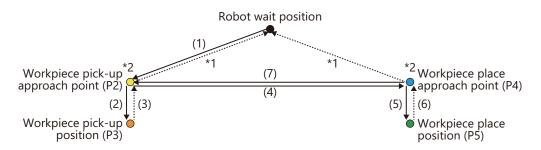
This section describes the operating specifications and procedures for the dynamic pick-and-place equipment.

# 1-6-1 Operating Specifications

This equipment picks up a workpiece that is moving on the conveyor A after a camera detects it, and places it to the specified position on the conveyor B.



The following figure shows a specific operation for a robot.



\*1. When there is no workpiece to pick up on the conveyor and no item is detected by the camera, the robot once moves from the workpiece pick-up approach point (P2) or workpiece pick-up position (P3) to the robot wait position (P1). While the camera is detecting the workpiece, operation from (2) to (7) is repeatedly performed.

\*2. In above operation digram, both of the transit points of the robot in approaching to the workpiece and departing from the workpiece are called "workpiece pick-up approach point (P2)". The function of the Pack Manager allows you to set the transit positions in approaching to the workpiece and moving away from the workpiece to different locations. Similarly, you can set different locations for "workpiece place approach point (P4)".

Number	Description of operation
(1)	Move from the robot wait position (P1) to the workpiece pick-up approach point (P2) in linear interpo-
	lation operation.

Number	Description of operation
(2)	Move from the workpiece pick-up approach point (P2) to the workpiece pick-up position (P3) in linear interpolation operation.
(3)	Move from the workpiece pick-up position (P3) to workpiece pick-up approach point (P2) in linear in- terpolation operation.
(4)	Move from the workpiece pick-up approach point (P2) to the workpiece place approach point (P4) in linear interpolation operation.
(5)	Move from the workpiece place approach point (P4) to the workpiece place position (P5) in linear in- terpolation operation.
(6)	Move from the workpiece place position (P5) to the workpiece place approach point (P4) in linear in- terpolation operation.
(7)	Move from the workpiece place approach point (P4) to the workpiece pick-up approach point (P2) in linear interpolation operation.

The "approach point" is the same as "approach location" and "depart location" that are used with the Pack Manager described in *4-3-6 Creating a Pack Manager Sample* on page 4-53.



#### **Additional Information**

The operations for conveyor B are not described in this guide. Program it by the customer according to the operating specifications of actual equipment.

# **1-6-2** Operating Modes for Equipment

Assume that this equipment have two operating modes, manual operation and automatic operation modes.

Perform teaching in manual operation, and execute the actual pick-and-place operations in automatic operation.

1

# 1-7 Hardware

The following table shows an overview of each hardware in the system configuration. Refer to the manual for the specific product for details.

Hardware	Model	Description	Static	Dy- na- mic
Robot Inte- grated CPU Unit	NJ501-R□□□	A CPU Unit that integrates the sequence control and robot control. To use the robot control function, you must insert the included SD Memory Card.	0	0
EtherCAT- compatible OMRON robot	RLD-000000	OMRON's SCARA robot that supports EtherCAT.	0	0
	RXD-000000	OMRON's parallel robot that supports EtherCAT.	0	0
Computer		A computer that the Sysmac Studio Automation Software to make the settings for the robot inte- grated system and perform debugging is installed. *1	0	0
Front Panel	90356-10358	A control panel for a robot. The panel has switches to change modes, enable the high power, and make a emergency stop.	0	0
T20 Pendant	10046-010	A teaching pendant for a robot. Use the pendant for teaching coordinates. It has the built-in E-Stop button and built-in enable switch as safety func- tions.	0	0
Safety circuits		The safety circuits that consist of safety I/O devi- ces, a Safety Controller, etc. Refer to A-1 Design- ing Example of the Safety Functions for the Pick- and-place Equipment on page A-2 for details.	0	0
Connected external devi- ces		I/O devices connected to the digital I/O terminals of the robot.	0	0
EtherCAT slaves		EtherCAT slaves such as digital I/O, servos, and inverters.	0	0
Industrial Ethernet switch	W4S1-□□	This is used for branching the Ethernet network.		0
IPC Applica- tion Controller	AC1-152000	An industrial computer. The computer executes pre-installed softwares for the robot control system (Application Manager). It has a interface for con- necting a camera (PoE port).		0
Industrial camera	24114-□□□	A camera for sensing an image. The camera can connect to the IPC Application Controller to detect and inspect a workpiece.		0
Inverter	3G3MX2-A□□□-V1	An inverter to control a belt conveyor. Select an applicable model from the Multi-function Compact Inverter MX2-series V1 type.		0
EtherCAT Communica- tions Unit	3G3AX-MX2-ECT	A communications unit to be attached for Ether- CAT communications.		0

Hardware	Model	Description	Static	Dy- na- mic
Conveyor Belt		A belt conveyor of MISUMI Corporation for con-		0
	T100-IM-9-H-A	veying workpieces.		
Encoder kit	09742-001	An encoder mounted on the belt conveyor.		0
IP65				

\*1. Refer to the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for information on the recommended operating environment for the computer.

# 1-8 Software

This section describes an overview of each software in the system configuration.

Use the Sysmac Studio as a development environment for the robot integrated system and Application Manager as a runtime to control the application.

# 1-8-1 Sysmac Studio

The Sysmac Studio provides development environment for a robot integrated system on a computer.



#### **Precautions for Correct Use**

For a robot integrated system, use the 64-bit edition DVD (SYSMAC-SE200D-64) with the Sysmac Studio version 1.

The Sysmac Studio has the following functions.

Function	Description
Robot control	A function to make settings and create a program to control a robot with the Robot Integrat-
function	ed CPU Unit and IPC Application Controller. To use this function, you need a license for the
	Standard Edition (SYSMAC-SE2□□L).
3D simulation	A function to perform a 3D simulation including robots and peripheral devices. To use this
function	function, you need a license with the 3D Simulation Option (SYSMAC-SA4□□L-64).

Refer to the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for information on the robot control function in the Sysmac Studio 3D Simulation Function Operation Manual (Cat. No. W618) for information on the 3D simulation function.



#### **Additional Information**

Refer to A-3 Setting Items on the Sysmac Studio and the Setting Targets on page A-28 for information on which hardware setting corresponds to the items on the Multiview Explorer of the Sysmac Studio.

## 1-8-2 Application Manager

The Application Manager is one of the functions for ACE that is a software pre-installed in the IPC Application Controller.

The Application Manager has following functions.

Function	Description
Process Manag-	Determines which robot will use for a workpiece automatically, and performs the variance of
er	loads.
Recipe Manager	Manages the robot control parameters for the product type change of a workpiece.
Robot Vision Manager	Detects a workpiece position and inspect the appearance by sensing an image with a cam- era. To enable this function, you must mount the USB Dongle (20410-000 or 20433-000) on the IPC Application Controller.
Pack Manager	Executes packing applications that are created in the application sample. To enable this function, you must mount the USB Dongle (20409-000 or 20433-000) on the IPC Application Controller.

## Precautions for Correct Use

**N** 

The ACE has a function as a development environment of a robot system with the Smart Controller EX, but it cannot be used as a development environment of a robot integrated system. Use the Sysmac Studio to develop the robot integrated system.

1

# 1-9 User Program

The user program for robot control is created in the Sysmac Studio.

There is more than one method to create a user program. Realize applications to use with programs created by multiple methods.

# **1-9-1** Types of Method to Create User Program

Method	Description
Sequence	The user program that is operated in the Robot Integrated CPU Unit can be programmed with
control pro-	the language that is defined in IEC61131-3. The robots are controlled with robot control instruc-
gram	tions and system-defined variables for robot control.
	This program is suitable for operating simple robot motions or controlling with robots and periph-
	eral devices.
	Ladder diagram is used in this guide.
V+ program	The user program that is operated in the Robot Integrated CPU Unit can be programmed with V+
	language. The language is a programming language for robot control for the OMRON robots.
	The robots can be controlled using V+ keywords.
	In addition, you can use ACE Sight V+ keywords and V+ module API to call and use the func-
	tions of the Application Manager.
	This program is suitable for using various robot control.
C# program	The user program that is operated in the IPC Application Controller can be programmed with C#
	language. Use this program when the functions of the Application Manager are called and used.
Application	You can create an application sample on the interactive setup wizard. The application sample in-
sample	cludes the settings and programs for the IPC Application Controller and Robot Integrated CPU
	Unit.
	The Pack Manager sample is used in this guide.

The following table shows the types of method to create a user program.

# 1-9-2 Proper Use of Sequence Control Program and V+ Program

The following shows proper use of the sequence control program and V+ program.

- The sequence control program manages the status, errors, and interlocks of the entire system including sequence control and robot control.
- The robot control is performed with a combination of the sequence control program and the V+ program.
- The sequence control program performs the control other than robot control.

A typical example of differences for robot control that can be used in the sequence control program and the V+ program is given below.

The sequence control program can use a part of the control that is available in the V+ program.

Classification	Item	Applicability ( if applicable, the specified method is described.)		
		Sequence control program	V+ program	
Robot operations	Joint interpolation operation	RC_MoveDirect *1	MOVE	
	Linear interpolation operation	RC_MoveLinear *1	MOVES	
	Circular interpolation opera- tion	Not possible.	MOVEC	
	Jog operation	Not possible.	JOG	
	Joint coordinate system oper- ation	Not possible.	JMOVE	
	Tool coordinate system opera- tion	Not possible.	APPRO/DEPART/ ALIGN	
Robot's coordinate	Flange surface	_RC_RBT[*].TCPActPos *2	HERE	
	Coordinates of the tool center	_RC_RBT[*].TCPActPos *2	HERE	
	point	(RC_SetToolTransform <sup>*1</sup> )	(TOOL)	
	Joint coordinates for each ax- is	_RC_RBT[*].JointActPos *2	#PHERE	
Other functions	Robot built-in I/O	_RC_RBT_IO[*].XIO *2	SIGNAL/SIG	
	Expanded robot I/O	_RC_RBT_IO[*].IOBlox1 *2	SIGNAL/SIG	
		_RC_RBT_IO[*].IOBlox2 *2		
	Teaching	Not possible.	Position variables	
	End effector operation	_RC_RBT_IO[*].RO *2	SIGNAL/SIG	
	Robot position latching	Not possible.	LATCH	
	Local encoder latch	Not possible.	DEVICE	
	Cooperation with Application	Not possible.	ACE Sight V+ key-	
	Manager		word	
			V+ Module API	

\*1. This is a robot control instruction.

\*2. This is a system-defined variable for robot control.

Refer to the *NJ-series Robot Integrated CPU Unit User's Manual (Cat. No. 0037)* for detailed information when a robot is controlled with a sequence control program.

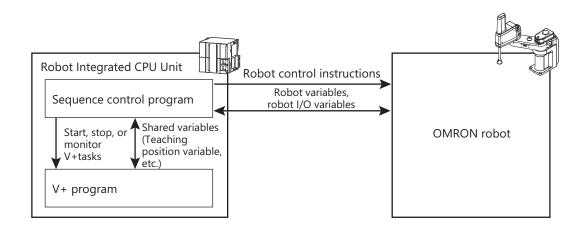
Refer to the eV+3 User's Manual (Cat. No. 1651) and eV+3 Keyword Reference Manual (Cat. No. 1652) for detailed information when a robot is controlled with a V+ program.

# 1-9-3 Command and Data Flow

This section describes the flow of commands and data for the sequence control program, V+ program, Application Manager, and robot.

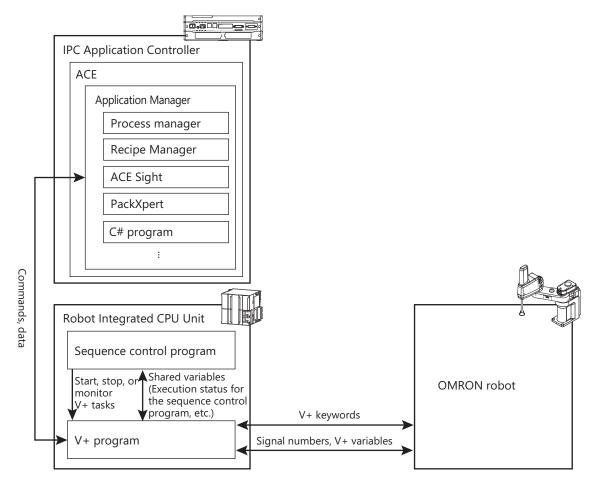
The sequence control program can control robots with robot control instructions, robot variables, and robot I/O variables.

Since the taught position data is stored in the position variable of the V+ program, to use it in the sequence control program, V+ programs need to be called from RC\_ExecVpPrgTask and the position data must be copied to the shared variables. 1



The V+ program can control robots with V+ keywords, signal numbers, and V+ variables. In addition, the V+ program can execute the functions of the Application Manager in the IPC Application Controller with ACE Sight V+ keywords and V+ module API.

The V+ program is launched and stopped by RC\_ExecVpPrgTask from the sequence control program.



Refer to the *NJ-series Robot Integrated CPU Unit User's Manual (Cat. No. 0037)* for details on the robot control function and shared variables in the sequence control program. Refer to the *eV+3 User's Manual (Cat. No. 1651)* and *eV+3 Keyword Reference Manual (Cat. No. 1652)* for details on the robot control function in the V+ program.

# 2

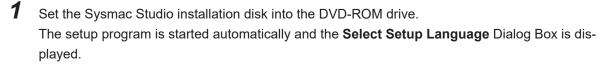
# **Before You Begin**

This section describes the installation procedure of the Sysmac Studio.

2-1	Installing the Sy	/smac Studio24	-2
<u> </u>	motaning the og	/ SINAC Studio	

# 2-1 Installing the Sysmac Studio

The Sysmac Studio Ver.1.  $\Box$  64-bit edition DVD (SYSMAC-SE200D-64) is the Support Software that you use for the Robot Integrated System. On it, you can set up the configurations and parameters, you can create programs, and you can debug and simulate operation.



2

Select the language to use, and then click the **OK** button. The Sysmac Studio Setup Wizard is started.

3

Follow the instructions given by the Setup Wizard to complete the installation.



### **Additional Information**

- Refer to the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for information on the system requirements for the computer to which you install the Sysmac Studio.
- Refer to the Sysmac Studio Version 1 Operation Manual (Cat. No. W504) if you are unable to install the Sysmac Studio with the above instructions.

# 3

# Implementation Example of Static Pick-and-place Equipment

This section describes the implementation example of the static pick-and-place equipment.

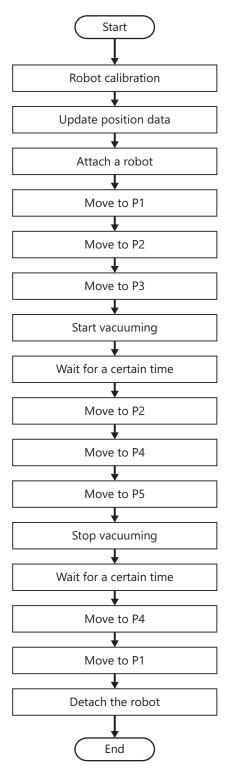
An equipment to move a workpiece that is not moved at the specified position to the target position is called a static pick-and-place equipment in this guide.

This example can realize with the sequence control program and V+ program.

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# 3-1 Program Specifications for Static Pick-and-place Equipment

The program specifications are described if operations of static pick-and-place equipment are controlled with the sequence control program and if the operations are controlled with the V+ program. A flow chart of a program is given below. Refer to *1-4-1 Operating Specifications* on page 1-6 for information on the positions of P1 to P5 in the flow chart.



There are two ways to program the static pick-and-place equipment; one is to control with a sequence control program, and the other is to control with a V+ program. Create the program in either way. For information on how to create a program, refer to *3-3 Programming and Simulation Procedures* on page 3-19.

# 3-1-1 When Operations are Controlled with Sequence Control Program

The program specifications when operations of static pick-and-place equipment are controlled with the sequence control program are described below.

Program name	Language	Description	
Main	Sequence control program (Ladder diagram)	Main program	
Run	Sequence control program (Ladder diagram)	Operating program	
Іоссору	V+ program	Variable copy program	

The program consists of the following programs.

# Shared Variables

The following table shows a list of shared variables that are used in this program.

No.	Variable name	Data type	Description
1	eLoc_Wait	ARRAY[05] OF	Use the variable to send the robot wait position from the V+ pro-
		LREAL	gram to the sequence control program.
2	eLoc_Place	ARRAY[05] OF	Use the variable to send the robot place position from the V+ pro-
		LREAL	gram to the sequence control program.
3	eLoc_Pick	ARRAY[05] OF	Use the variable to send the robot pick-up position from the V+ pro-
		LREAL	gram to the sequence control program.
4	eBool_Exe	BOOL	Use the variable to check that the execution of a V+ task is started
			in the sequence control program.

# Sequence Control Program

This section describes the sequence control program to control the static pick-and-place equipment. The sequence control program is used to register global variables and create two programs, "Main" (main program) and "Run" (operating program).

# Global Variables

Register the global variables that are used in the sequence control program.

Name	Data Type	Initial Value	AT	Retain	Constant	Network Publish	Comment
RC_Robot001	_sRC_RBT_REF		RC://_RC_RBT[		*	Do not publish 🛛 🔻	
RC_Robot001_IO	_sRC_RBT_IO_REF		RC://_RC_RBT_			Do not publish 🛛 🔻	
E001_Write_output_1st_word	WORD		ECAT://node#			Do not publish 🔻	
E001_Read_input_1st_word	WORD		ECAT://node#			Do not publish 🔻	
E001_Sysmac_Error_Status	BYTE		ECAT://node#			Do not publish 🔻	
E001_Out_Bit00	BOOL					Do not publish 🔻	4001
E001_Out_Bit01	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit02	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit03	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit04	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit05	BOOL		ECAT://node#			Do not publish 🔻	
001_Out_Bit06	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit07	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit08	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit09	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit10	BOOL		ECAT://node#			Do not publish 🔻	
001_Out_Bit11	BOOL		ECAT://node#			Do not publish 🔻	
001_Out_Bit12	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit13	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit14	BOOL		ECAT://node#			Do not publish 🔻	
E001_Out_Bit15	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit00	BOOL					Do not publish 🔻	
E001_In_Bit01	BOOL					Do not publish 🔻	
001_In_Bit02	BOOL					Do not publish 🔻	
001_In_Bit03	BOOL		ECAT://node#			Do not publish 🔻	
001_In_Bit04	BOOL		ECAT://node#			Do not publish 🔻	
001_In_Bit05	BOOL		ECAT://node#			Do not publish 💌	
E001_In_Bit06	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit07	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit08	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit09	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit10	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit11	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit12	BOOL		ECAT://node#			Do not publish 🔻	
E001_In_Bit13	BOOL		ECAT://node#			Do not publish 🔻	
001_In_Bit14	BOOL		ECAT://node#			Do not publish 🔻	
001_In_Bit15	BOOL		ECAT://node#			Do not publish 🔻	
E001_Observation	BOOL		ECAT://node#			Do not publish 🔻	
001_Minor_Fault	BOOL		ECAT://node#			Do not publish 🔻	
Bool_Exe	BOOL					Do not publish 🔻	Start V+ program
eLoc_Pick	ARRAY[05] OF LREAL					Do not publish v	Pickup position
eLoc_Place	ARRAY[05] OF LREAL					Do not publish 🔻	Place position
eLoc_Wait	ARRAY[05] OF LREAL					Do not publish 🔻	Wait position
gStart	BOOL		ECAT://node#			Do not publish 🔻	Auto-operation start button
Reset	BOOL		ECAT://node#			Do not publish 🔻	Auto-operation stop button
gAutoOn	BOOL					Do not publish 🔻	Auto-operation
AutoRun	BOOL					Do not publish 🔻	Start auto-operation
PosDataOK	BOOL					Do not publish v	Position data updated
gRC_Err	BOOL					Do not publish 🔻	Robot control error
SuctionOff	BOOL					Do not publish v	Suction OFF
gSuctionOn	BOOL					Do not publish 🔻	Suction ON
gSysOK	BOOL					Do not publish v	Operation ready
gTaskStatus	INT					Do not publish v	Task status
gCalib	BOOL		ECAT://node#			Do not publish v	Calibration start button

## • Main program (Main)

"Main" (main program) is used to monitor the status of the following robots and EtherCAT Digital I/O Terminals and determine whether the automatic operation can start. Refer to the manual for each device for details on variables.

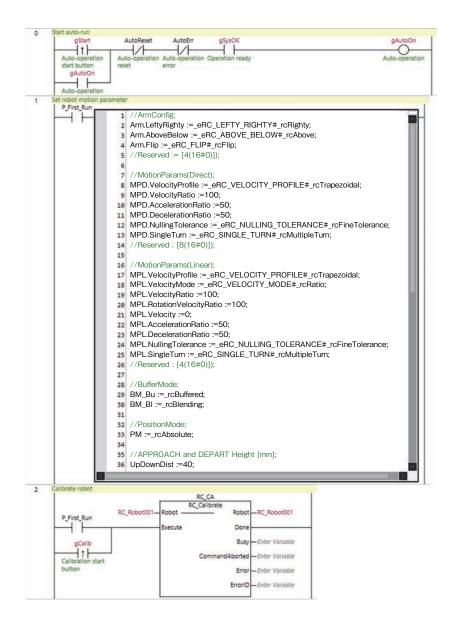
No.	Variable name	Description
1	_EC_PDSlavTbl[1]	Check that the communications of the EtherCAT Digital I/O Termi- nal are established.
2	_RC_RBT[0].DrvStatus.Run- Mode	Check that the communications between the Robot Integrated CPU Unit and the robot are established.
3	GetRCError	Check whether an error caused by the Robot Control Function Module exists.

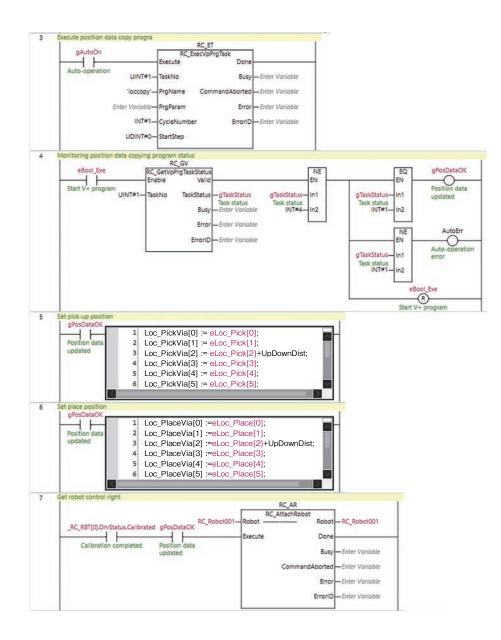
No.	Variable name Description				
4	_RC_RBT[0].DrvStatus.ESTOP	Check whether the robot is in ESTOP state.			
5	_RC_RBT[0].DrvStatus.Manual	Check that the operating mode of the robot is Manual mode.			
6	_RC_RBT[0].DrvStatus.Power- Enabled	Check that the robot high power is enabled.			

A program is described below.

	GetRCError EN	gRC_Err		
	Level - Enter Variable	Robot contr error	lo	
	Code - Enter Variable			
M	tonitoring system operation status _EC_PDSiavTbl[1] _RC_R8T[0].DrvStatus.RunMode gRC_Err _RC_R8T[0].DrvStatus.EST	OP _RC_RBT[0].DrvStatus.Manual _RC_f	RBT[0].DrvStatus.PowerEnabled	gSysOK
M		OP _RC_RBT[0].DrvStatus.Manual _RC_F	RBT[0].DrvStatus.PowerEnabled	gSysOK

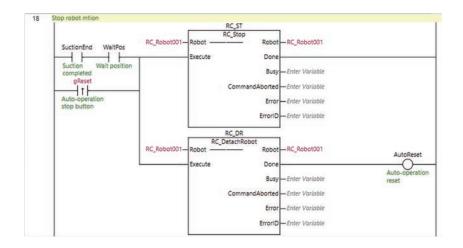
# • Operating program (Run)

"Run" (operating program) is used to operate a robot. A program is described below. 



8 Start robot motion gAutoOn _RC_RBT[0].Status.Ready AutoReset	gAutoRun
Auto-operation gAutoRun Start auto-	Start auto- operation
operation 9 Move to wait position	
RC_MD01	
gAutoRun RC_Robot001 Robot Rob	WaitPos
Start auto- operation RC_MD03.Active Walt position Busy—Enter Var	Wait position
Suction MPD-MotionParams CommandAborted Enter Var	WILL R
completed BM_BI—BufferMode Error—Enter Var	lable
PM—PositionMode ErrorID—Enter Var	
10 Move to pick-up approach position RC_MD02	
RC_MoveDirect	
WaitPos SuctionEnd RC_Robot001—Robot Robot_RC_Robot00	
Wait position Suction Execute Done	_
completed Loc_PickVia— Position Busy—Enter Variable	e
StableSuction Arm—ArmConfig Active—Enter Variable	e
Suction stable MPD—MotionParams CommandAborted — Enter Variable	
BM_Bu—BufferMode Error—Enter Variable	e
PM—PositionMode ErrorID—Enter Variable	e
11 Move to pick-up position RC_ML01	
RC_MoveLinear RC_Robot001—Robot — RC_MoveLinear RC_Robot001—Robot — RC_Robot0	01
gSuctionOn_RC_MD02.Active	PickPos
Suction ON Pick-up	Pick-up position
approach point eLoc_Pick— Position Busy — Enter Varian Pickup position	bie
MPL—MotionParams Active—Enter Varia	ble
BM_BI—BufferMode CommandAborted —Enter Varia	ble
PM—PositionMode Error—Enter Varia	ble
ErroriD — Enter Varia	ne
12 Suctioning on PickPos gSuctionOff AutoReset	gSuctionOn
Pick-up position Suction OFF Auto-operation	Suction ON
gSuctionOn reset	E001_Out_Bit00
	0
Suction ON	V+ digital IO 4001

13	Walt stable suction TON_Pick gSuctionOn TON_	StableSuction
	Suction ON T#0.5s PT ET -Enter Variable	Suction stable
14	Move to place aproach position	
	gSuctionOff Arm—ArmConfig Active—Enter Varia Suction OFF MPD—MotionParams CommandAborted—Enter Varia BM_BI—BufferMode Error —Enter Varia PM—PositionMode ErrorD—Enter Varia	able
15	Move to place position  RC_ML02  RC_MOULINEAR  StableSuction RC_MD03.Active  RC_Robot001  Robot  RC_MOveLinear  Robot  RC_MOveLinear  Robot  RC_Robot001  Robot  RC_MOveLinear  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  RC_Robot001  Robot  Robot  Robot  Robot  Robot  RC_Robot001  Robot  Ro	PiacePos Place position
6	Monitoring suction off PlacePos AutoReset Place position gSuctionOff Auto-operation reset Suction OFF	gSuctionOff Suction OFF
7	Monitoring suction end gSuctionOff TON	SuctionEnd
	Suction OFF T#0.25- PT ET Enter Variable	Suction



# V+ Program

The V+ program that is required for controlling operations of the static pick-and-place equipment in the sequence control program is described below.

The V+ program is used to register global variables and create two programs, "loccopy" (variable copy program) and "auto" (read program).

# Global Variables

Register the global variables that are used in the V+ program.

Name	Type	Value	Robot	Display Mod Category	Description
gl.pick	Location	408.400 0.000 263.000 0.000 180.000 -150.000	R1Cobra600	Do not disp	
gl.place	Location	-274.918 498.787 261.936 0.000 180.000 -179.927	R1Cobra600	Do not disp	
gl.wait	Location	400.000 0.000 330.000 0.000 180.000 -150.000	R1Cobra600	Do not disp	

## • Variable Copy Program (loccopy)

"loccopy" (variable copy program) is used to copy the global variables in the V+ program to the shared variables with the sequence control program.

A program is described below.

```
.PROGRAM loccopy()

GLOBAL gl.pick, gl.place, gl.wait

EXTERNAL eloc_pick[]

EXTERNAL eloc_wait[]

EXTERNAL eloc_wait[]

EXTERNAL ebool_exe

; Copy location data to external variables

DECOMPOSE eloc_pick[] = gl.pick

DECOMPOSE eloc_place[] = gl.place

DECOMPOSE eloc_wait[] = gl.wait

ebool_exe = TRUE
```

```
.END
```

#### Read Program

"auto" (read program) is used to read the V+ program and global variables from the SD Memory Card to main memory.

Refer to 3-3-8 Setting up Automatic Loading of V+ Programs and Variables at Power ON on page 3-77 for information on "auto" (read program).

## 3-1-2 When Operations are Controlled with V+ Program

The program specifications when operations of static pick-and-place equipment are controlled with the V+ program are described below.

Program name	Language	Description
Main	Sequence control program (Ladder diagram)	Main program
run	V+ program	Robot commands send program
supervisor	V+ program	Status monitoring program

The program consists of the following programs.

#### Precautions for Correct Use

The V+ program continues to run even if the Robot Integrated CPU Unit goes into PROGRAM mode. The supervisor detects the Controller's PROGRAM mode and stops the robot motion and V+ programs.

# Shared Variables

Variable name Description No. Data type eBool ExeT1 Use the variable to check that the execution of V+ task 1 is started in the BOOL 1 sequence control program. 2 eBool\_ExeT2 BOOL Use the variable to check that the execution of V+ task 2 is started in the sequence control program. 3 eBool Mode BOOL Use the variable to check the operating mode in the Robot Integrated CPU Unit in the V+ program. 4 eBool Reset BOOL Use the variable to check that the reset button is pressed during automatic operation in the V+ program.

The following table shows a list of shared variables that are used in the sequence control program.

# Sequence Control Program

This section describes the sequence control program required for controlling the operation of the static pick-and-place equipment with the V+ program.

The sequence control program is used to register global variables and create "Main", a main program that monitors the status of peripheral devices and determines whether the automatic operation can start.

# Global Variables

NJ-series Robot Integrated System Startup Guide (0049)

Register the global variables that are used in the sequence control program.

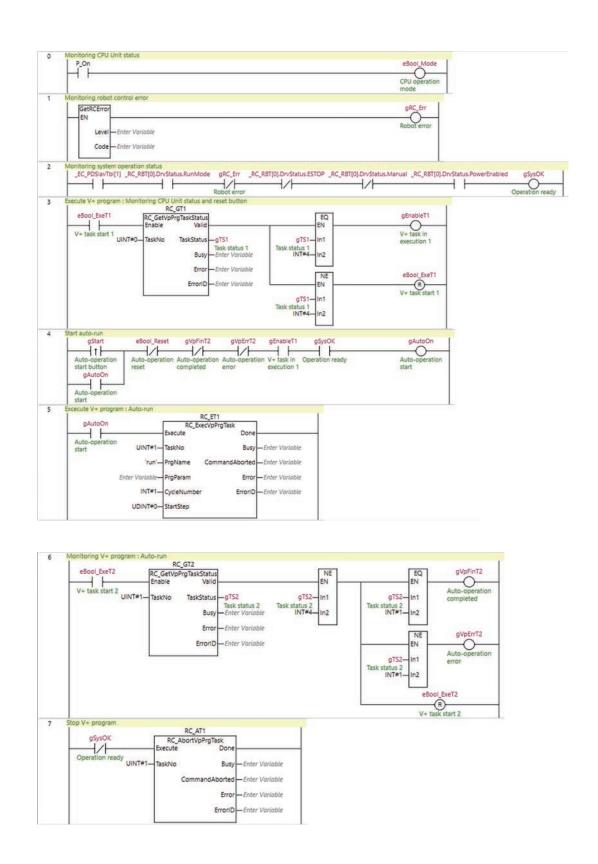
Name	🔺 🛛 Data Type	Initial Value	AT	Retain	Constant	Network Publish	Comment
E001_In_Bit00	BOOL					Do not publish 🔻	
E001_In_Bit01	BOOL		ECAT://node#1/Read input 1st word/In Bit01			Do not publish v	1
E001_In_Bit02	BOOL		ECAT://node#1/Read input 1st word/In Bit02			Do not publish v	
E001_In_Bit03	BOOL		ECAT://node#1/Read input 1st word/In Bit03			Do not publish 🔻	
001_In_Bit04	BOOL		ECAT://node#1/Read input 1st word/In Bit04			Do not publish 🔻	
E001_In_Bit05	BOOL		ECAT://node#1/Read input 1st word/In Bit05			Do not publish 🔻	
001_In_Bit06	BOOL		ECAT://node#1/Read input 1st word/In Bit06			Do not publish 🔻	
001_In_Bit07	BOOL		ECAT://node#1/Read input 1st word/In Bit07			Do not publish 🔻	8
001_In_Bit08	BOOL		ECAT://node#1/Read input 1st word/In Bit08			Do not publish 🔻	8
001_In_Bit09	BOOL		ECAT://node#1/Read input 1st word/In Bit09			Do not publish *	5
001_In_Bit10	BOOL		ECAT://node#1/Read input 1st word/In Bit10			Do not publish *	8
001_In_Bit11	BOOL		ECAT://node#1/Read input 1st word/In Bit11	Ē		Do not publish 🔻	
001_In_Bit12	BOOL	-	ECAT://node#1/Read input 1st word/In Bit12			Do not publish 🔻	
001 In Bit13	BOOL		ECAT://node#1/Read input 1st word/In Bit13			Do not publish *	
001 In Bit14	BOOL	-	ECAT://node#1/Read input 1st word/In Bit14			Do not publish	× 1.
001_In_Bit15	BOOL		ECAT://node#1/Read input 1st word/In Bit15			Do not publish V	
001_Minor_Fault	BOOL		ECAT://node#1/Sysmac Error Status/Minor Fault			Do not publish	
001_Observation	BOOL	-	ECAT://node#1/Sysmac Error Status/Winter Patie ECAT://node#1/Sysmac Error Status/Observation			Do not publish *	-
001_Out_Bit00	BOOL		ECAL//HODE#1/Sysmac Error Status/Observation			Do not publish T	
001_Out_Bit01	BOOL		ECAT://node#1/Write output 1st word/Out Bit01			Do not publish *	2 B
	BOOL				Count .		
001_Out_Bit02	BOOL		ECAT://node#1/Write output 1st word/Out Bit02				
001_Out_Bit03			ECAT://node#1/Write output 1st word/Out Bit03			Do not publish T	S ().
001_Out_Bit04	BOOL	-	ECAT://node#1/Write output 1st word/Out Bit04			Do not publish v	- V
001_Out_Bit05	BOOL		ECAT://node#1/Write output 1st word/Out Bit05			Do not publish 🔻	- I.
001_Out_Bit06	BOOL		ECAT://node#1/Write output 1st word/Out Bit06			Do not publish 🔻	
001_Out_Bit07	BOOL		ECAT://node#1/Write output 1st word/Out Bit07			Do not publish 🔻	<u>6 8.</u>
001_Out_Bit08	BOOL		ECAT://node#1/Write output 1st word/Out Bit08			Do not publish 🔻	2
001_Out_Bit09	BOOL		ECAT://node#1/Write output 1st word/Out Bit09			Do not publish 🔻	
001_Out_Bit10	BOOL		ECAT://node#1/Write output 1st word/Out Bit10			Do not publish 🔻	
001_Out_Bit11	BOOL		ECAT://node#1/Write output 1st word/Out Bit11			Do not publish 🔻	
001_Out_Bit12	BOOL		ECAT://node#1/Write output 1st word/Out Bit12			Do not publish v	- C
001_Out_Bit13	BOOL		ECAT://node#1/Write output 1st word/Out Bit13			Do not publish 🔻	- V
001_Out_Bit14	BOOL		ECAT://node#1/Write output 1st word/Out Bit14			Do not publish v	
001_Out_Bit15	BOOL		ECAT://node#1/Write output 1st word/Out Bit15			Do not publish 🔻	2
001_Read_input_1st_word	WORD		ECAT://node#1/Read input 1st word			Do not publish 🔻	
001_Sysmac_Error_Status	BYTE		ECAT://node#1/Sysmac Error Status			Do not publish v	
001_Write_output_1st_word	WORD		ECAT://node#1/Write output 1st word			Do not publish 🔻	
Bool_ExeT1	BOOL					Do not publish 🔻	V+ task start 1
Bool_ExeT2	BOOL					Do not publish v	V+ task start 2
Bool_Mode	BOOL					Do not publish 🔻	CPU operation mode
Bool_Reset	BOOL					Do not publish 🔻	Auto-operation reset
AutoOn	BOOL					Do not publish 🔻	Auto-operation start
EnableT1	BOOL	- C				Do not publish 🔻	V+ task in execution 1
RC_Err	BOOL					Do not publish 🔻	Robot error
Start	BOOL		ECAT://node#1/Read input 1st word/In Bit00			Do not publish v	Auto-operation start butto
SysOK	BOOL					Do not publish 🔻	Operation ready
TS1	INT					Do not publish 🔻	
ITS2	INT					Do not publish 🔻	
VpErrT2	BOOL					Do not publish v	<ul> <li>North Accession 75.</li> </ul>
VpFinT2	BOOL					Do not publish *	
C_Robot001	_sRC_RBT_REF		RC://_RC_RBT[0]		~	Do not publish	
IC_Robot001_IO	_sRC_RBT_IO_REF	-	RC://_RC_RBT_IO[0]	1	1000	Do not publish	

## Main Program

"Main" (main program) is used to monitor the following status of the robot and EtherCAT Digital I/O Terminal and determine whether the automatic operation can start. Refer to the manuals of each device for details on the variables.

No.	Variable name	Description
1	_EC_PDSlavTbl[1]	Check that the communications of the EtherCAT Digital I/O Termi- nal are established.
2	_RC_RBT[0].DrvStatus.Run- Mode	Check that the communications between the Robot Integrated CPU Unit and the robot are established.
3	GetRCError	Check whether an error caused by the Robot Control Function Module exists.
4	_RC_RBT[0].DrvStatus.ESTOP	Check whether the robot is in ESTOP state.
5	_RC_RBT[0].DrvStatus.Manual	Check that the operating mode of the robot is Manual mode.
6	_RC_RBT[0].DrvStatus.Power- Enabled	Check that the robot high power is enabled.

A program is described below.



# V+ Program

This section describes the V+ program to control the static pick-and-place equipment. The V+ program is used to register global variables and create three programs, "run" (robot commands send program), "run.checkmode" (V+ program stop program), and "auto" (read program). 3-1 Program Specifications for Static Pick-and-place Equipment

3

3-1-2 When Operations are Controlled with V+ Program

#### Global Variables

Register the global variables that are used in the V+ program.

Name	Туре	Value	Robot	Display Mod Ca	ategory	Description
gl.pick	Location	408.400 0.000 263.000 0.000 180.000 -150.000	R1Cobra600	Do not disp		
gl.place	Location	-274.918 498.787 261.936 0.000 180.000 -179.927	R1Cobra600	Do not disp		
gl.wait	Location	400.000 0.000 330.000 0.000 180.000 -150.000	R1Cobra600	Do not disp		

### Robot Commands Send Program

"run" (robot commands send program) is used to send robot commands to execute the static pickand-place operations.

A program is described below.

```
.PROGRAM run()
; ABSTRACT: Pick and place program
        AUTO ar.speed, ar.accel, ar.wait_on, ar.wait_off, ar.dist, ar.loc[5], al.
safe
        EXTERNAL ebool exet2
        ebool exet2 = TRUE
; Set parameter
        ar.speed = 100 ; Speed ratio per full speed [%]
        ar.accel = 50 ; Accel ratio per full speed [%]
        ar.wait on = 0.5 ; Wait time for air-on [sec]
        ar.wait off = 0.2 ; Wait time for air-off [sec]
        ar.dist = 40 ; Approach and deppart distance [mm]
; Calculate and set temporary destination
        DECOMPOSE ar.loc[] = HERE
        SET al.safe = TRANS(ar.loc[0],ar.loc[1],DZ(gl.wait),ar.loc[3],ar.loc[4],a
r.loc[5])
; Prepare robot motion ready
        CALIBRATE
        ATTACH ()
        SPEED ar.speed, ar.speed ALWAYS
        ACCEL ar.accel, ar.accel
; Approach/Move to wait position
        MOVES al.safe
        MOVE gl.wait
        BREAK
; Approach/Move to pick position
        APPRO gl.pick, ar.dist
        MOVES gl.pick
        BREAK
;Suctioning on and waiting
        SIGNAL 4001
        WAIT.EVENT ar.wait on
;Depart/Approach/MOVE to palce position
        DEPART ar.dist
        APPRO gl.place, ar.dist
```

```
MOVES gl.place
        BREAK
; Suctioning off and waiting
        SIGNAL -4001
        WAIT.EVENT ar.wait off
; Depart/Move to wait position
        DEPART ar.dist
        MOVE gl.wait
        BREAK
; Release robot control
        DETACH ()
.END
```

## Status Monitoring Program (supervisor)

The "supervisor" (V+ program stop program) detects the Robot Integrated CPU Unit going into PROGRAM mode and stops the robot motion and V+ programs by using the shared variables for the sequence control program and V+ programs.

A program is described below.

```
.PROGRAM supervisor()
; ABSTRACT: Stop pic and place program
        EXTERNAL ebool mode
        EXTERNAL ebool_exet1, ebool_reset
        ebool exet1 = TRUE
       WHILE TRUE DO
; Check NJ mode and reset-button
            IF (ebool mode == FALSE) OR (ebool reset == TRUE) THEN
; Abort current robot motion
                BRAKE
; Terminate "run" program task
                ABORT 1
; Wait until "run" program task has stopped
                CYCLE.END 1
; Clear a program execution stack
                KILL 1
            END
            IF (ebool mode == TRUE) THEN
                ebool exet1 = TRUE
            END
; Wait next robot control period
            WAIT
        END
.END
```

## Read Program

"auto" (read program) is used to read the V+ program and global variables from the SD Memory Card to main memory.

Refer to 3-3-8 Setting up Automatic Loading of V+ Programs and Variables at Power ON on page 3-77 for information on "auto" (read program).

# **3-2 Basic Startup Procedures**

This section gives an overview of the basic startup procedures to build a static pick-and-place system. First, program a machine operation, configure and check the settings using the simulator, and then run the system for fine-tuning the operation.

No.	Proc	cedure	Description	Reference
1	Programming and Sim- ulation Procedures	Creating a project	Create a project file in the Sysmac Studio.	page 3-19
2		Creating the network configuration	Create the EtherCAT Network Configu- ration and add a robot on the network.	page 3-20
3		Writing the programs	Create a sequence control program and V+ programs.	page 3-22 page 3-28
4		Placing 3D shape data	Place 3D shape data and make the operating range of the robot visible on the 3D Visualizer.	page 3-35
5		Starting simulation	Activate the simulation function and start to simulate the robot motion.	page 3-65
6		Teaching (Simulation)	Use the simulation function of the Sys- mac Studio for teaching the positions.	page 3-66
7		Running the program (Simulation)	Run the sequence control program on the simulator of the Sysmac Studio.	page 3-81
8	Installing and Wiring the System	Wiring the Robot Inte- grated CPU Unit and the EtherCAT Digital I/O Ter- minal	Wire the Robot Integrated CPU Unit and the EtherCAT Digital I/O Terminal.	page 3-86
9		Setting the node address of the EtherCAT Digital I/O Terminal	Set the EtherCAT node address of the EtherCAT Digital I/O Terminal.	page 3-87
10	-	Wiring the EtherCAT Dig- ital I/O Terminal and the robot	Wire the EtherCAT Digital I/O Terminal and the robot.	page 3-87
11	-	Setting the EtherCAT node address of the ro- bot	Set the EtherCAT node address of the robot.	page 3-88
12		Wiring the Robot Inte- grated CPU Unit and the computer	Wire the Robot Integrated CPU Unit and the computer.	page 3-88
13		Wiring the robot, T20 pendant and the front panel	Wire the robot and the T20 pendant, as well as the robot and the front pan- el.	page 3-89
14		Wiring the EtherCAT Dig- ital I/O Terminal and the solenoid valve	Wire the EtherCAT Digital I/O Terminal and the solenoid valve.	page 3-90

No.	Procedure		Description	Reference
15	Setup Procedure for	Going online	Place the Sysmac Studio online with	page
	Actual System		the Robot Integrated CPU Unit.	3-92
16		Transferring settings and	Download the programs and settings	page
		programs	in the Sysmac Studio project file to the	3-94
			Robot Integrated CPU Unit.	
17		Teaching (On the actual	Operate the robot to check and correct	page
		equipment)	the teaching data.	3-96
18		Running the programs	Let the robot operate automatically ac-	page
		(On actual equipment)	cording to the programs.	3-110

# 3-3 Programming and Simulation Procedures

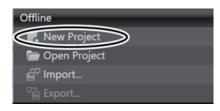
This section describes the procedure for creating project files, programing, and setting and checking operation in simulation.

The simulation function allows you to check the equipment operation in advance without purchasing actual equipment.

# 3-3-1 Creating a Project File

Create a project in the Sysmac Studio.

1 Start the Sysmac Studio and click **New Project** in the Start page.



The Project Properties dialog box is displayed.

2 In the **Project Properties** dialog box, enter the **Project name**, **Author**, and **Comment**, and select the **Category**, **Device**, and **Version** as shown in the figure below.

Select Device				
Category	Controller		•	
Device	NJ501	▼ - R300	•	
Version	1.43		•	

**3** Select the **Open in Emulation Mode** check box, and click the **Create** button.



New Project - new Controller O - Sysmac Studio (64bit)
File Edit View Insert Project Controller Simulation Tools Window Help
Multiview Explorer
Multiview Explorer
Forgramming
Frogramming
Frogramming
Frogramming
Frogramming
Configurations and Setup
Frogramming
Frogramming
Configurations and Setup
Frogramming
Configurations
Configurations
Configurations
Configurations
Configurations
Configurations
Frogramming
Configurations
Configurations
Frogramming
Configurations
Configurations
Configurations
Frogramming
Configurations
Configurations
Conversion
Bit String Processing
Conversion
Ended
Ended
Ended
Ended

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

## **3-3-2** Creating the EtherCAT Network Configuration

Create the EtherCAT network configuration and add a robot on the network.

1 Click **Configurations and Setup** in the Multiview Explorer.



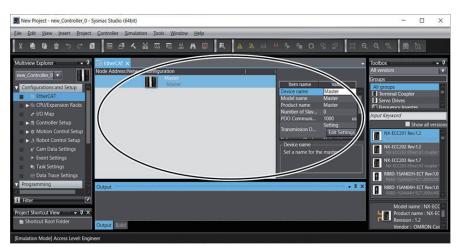
Setting items are displayed under Configurations and Setup in the tree.



2 Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or rightclick EtherCAT under Configurations and Setup and select Edit from the menu.



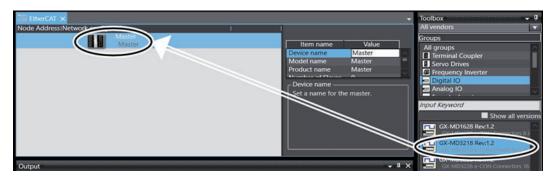
The EtherCAT Master is displayed in the EtherCAT tab page.



**3** From the **Toolbox**, select the group of **Digital I/O**.



4 Click and drag the digital I/O to use and drop it on the EtherCAT Master in the EtherCAT tab page. In this example, select **GX-MD3218**.



A **GX-MD3218** is registered under the EtherCAT Master.

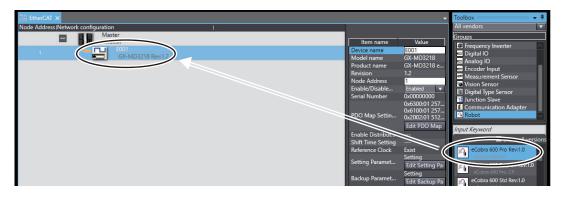
EtherCAT 🗙	
Node Address Network	configuration
	Master Master
	6001 GX-MD3218 Rev:1.2

**5** From the **Toolbox**, select the group of **Robot**.



6

Select and drag the robot to use and drop it on the **GX-MD3218** in the EthercAT tab page. Here, select **eCobra 600 Pro**.



An eCobra 600 Pro is added under the GX-MD3218.



### 3-3-3 Creating a Sequence Control Program

This section provides the procedure for creating a sequence control program. For details on the program to create, refer to *3-1 Program Specifications for Static Pick-and-place Equipment* on page 3-2.

## **Creating Device Variables**

Create device variables to control solenoid valves.

You need to create device variables to use sequence control programs for controlling static pick-andplace operation.

This setting is not required if you use V+ programs for controlling the operation.

**1** Double-click **I/O Map** under **Configurations and Setup** in the Multiview Explorer.



The **I/O Map** tab page is displayed.

🥔 I/O Map 🕽	🕂 I/O Map 🗙								
Position	Port	Description	R/W	Data Type					
	🔻 💐 EtherCAT Network Configuration								
Node1	GX-MD3218								
Node2	eCobra 600 Pro								
	🔻 👰 CPU/Expansion Racks								
CPU Rack	CPU Rack 0								

**2** Tap the  $\square$  icon to the left of **GX-MD3218**.

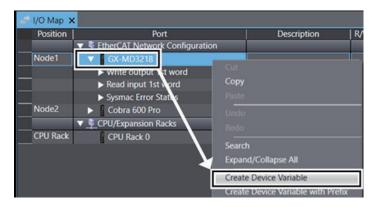
🥔 I/O Map 🕻	(
Position	Port
	🔻 💐 EtherCAT Network Configuration
Node1	GX-MD3218
Node2	eCobra 600 Pro

The I/O ports of the GX-MD3218 are displayed.

Position	Port
	V StherCAT Network Configuration
lode1	🐺 📕 GX-MD3218
	Write output 1st word
	Read input 1st word
	Sysmac Error Status

3

Right-click on the **GX-MD3218** and select **Create Device Variable** from the menu.



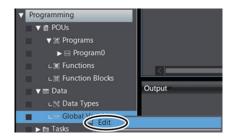
Device variables are automatically registered for the I/O ports of the GX-MD3218.

Position	Port	Description	R/W	Data Type	Variable
	V SettlerCAT Network Configuration				
Node1	GX-MD3218				
	Write output 1st word	Digital output v	w	WORD	E001_Write_output_1st_word
	Read input 1st word	Digital input va	R	WORD	E001_Read_input_1st_word
	Sysmac Error Status	Sysmac error st	R	BYTE	E001 Sysmac Error Status

# **Defining Global Variables**

Define global variables used as the position data in the sequence control program.

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



The global variable table is displayed.

e Edit View Insert Project	Controller Simulation Tools	Window Help				_			
			🔺 🔌 63	\$ 5 m	o 93	2	] <b>Q, Q,</b> "Q	n 10	
ultiview Explorer 🗸 🗸	📌 I/O Map 👘 Global Variable	(X	_					Toolbox	 •
ew_Controller_0 🔻	Group Filt (No group)	-						<search></search>	<b>•</b> 9
v m Data ∧ L≋ Data Types L⊯ Global Variables In Tasks	Name RC_Robot001 RC_Robot001_IO EU07Coutput_1st_word	Data Type _sRC_RBT_REF _sRC_RBT_IO_REF WORD	Initial Value	AT RC://_RC_RBT[0 RC://_RC_RBT_I ECAT://node#1	Retain	Constant	Network Publish Do not publish Do not publish Do not publish Do not publish		
Filter ₹	Build	l Program	l Locati	on I			• 1 ×		

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

Gro	oup Filter 🍸 (No group)	<b>V</b>		
	Name	Data Type	Initial Value	AT
	RC_Robot001	_sRC_RBT_REF		RC://_RC_RBT[0
	RC_Robot001_IC E001_Write_ou	New DC DDT IO DEC		Insert
	E001_Read_inp E001_Sysmac_l			Ctrl+X Ctrl+C

**3** Enter or select setting for each item, and then press the **Enter** key.

Global Variables ×								
Gro	oup Filter 🝸 (No group)	-						
	Name	Data Type	Initial Value	AT	Retain	Constant	Network Publish	
	RC_Robot001	_sRC_RBT_REF		RC://_R		<b>X</b>	Do not publish 🔻	
	RC_Robot001_IO	SRC RRT IO REE		RC·II R			Do not publish 🔻	
	eLoc Pick	ARRAY[05] OF LREAL					Do not publish 🔻	PICK

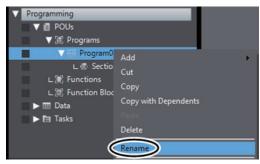
For information on global variables to register, refer to *Sequence Control Program* on page 3-3 if the system is controlled by the sequence control program or *Sequence Control Program* on page 3-11 when it is controlled by the V+ program.

The global variable is registered.

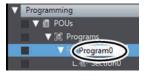
# Creating Ladder Diagram Programs

This section describes how to create the ladder diagram programs.

**1** Right-click **Program0** under **Programming - POUs - Programs** in the Multiview Explorer and select **Rename** from the menu.



This allows you to edit the name of the sequence control program.



2

Enter the name of the sequence control program. The name of the sequence control program is changed.



**3** Double-click the section to edit.



The variable table and Ladder Editor are displayed in the Edit Pane.

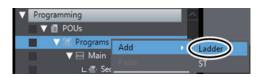
New Project - new_Controller_0 - Sysmac Studio (64bit)	1. <u>_</u> 1	
<u>Eile Edit View Insert Project Controller Simulation Tools Window H</u> elp		
Х ● № ● う ぐ 図 回 ♂ く 站 區 局 魚 A 回 一枚 🔺 & 🖗 🦫 👘 〇 임 :	ୁ ଅ <b>ଜ୍ଜ୍</b>	00 DD
Multiview Explorer	· ·	Toolbox 👻 🖡
new_Controller_0 Variable	A	<search></search>
Programming		Analog Cor
	N	BCD Conve
● V 🖟 Programs 🖉		Bit String P
		Communic
Leg runcions		Compariso
L 🕱 Function Blocks		Conversion
Build Build Return Region Strategy (NUMARINITY)	- # ×	• ~ ·
Project Shortcut View		
M Shortcut Root Folder		
Output Build		

4 Enter the program in the Ladder Editor. Internal and external variables are automatically registered when they are entered in the program.

For information on the programs, refer to *Sequence Control Program* on page 3-3 if the system is controlled by the sequence control program or *Sequence Control Program* on page 3-11 when it is controlled by the V+ program.

To create more than one sequence control program, perform the following steps.

**5** Right-click **Programs** under **Programming** - **POUs** in the Multiview Explorer, and then select **Add** - **Ladder** from the menu.



Program0 is added under Programs.





Click the icon displayed to the left of **Program0** under **Programming - POUs - Programs** in the Multiview Explorer.



Section0 is added under Program0.



**7** Returns to step 1 and repeat the above steps.

# Assigning Programs to Tasks

In this section, assign the ladder diagram programs to tasks of the Robot Integrated CPU Unit. In this guide, multiple ladder diagram programs are used to control the static pick-and-place equipment, so it is necessary to assign the programs to tasks.

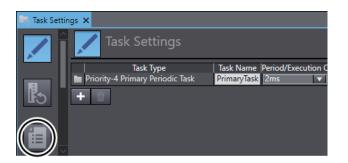
When the equipment is controlled by the V+ Program, only one ladder diagram program is used and you do not need to perform the steps in this section.

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

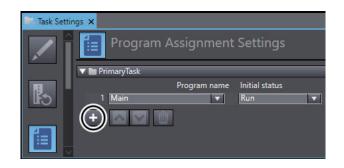


The Task Settings tab page is displayed.

2 Click the **Program Assignment Settings** button (**III**) in the Edit Pane.



**3** Click the **+** button.



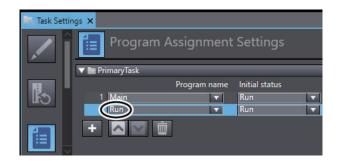
A new row is added for the program to assign.

Task Setting	gs ×			
	Program /	Assignment	Settings	
	🔻 🖿 PrimaryTask			
19		Program name	Initial status	
LES .	Main		Run	<b>•</b>
		<b>T</b>	Run	<b>T</b>

**4** Select a name of the program to use from the list of the **Program name**.

🖏 Task Settin	ngs X			
<b>Z</b> Î	Program A	Assignment	Settings	
	🔻 🖿 PrimaryTask	_		
18		Program name	Initial status	
ES .	1 Main	<b></b>	Run	
			Run	
	Run	,,		

The name of the selected program is displayed.



## 3-3-4 Creating V+ Programs

This section provides the procedure for creating the V+ programs.

For details on the program to create, refer to 3-1 Program Specifications for Static Pick-and-place Equipment on page 3-2.

# Setting V+Digital I/O

To control EtherCAT Slaves by V+ programs, you must assign V+ digital I/Os. This setting is required to control the operation of the static pick-and- place equipment with the V+ program. If you use sequence control programs for controlling the operation, this setting is unnecessary.

1 In the Multiview Explorer, select **new\_Controller\_0** from the device list.



2 Click the icon to the left of **Robot Control Setup** in the Multiview Explorer.



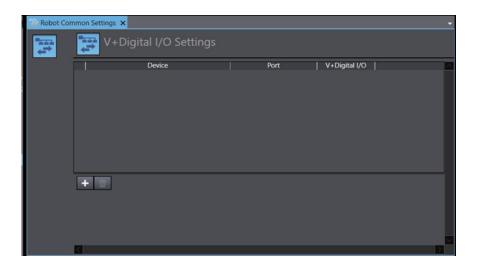
The setting items are displayed in the tree view as shown below.



## **3** Double-click **Robot Common Settings**.



The Robot Common Settings tab page is displayed.



4 Click the + button in the **Robot Common Settings** tab page.



A row for registering a new V+ digital I/O is added.

📡 Robot Co	ommon Setti	ngs 🗙				
t H	1 H	V+Digital I,	/O Settir	igs		
		Device	1	Port	1	V+Digital I/O
	<not< th=""><th>assigned&gt;</th><th>▼ <not< th=""><th>assigned&gt;</th><th></th><th></th></not<></th></not<>	assigned>	▼ <not< th=""><th>assigned&gt;</th><th></th><th></th></not<>	assigned>		



Click the drop-down list for **Device** in the newly added row, and then select **Node:1 GX-MD3218(E001)**.



**6** Click the drop-down list for **Port** in the same row, and select **Out Bit00**.

Device	Port	
Node : 1 GX-MD3218(E00 🔻	Not assigned>	-
	In Bit13	~
	In Bit14	
	In Bit15	
	Minor Fault	
	Observation	
	Out Bit00	-
	COLDIG1	
	Out bito i	

7 Enter 4001 for V+Digital I/O.

Device	Port	V+Digital I/O
Node : 1 GX-MD3218(E001 🔻	Out Bit00 🔻	4001

# **Defining Global Variables**

Define the global variables for use in the V+ program.

Here, the procedure to create a variable *gl.wait* is given below as an example, which is a global variable used in the V+ program in *3-1-1 When Operations are Controlled with Sequence Control Program* on page 3-3.

1 In the Multiview Explorer, select **RobotControlSettings** from the device list.

B	ohotC	ontrol	Settin	as 🔻	
			Jetun	95 ·	
	Contro			_	
F	obotC	ontrol	Settin	gs	

2 Dout

Double-click Variables under Programming in the Multiview Explorer.



A tab page to edit variables is displayed in the Edit Pane so that you can register variables.

Several Variables ×				-
<b>•</b>	Name	Туре	Initial Value	Robot
Types Real String Location Precision Point				
Categories				

**3** Click the **+** button.



The Add New Variable table is displayed.

Add a new va	ariable							×
Variable Name: Variable Type:	Real	_		_	-	-	_	
Description:								
Category			_					•
Value:	0.000							\$
Array:	Index Count:	1						
	Starting Index:	)	-	0	÷	0		÷
	Ending Index	)	\$	0	¢	0		÷
				Accep	it i		Cancel	

### **4** Input a variable name.

Add a new va	ariable							×
Variable Name:	gl.wait							
Variable Type:	Real							M
Description:								
Category								
Value:	0.000							\$
Array:	Index Count:	1 -						
				2				
	Starting Index:	0	÷	0	÷	0		*
	Ending Index:	0	\$	0	÷	0		÷
				Acce	pt		Cancel	

For information on global variables to register, refer to V+ *Program* on page 3-9 if the system is controlled by the sequence control program or V+ *Program* on page 3-13 when it is controlled by the V+ program.

**5** Select **Locations** from the list of variable types.

Add a new v	ariable							×
Variable Name:	gl.wait							
Variable Type:	Real							•
Description:	Real							
Category	String	_	_	_	_	_	_	-
Value:	Location N		_					
Array:	Index Count	: 1		_	_	_	_	
		1			2			
	Starting Index:	0	¢	0	÷	0		÷
	Ending Index:	0	¢	0	÷	0		\$
				Ac	cept		Cancel	

6 Select R1Cobra600 from the list for the robot.

📓 Add a new va	ariable 🔓			×
Variable Name:	gl.wait			
Variable Type:	Location			<b></b>
Description:				
Category				•
Value:	000000			÷ •
Robot:	R1Cobra600 [RobotC	ontrolSettings	;]	<b>•</b>
	Here			
Display Mode:	Do not display			<b></b>
Array:	Index Count: 1			
	Starting Index: 0	4 *	0 ‡	0 ‡
	Ending Index: 0	\$	0 🌲	0 ‡
			Accept	Cancel

### 7 Click the Accept button.

Add a new v	ariable			×
Variable Name:	gl.wait			
Variable Type:	Location			<b>•</b>
Description:				
Category				•
Value:	000000			÷ •
Robot:	R1Cobra600 [RobotControls	Setting:	5]	<b>•</b>
	Here			
Display Mode:	Do not display			<b>•</b>
Array:	Index Count: 1			
	Starting Index: 0	÷	0 🗘	0 ‡
	Ending Index: 0	\$	0 ‡	0 ‡
			Accept	Cancel

The variable **gl.wait** is added to the table.

🛢 Variables 🗙						
		-	i voite	Robot	Bisplay Mode	
+	gl.wait	Location	584.953 0.100 379.410 0.000 180.000 180.000		Do not display	

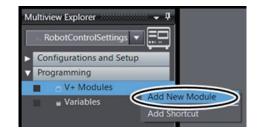
## **Creating V+ Programs**

This section describes the procedure to create V+ programs.

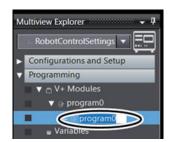
1 In the Multiview Explorer, select **RobotControlSettings** from the device list.

Robot	ControlSe	ttings 🔻	
new Contr	oller 0.		
Robot	ControlSe	ttings	>

2 Right-click V+ Modules under Programming in the Multiview Explorer, and select Add New Module from the menu.



In the tree of the Multiview Explorer, **program0 - program0** are added under **V+ Modules**, which allows you to edit the name of the V+ program.



**3** Enter the name of the V+ program. The name of the V+ program is changed.



**4** Double-click the program to edit.



A tab page to edit the V+ program is displayed in the Edit Pane.



**5** Create the program in the Edit Pane. For information on the programs, refer to V+ *Program* on page 3-9 if the system is controlled by the sequence control program or V+ *Program* on page 3-13 when it is controlled by the V+ program.

## 3-3-5 Placing 3D Shape Data

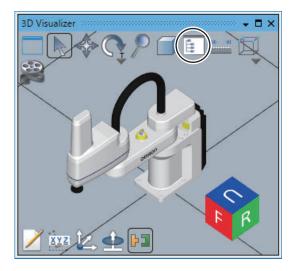
## Making the Robot Motion Range Visible

You can make the operating range of the robot visible on the 3D Visualizer. Making the operating range visible makes it easier to set the position of the robot.

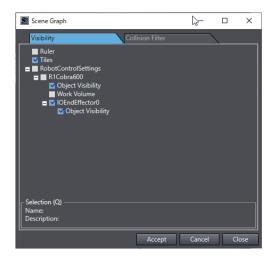
**1** Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

File	Edit	View	Insert	Controller	Tools	Window	Help
x	ill)	Mu	Itiview Ex	plorer		Alt+1	
^	-	Pro	ject Shor	tcut View		Alt+S	hift+1
Mult	iview E	Too	lhov			Alt+2	
	. 6	3D	Visualize	>		Alt+S	hift+2
-	Robot	Out	put Tab I	Page		Alt+3	
> C	onfigu	Wat	tch Tab P	age		Alt+4	
V P	rogran	Wat	tch Tab P	age(Table)		Alt+S	hift+4

**2** In the 3D Visualizer, click the Scene Graph icon.

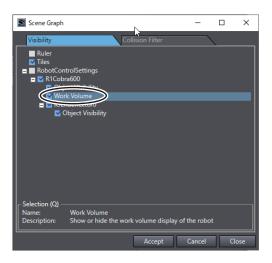


**Note** The 3D Visualizer is in Float mode state in this procedure. For information on Float mode, refer to *A-2-1 Set the 3D Visualizer to the Float Mode* on page A-21.

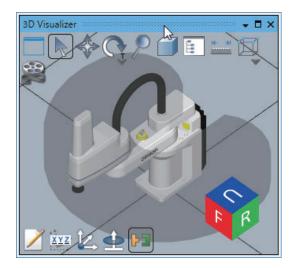


The Scene Graph dialog box is displayed.

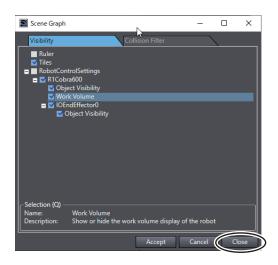
3 In the Visibility tab page, select the Work Volume check box located under RobotControlSettings - R1Cobra600.



The 3D Visualizer illustrates the robot's operating range in gray.



4 Click the **Close** button in the **Scene Graph** dialog box.



# Importing 3D CAD Data

Import the 3D CAD data of the conveyors as 3D shape data to the Sysmac Studio. This section describes the procedure to import the 3D CAD data of Conveyor A and Conveyor B used in the equipment model in *1-4 Operations of Static Pick-and-place Equipment* on page 1-6.

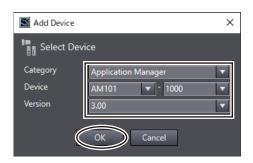
**1** Select **Application Manager** from the **Insert** menu on the main window of the Sysmac Studio.

File	Edit	View	Insert	Controller	Tools	Win
У	a la	ß	Cont	roller		•
<u> </u>	-	- 4	Appl	ication Mana	ger	
Mult	iview E	xplorer	Appl	ication Samp	e	•
	D-1-4		Safet	y Network Co	ontroller	•

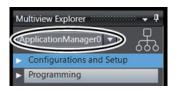
The Add Device dialog box is displayed.



2 Select Category, Device, and Version as shown in the figure below, and then click the OK button.



ApplicationManager0 is added to the drop-down list at the top of the Multiview Explorer





#### **Additional Information**

Application Manager added by this operation can only be used for simulation. Do not use it for actual device

**3** Click **Configurations and Setup** in the Multiview Explorer.



Setting items are displayed under Configurations and Setup in the tree.

Mul	tiview Explorer 👻 🗸
Ap	plicationManager0 🔻 📈
Υ.	Configurations and Setup
	III Settings
	3D Visualization
	👝 Robot Vision Manager
	👝 Cameras
	Configuration
	Feeders
	Process
	🖻 Vision Tools

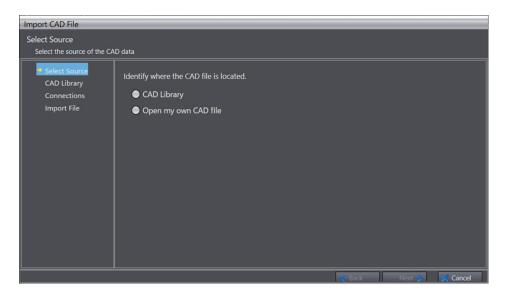
## **4** Right-click **3D Visualization**.

The menu commands are displayed.

5 From the menu, select Add - CAD Data.

Multiview Explorer	• <b>1</b>			
ApplicationManager0 🔻	ъ.			
▼ Configurations and Setup				
III Settings				
3D Visualization	Add			
📄 Robot Vision Ma	Add		Box	
Cameras	Paste		Cylinder	
<ul> <li>Configuration</li> </ul>	Add Shortcut	-(	CAD Data	

The Import CAD File wizard starts.



6

Select Open my own CAD file.

7 Click the **Next** button.

Import CAD File	
Select Source Select the source of the CA	ND data
Z Select Source CAD Library Connections Import File	Identify where the CAD file is located.  CAD Library  Open my own CAD file
	A Back Next S S Cancel

## 8 Click the Open File button.

Import CAD File	
Import File Import the selected CAD	le
<ul> <li>Select Source</li> <li>CAD Library</li> <li>Connections</li> <li>Import File</li> </ul>	Select the file which should be imported. File Name +90 Pitch +90 Pitch

The **Open** dialog box is displayed.

S Open							×
← → • ↑	🕽 > This P	C > 3D Objects		~ U	Search 3D Objects		٩
Organise • N	ew folder				= -		0
📕 x64	^		No items match your search.				
<ul> <li>This PC</li> <li>3D Objects</li> </ul>							
So Objects     Desktop     Documents     Ovinloads     Music     Dictures							
	File name:	SVKN-100-1000-25-T100-IM-9-H-A.stp		~	STEP File (*.stp;*.step	)	~
					Qpen	Cancel	U)

9

Select 3D CAD data to import, and then click the **Open** button.

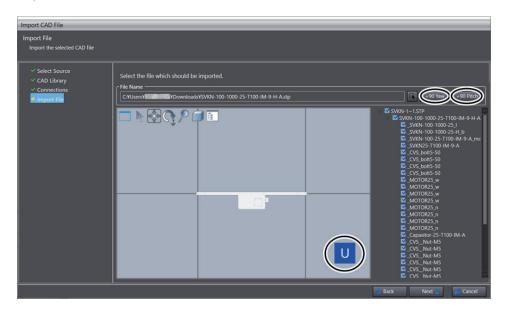
In this example, you select the conveyor of MISUMI Corporation whose model number is SVKN-100-1000-25-T100-IM-9-H-A for the Conveyor A. You can import the 3D CAD data with the file name extension "stp".

S Open							×
← → • ↑	🕽 > This	PC > 3D Objects	~ U	Search 3D Of	ojects		٩
Organise • Ne	ew folder				88 ·		0
📜 хб4	^	SVKN-100-1000-25-T100-IM-9-H-A.stp					
J This PC							
3D Objects							
Desktop							
Documents							
Downloads							
Music							
Dicture	~						
	E name	SVKN-100-1000-25-T100-IM-9-H-A.stp	~	STEP File (*.s	tp;*.step)		~
	100 C 100 C			Open		Cancel	

The Open dialog box is closed and import of 3D CAD data starts automatically.



When the import completes, the assemblies of the import 3D CAD data is displayed in the **Import CAD File** wizard.





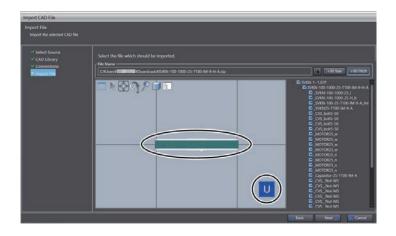
#### Additional Information

Align the conveyor top to the U face. Click the **+90 Yaw** button or **+90 Pitch** button to change the orientation of the conveyor.

If you use positioned and oriented CAD data, this operation is not necessary.

**10** Click the buttons in the following order; **+90 Yaw**, **+90 Pitch**, **+90 Yaw**, **+90 Pitch** and **+90 Pitch** 

The conveyor top comes to the U face.

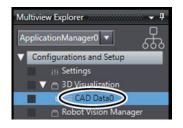


**11** Select the parts to add for simulation, and click the **Next** button.

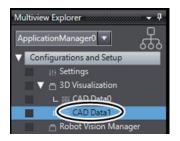
Import CAD File		
Import File Import the selected CAD file		
Select Source     CAD Library     Connections     Import File	Select the file which should be imported. File Name CYUSersYI CYUSersYI CYUSersYI	90 Yaw +90 Pitch
		C SV07 STP C SV07 STP C SV07 STP C SV07 STP C SV07 SV07 SV07 SV07 SV07 SV07 SV07 SV07
	·	Cancel

The Import CAD File wizard is closed and the main window is displayed again.

12 Check that CAD Data0 is added under Configurations and Setup - 3D Visualization in the Multiview Explorer.



13 Perform step 4 and later to import the 3D CAD data of the Conveyor B.In the Multiview Explorer, CAD Data1 is added under Configurations and Setup - 3D Visualization.



The 3D CAD Data for Conveyor A and Conveyor B are now imported.

# Placing 3D Shape Data on the 3D Visualizer

Place the imported 3D shape data in the appropriate position on the 3D Visualizer. When 3D shape data is imported, the 3D shape data is positioned so that it has the same coordinate origin as the robot coordinate system. Therefore, it is necessary to move the 3D shape data to the appropriate position.

This section describes the procedure to place Conveyor A used in the equipment model in 1-4 Operations of Static Pick-and-place Equipment on page 1-6 as an example.



#### Additional Information

For information on setting up in the 3D Visualizer and translating the point of view in the 3D Visualizer, refer to the *A-2 How to Use 3D Visualizer* on page A-21.

Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

liew	Insert	Controller	Tools	Window	Help
Mul	tiview Ex	plorer		Alt+1	1
Project Shortcut View			Alt+Shift+1		
Toolbox		Alt+2			
3D Visualizer			Alt+9	Shift+2	
Eve	nt Loy		-		

The 3D Visualizer is displayed on the right side of the main window.

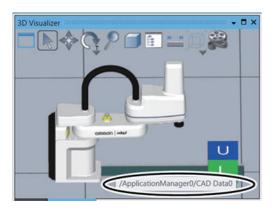
📓 Static P&P Sample_0.3 - ApplicationManager0 - Sysmac Studio (64bit)	- 🗆 X
File Edit View Insert Controller Tools Window Help	
Nubave Explore:	

**2** In the 3D Visualizer, select the imported 3D shape data with the mouse cursor and right-click it. The menu commands are displayed.

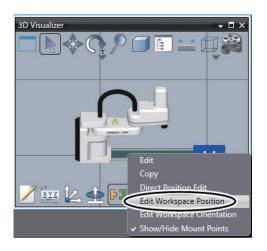


#### **Additional Information**

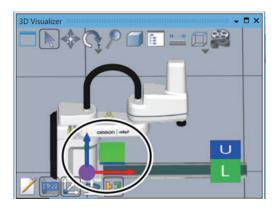
When you move the mouse cursor on the 3D shape data in the 3D Visualizer, the name of the 3D shape data **/ApplicationManager0/CAD Data0** is displayed.



**3** Select Edit Workspace Position from the menu.

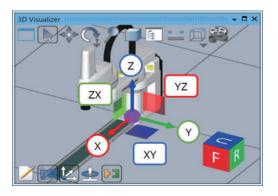


The Move icon consisting of colored arrows, a purple circle, and faces is displayed on the origin of the 3D shape data.

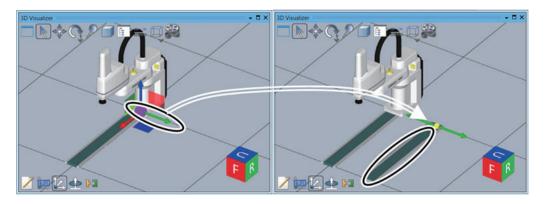


**4** Drag one of the arrows, faces, or the purple circle and drop it on the place to move the 3D shape data.

The Move icon has red, green, and blue arrows, which represent the X-axis, Y-axis, and Z-axis, respectively. The red face shows the YZ plane, the green face shows the ZX plane, and the blue face shows the XY plane.



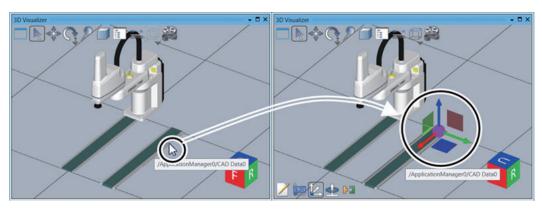
You can drag an arrow to move the 3D shape data along the axis. Or, use the face icon to move the 3D shape data on the corresponding plane. You can also move the 3D shape data independently from the axis direction by dragging the purple circle.





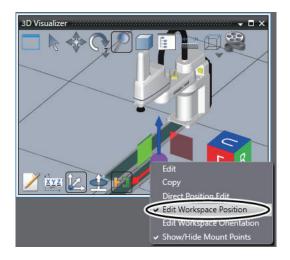
#### Additional Information

When the Move icon is hidden, click the 3D shape data to display it.

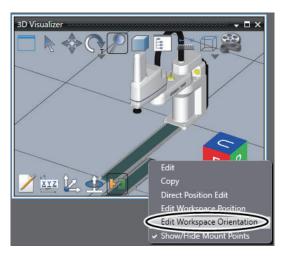


**5** Right-click the 3D shape data you are moving in the 3D Visualizer. The menu commands are displayed.

**6** Select **Edit Workspace Position** from the menu to clear the selection.

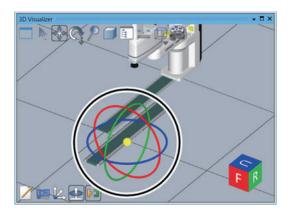


7 Right-click the 3D shape data in the 3D Visualizer. The menu commands are displayed.



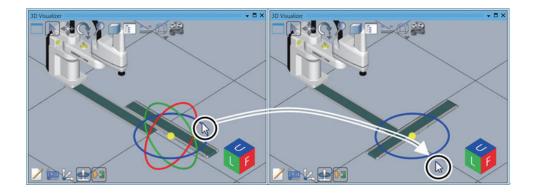
8 Select Edit Workspace Orientation from the menu.

The Rotate icon is displayed on the 3D shape data.



**9** Drag and drop the handle of the Rotate icon to rotate the 3D shape data around the axis to an appropriate orientation.

The icon has red, green, and blue handles, which represent rotation around the X-axis, Y-axis, and Z-axis, respectively.

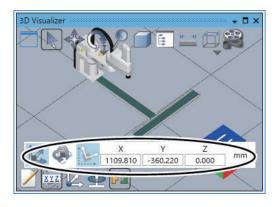


- **10** Right-click the 3D shape data to adjust the orientation in the 3D Visualizer. The menu commands are displayed.
  - 3D Visualizer
- **11** Select Edit Workspace Orientation from the menu to clear the selection.

- **12** Right-click the 3D shape data that you were adjusting the orientation in the 3D Visualizer. The menu commands are displayed.
- **13** Select **Direct Position Edit** from the menu.

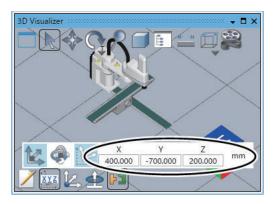


The input fields for editing the position of the 3D shape data is displayed.

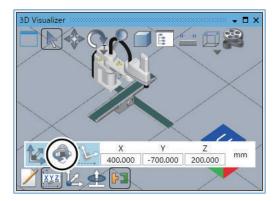


**14** Enter values in mm in the X, Y, and Z fields to move the 3D shape data to an appropriate position.

The position of the 3D shape data changes according to the input values.



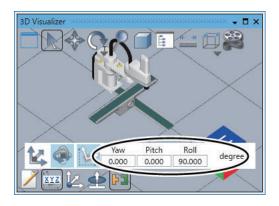
**15** Click the Edit Workspace Orientation icon.



The input fields for editing the orientation of the 3D shape data is displayed.

**16** Enter values in degree in the input fields for Yaw, Pitch, and Roll to adjust the orientation of the 3D shape data.

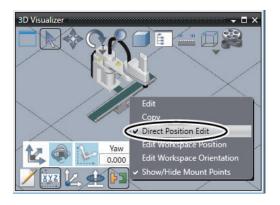
The orientation of the 3D shape data changes according to the input values.



**17** In the 3D Visualizer, right-click the 3D shape data that you adjusted the position and orientation.

The menu commands are displayed.

**18** Select **Direct Position Edit** from the menu to clear the selection.

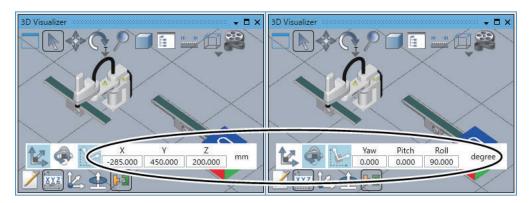




### Precautions for Correct Use

Refer to the Sysmac Studio 3D Simulation Function Operation Manual (Cat. No. W618) for details on coordinate system in the 3D Visualizer.

**19** Perform step 2 and later to adjust the position and orientation of the CAD Data1 of Conveyor B.



The 3D shape data of Conveyor A and Conveyor B are now placed in the appropriate positions in the 3D Visualizer.

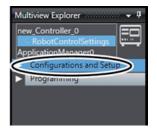
## Setting the 3D Information of the Robot's End-effector

Set the 3D information of the Robot's end-effector.

**1** Select **RobotControlSettings** from the device list in the Multiview Explorer.

luitiv	iew Exp	lorer ~			• • 4
L R	obotCo	ntrolSe	ttings	•	
new I	Control	ler 0			·
R	obotCo	ntrolSe	ttings		
	Subolici		uniys		

2 Click Configurations and Setup in the Multiview Explorer.



Setting items are displayed under Configurations and Setup in the tree.



## **3** Double-click **Robots**.



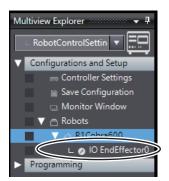
Setting items are displayed under **Robots** in the tree.



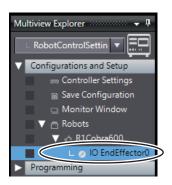
4 Click the  $\square$  icon to the left of **R1Cobra600**.



Setting items are displayed under R1Cobra600 in the tree.



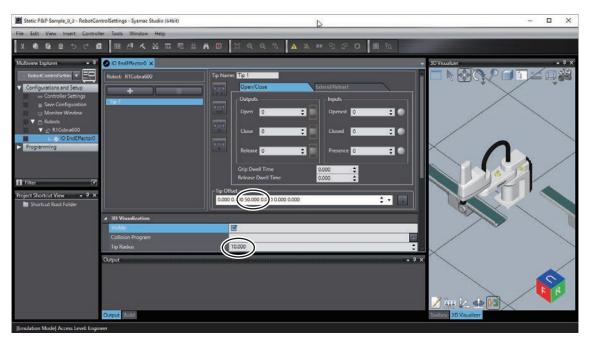
**5** Double-click **IO EndEffector0**.



The IO EndEffector0 dialog box is displayed.

Static P&P Sample_0_3 - RobotControlSettings - Sysmac Studio (64bit)		- D X
File Edit View Insert Controller Tools Window Help		
メ ● 毎 ● っ ? 四 国 印 人 路 同 目 並 ま	□ ゴ Q Q 3 ▲ ※ # 2 2 0 第 5	
Induitive Explorer       Image: Configurations and Saturp         Configurations and Saturp       Controller Setting         Controller Setting       Configurations and Saturp         Monitor Window       Readors         Programming       Configuration         Filter       Programming         Programming       Shortcut New         Shortcut Root Folder       Shortcut New         Output       Output         Top Radius       Output         Emulation Model Access Levek Engineer	Tr Name: Tr 1 Tr Name: Tr 1 Corr 0 Corr	
[Emulation Mode] Access Level: Engineer		

Set the length of the tool in the Z direction of the **Tip Offset**. In this example, enter the value as an example that the tool length is 50mm. Set **Tip Radius**, as required.



The end-effector of the set size is displayed on the 3D Visualizer.

6



# Activating Collision Detection Function

The collision detection function detects the contacts in simulation that may occur between the robot and other 3D shape data, such as objects imported as 3D CAD data. If the robot may contact with other 3D shape data, you need to change the layout of the robot or the 3D shape data, or modify the movement of the robot.

In this section, the setting procedure to detect a contact between the robot, Conveyor A and Conveyor B is given. Because the collision detection function checks whether 3D shape data may conflict between groups, you create two groups; Group 0, which includes the robot, and Group 1, which includes Conveyor A and Conveyor B.

### Precautions for Correct Use

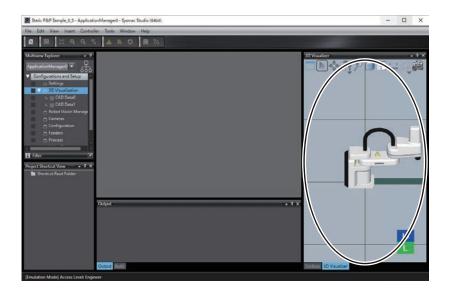
In this guide, the target of collision detection is the robot. When the 3D shape data is placed at the tool center point, collision detection of that 3D shape data is also required. For the operation procedure for the 3D shape data placed at the tool center point, refer to the *Sysmac Studio 3D Simulation Function Operation Manual (Cat. No. W618)*.



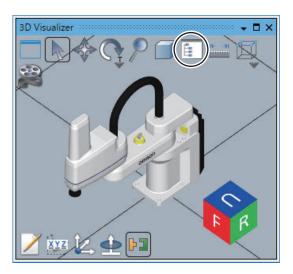
Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

liew	Insert	Controller	Tools	Window	Help	
Mul	Multiview Explorer			Alt+1	i i	
Project Shortcut View				Alt+Shift+		
Tool	lbox			Alt+2		
3D V	Visualizer	5		Alt+9	Shift+2	
Ever	nt Loy		_			

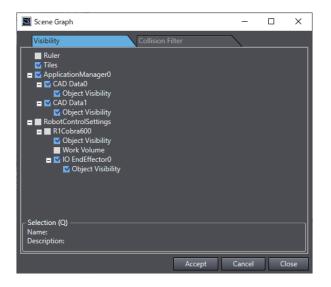
The 3D Visualizer is displayed on the right side of the main window.



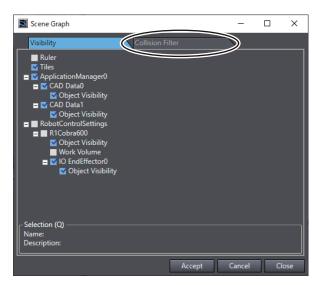
**2** In the 3D Visualizer, click the **Scene Graph** icon.



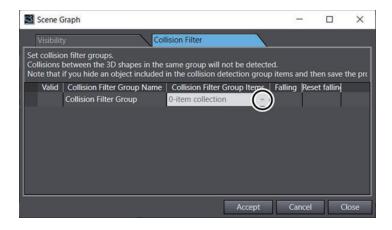
The Scene Graph dialog box is displayed.



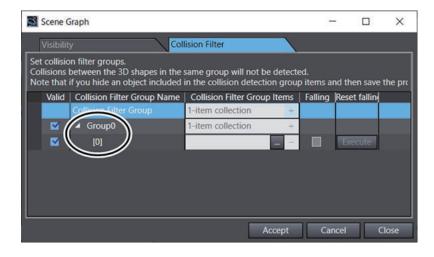
**3** Click the **Collision Filter** tab.



4 Click the + button in the Collision Filter Group Items column for the Collision Filter Group.



A new row with the **Collision Filter Group Name** set as **Group0** is added on the **Scene Graph** dialog box.



**5** Repeat step 4 above.

A new row with the **Collision Filter Group Name** set as **Group1** is added on the **Scene Graph** dialog box.

Scene	Graph			- 🗆	×
Visibil	ity Col	lision Filter			
Collision	ion filter groups. s between the 3D shapes in the t if you hide an object included			nd then save	e the pro
Valid	Collision Filter Group Name	Collision Filter Group Items	Falling	Reset fallin	-
	Collision Filter Group	2-item collection +			
<b>M</b>	▲ Group0	1-item collection +			
	101			Execute	
	A Group1	1-item collection +			
				Execute	3
			).		
L					
		Accept	Car	ncel	Close

6

Click the ... button in the Collision Filter Group Items column for Group0 - [0].

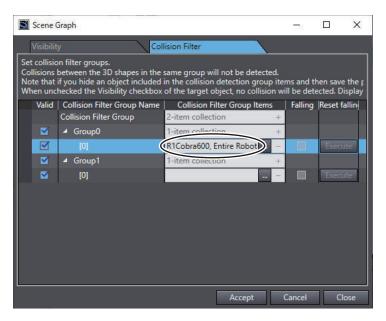
3	Scene G	iraph		-	- 🗆	×			
	Visibilit	y Col	lision Filter						
Co	Set collision filter groups. Collisions between the 3D shapes in the same group will not be detected. Note that if you hide an object included in the collision detection group items and then save the pro								
	Valid	Collision Filter Group Name	Collision Filter Group Items	Falling	Reset fallin				
		Collision Filter Group	2-item collection +						
		✓ Group0	1-item collection +						
		[0]			Execute				
		▲ Group1	1-item collection +						
		[0]			Execute				
Γ									
			Accept	Car	icel	Close			

The Select a collision filter group item dialog box is displayed.

7 Select new\_Controller\_0 - RobotControlSettings - Robots - R1Cobra600 - Entire Robot in the tree, and then click the Select button.



The Select a collision filter group item dialog box closes and the Scene Graph dialog box is displayed again. R1Cobra600, Entire Robot is registered as the Collision Filter Group Items for Group0 - [0].



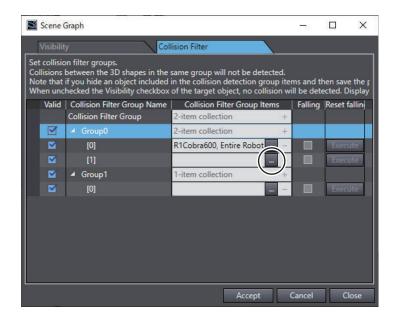
8 Click the + button in the Collision Filter Group Items column for Group 0.

1	Scene (	Graph				×
	Visibilit	y Col	lision Filter			
Col No	llisions l te that i	if you hide an object included	same group will not be detected in the collision detection group i of the target object, no collision	tems and t		
	Valid	Collision Filter Group Name	Collision Filter Group Items	Falling	Reset fa	allin
		Collision Filter Group	2-item collection -	+		
		✓ Group0	1-item collection			
			R1Cobra600, Entire Robot	-	Execu	te
		▲ Group1	1-item collection	+	1	
		[0]		-	Execu	te
Γ_						
			Accept	Cancel	Clo	ose

A new row [1] is added under Group 0.

Scene (	Graph					×
Visibilit	y Col	lision Filter				
Collisions Note that	on filter groups. between the 3D shapes in the if you hide an object included hecked the Visibility checkbox	in the collision detection gr	oup iter			
Valid	Collision Filter Group Name	Collision Filter Group It	ems	Falling	Reset	fallin
	Collision Filter Group	2-item collection	+			
	✓ Group0	2-item collection	+			
	[0]	R1Cobra600, Entire Robot			Exec	ute
					Exec	ute
	▲ Group1	1-item collection	+			
	[0]				Exec	ute
		- A		I		1
		Accept		Cancel		lose

9 Click the ... button in the Collision Filter Group Items column for Group 0 - [1].



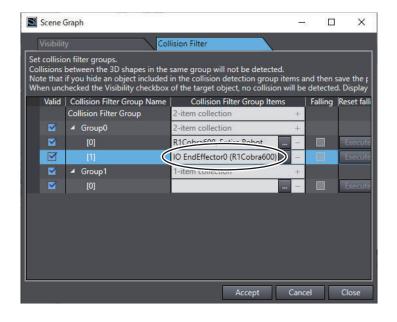
The Select a collision filter group item dialog box is displayed.



10 Select new\_Controller\_0 - RobotControlSettings - Robots - R1Cobra 600 - IO EndEffector0 in the tree, and then click the Select button.



The Select a collision filter group item dialog box closes and the Scene Graph dialog box is displayed again. IO EndEffector0(R1Cobra600) is registered as the Collision Filter Group Items for Group0 - [1].



11 Click the ... button in the Collision Filter Group Items column whose Collision Filter Group Name is Group1 - [0].

0	Scene (	Graph				×
	Visibilit	y Col	llision Filter			
Co No	llisions l te that i	if you hide an object included	same group will not be detected. in the collision detection group iter of the target object, no collision wi			
	Valid	Collision Filter Group Name	Collision Filter Group Items		Falling	Reset fall
		Collision Filter Group	2-item collection	*		
		▲ Group0	2-item collection	+		
		[0]	R1Cobra600, Entire Robot	4		Execute
		[1]	IO EndEffector0 (R1Cobra600)	-		Execute
		▲ Group1	1-item collection	+		
		[0]		$) \square$		Execute
				/		
Γ_						
	_					
			Accept C	Cance	el	Close

The Select a collision filter group item dialog box is displayed.

12 Select ApplicationManager0 - 3D Visualization - CAD Data0 from the tree, and then click the Select button.



The Select a collision filter group item dialog box closes and the Scene Graph dialog box is displayed again. CAD Data0 is registered to the Collision Filter Group Items column for Group1 - [0].

	Scene (	Graph		-		×
	Visibilit	y Col	lision Filter			
Col Not	lisions l te that i	if you hide an object included	same group will not be detected. in the collision detection group iter of the target object, no collision wi			
	Valid	Collision Filter Group Name	Collision Filter Group Items		Falling	Reset fall
		Collision Filter Group	2-item collection	+		
		▲ Group0	2-item collection	+		
		[0]	R1Cobra600, Entire Robot	-		Execute
		[1]	IO EndEffector0 (R1Cobra600)	-		Execute
		▲ Group1	1-item collection	+		
		[0]	CAD Data0	-		Execute
			Accept	Cance	el	Close

**13** Click the + button in the **Collision Filter Group Items** column for **Group1**.

1	Scene (	Graph		-15		×
	Visibilit	y Col	llision Filter			
Col No	llisions   te that	if you hide an object included	same group will not be detected. in the collision detection group item of the target object, no collision will			
	Valid	Collision Filter Group Name	Collision Filter Group Items	F	alling	Reset fall
		Collision Filter Group	2-item collection	+		
		Group0	2-item collection	+		
		[0]	R1Cobra600, Entire Robot	20		Execute
		[1]	IO EndEffector0 (R1Cobra600)	-		Execute
		▲ Group1	1-item collection	+))		
		[0]	CAD Data0	7		Execute
			Accept Ca	ancel		Close

A new row for [1] is added under Group1.

5	Scene (	Graph				×
Ĩ	Visibilit	y Co	Ilision Filter			
Col Not	lisions te that	if you hide an object included	same group will not be detected. in the collision detection group ite of the target object, no collision w			
	Valid	Collision Filter Group Name	Collision Filter Group Items		Falling	Reset falli
		Collision Filter Group	2-item collection	*		
		✓ Group0	2-item collection	+		
		[0]	R1Cobra600, Entire Robot			Execute
		[1]	IO EndEffector0 (R1Cobra600)	-		Execute
		Group1	2-item collection	+		
		<u>a</u>	CAD Data0	-		Execute
				1		Execute
		$\bigcirc$				
						-
			Accept	Cano	el	Close

14 Follow the step 11 to 12 to register CAD Data1 for Group1 - [1].CAD Data1 is registered to the Collision Filter Group Items column for Group1 - [1].

1	Scene (	Graph				×
	Visibilit	y Col	lision Filter			
Col No	lisions te that	if you hide an object included	same group will not be detecter in the collision detection group of the target object, no collision	items a		
	Valid	Collision Filter Group Name	Collision Filter Group Iten	ns	Falling	Reset fall
		Collision Filter Group	2-item collection	+		
		✓ Group0	2-item collection	+		
		[0]	R1Cobra600, Entire Robot			Execute
		[1]	IO EndEffector0 (R1Cobra600)			Execute
		▲ Group1	2-item collection	+		
		[0]	CAD Data0			Execute
		[1]	CAD Data1			Execute
			Accept	Cance	el	Close

**15** Check that the **Valid** check boxes are all selected. If there is a check box not selected, click it to select.

Scene	Graph				×
Visibilit	ty Co	llision Filter			
Collisions Note that	if you hide an object included	same group will not be detected. in the collision detection group ite of the target object, no collision w			
Valid	Collision Filter Group Name	Collision Filter Group Items		Falling	Reset fall
$\land$	Collision Filter Group	2-item collection	*		
│	✓ Group0	2-item collection	+		
	[0]	R1Cobra600, Entire Robot	223		Execute
	[1]	IO EndEffector0 (R1Cobra600)	-		Execute
	▲ Group1	2-item collection	+		
	[0]	CAD Data0	-		Execute
	[1]	CAD Data1	14		Execute
		Accept	Canc	el	Close

16 Click the Accept button.

A collision filter configuration is saved.

17 Click the Close button in the Scene Graph dialog box.

Visibil	ty Col	llision Filter			
Collisions Note that	if you hide an object included	same group will not be detected. in the collision detection group its of the target object, no collision v			
Valid	Collision Filter Group Name	Collision Filter Group Items		Falling	Reset fal
	Collision Filter Group	2-item collection	+		
	▲ Group0	2-item collection	+		
	[0]	R1Cobra600, Entire Robot			Executi
	[1]	IO EndEffector0 (R1Cobra600)			Executi
	▲ Group1	2-item collection	+		
	[0]	CAD Data0	-		Execut
	[1]	CAD Data1			Executi

The Scene Graph dialog box is closed.

Now, the settings for checking the conflict between the robot, Conveyor A, and Conveyor B have been completed.

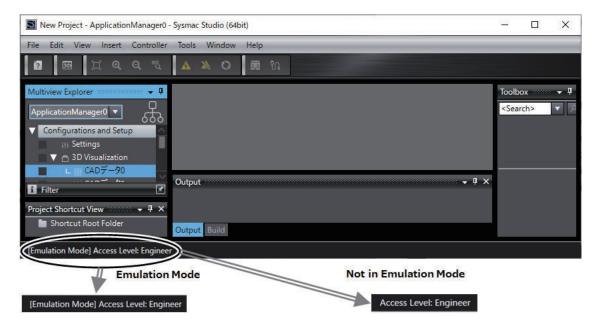
## 3-3-6 Starting Simulation

# **Enabling Robot Simulation Function**

Enable the simulation function of the Sysmac Studio.

To simulate the operation of the robot, open the project file in EMULATION mode.

If you want to know whether the project file opened on the Sysmac Studio is in EMULATION mode or not, check the status bar on the main window. When you see **[Emulation Mode] Access Level: Engineer** on the status bar, the project is opened in EMULATION mode.



If the project is opened in a different mode, click the **Enable emulation mode** icon on the toolbar to change to EMULATION mode.



1 In the Multiview Explorer, select **new\_Controller\_0** from the device list.

Ν	fultiview Explorer	88	• [
I	new_Controller_0 🔻		
	new_Controller_0	,	
Ļ	RobotControiSettings Programming	۲	1

2 Select **Run** from the **Simulation** menu. The screen below is displayed while the simulator is starting.



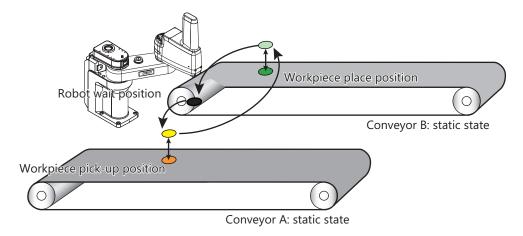
After this screen is closed, the lower part of the toolbar in the main window turns yellow-green.



### 3-3-7 Teaching Positions

This section describes the procedure to use the simulation function of the Sysmac Studio for teaching the positions.

The target of teaching in this equipment model is the wait position of the robot and the pick-up and place positions of the workpiece.



You can operate the robot during the simulation in either of the following two ways. Select one of the following depending on the positioning accuracy required for operation and movement.

- · Manipulate the tool center point of the robot with the mouse in the 3D Visualizer
- Manipulate each axis of the robot in V+ Jog Control pane



#### **Additional Information**

- To move the robot to its approximate position, it is convenient to use the mouse and move the tool center point of the robot on the 3D Visualizer.
- To move the robot precisely to its correct position, manipulate each axis of the robot in the V+ Jog Control pane



When teaching positions to the robot, you must store the position data of the robot in the V+ position variables. Here, create the following position variables.

Variable name	Data type	Application	Corresponding IEC variable
gl.pick	Location	Has the data of workpiece pick-up position.	eLoc_pick
gl.place	Location	Has the data of workpiece place position.	eLoc_place
gl.wait	Location	Has the data of robot wait position.	eLoc_wait

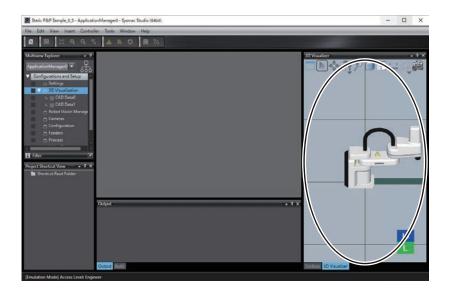
# Manipulating the Robot with the Mouse in the 3D Visualizer

This section describes the procedure to manipulate the tool center point of the robot with the mouse in the 3D Visualizer. This operation is suitable for determining rough position and posture, because the tool center point of the robot moves to follow the mouse cursor, enabling intuitive robotic operation.

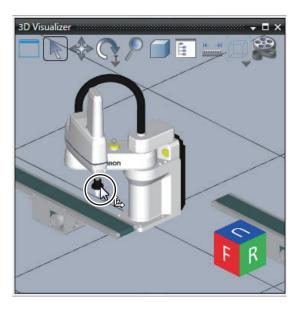
**1** Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

liew	Insert	Controller	Tools	Window	Help
Mul	tiview Ex	plorer		Alt+1	1
Proj	ect Short	tcut View		Alt+S	Shift+1
Tool	box			Alt+2	2
3D V	/isualizer	E.		Alt+9	Shift+2
Ever	nt Log				-

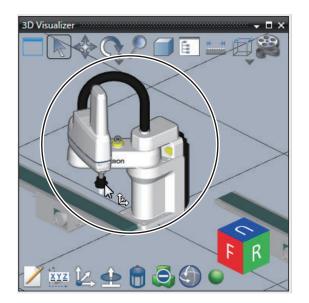
The 3D Visualizer is displayed on the right side of the main window.



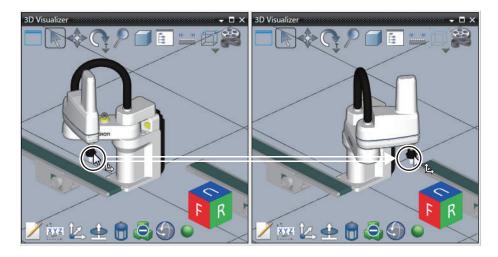
**2** Move the mouse cursor to the tool center point of the robot and click on it.



The outline of the robot is highlighted with black lines.

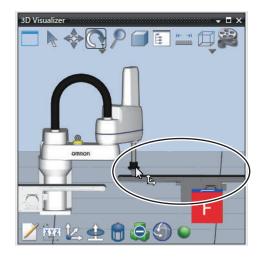


**3** Drag the mouse cursor. The tool center point moves to follow the mouse cursor.



**4** Move the tool center point to the position where it overlaps the conveyor, which is the position you specify.

The collision detection function set in *Activating Collision Detection Function* on page 3-53 detects a collision between the end-effector and the conveyor, and the color of them changes to gray.



**5** Drop with the mouse immediately after the color of the end-effector and the conveyor changes to gray.

The robot will stop at the drop position.

The robot position is now determined. If you set the current position as the picking or placing position of the robot, proceed to *Saving Current Positions to Variables* on page 3-74. If you need to specify a more precise position or want to specify a position along the axis of the robot coordinate system or each joint axis, proceed to *Manipulating the Robot in the* **V+** *Jog Control Pane* on page 3-70 for the next step.

# Manipulating the Robot in the V+ Jog Control Pane

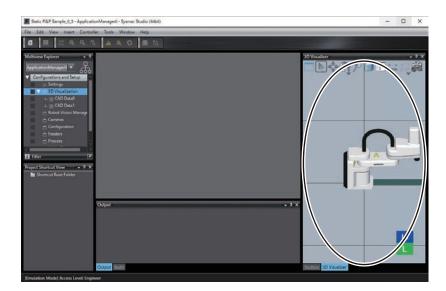
This section describes the procedure to manipulate the robot in **V+ Jog Control** pane. Use this procedure to move the robot along the coordinate system or each joint axis of the robot.



Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

View	Insert	Controller	Tools	Window	Help	
Mul	tiview Ex	plorer	Alt+1			
Proj	ect Short	tcut View	Alt+Shift+1			
Tool	Toolbox			Alt+2		
3D Visualizer				Alt+S	Shift+2	
Eve	nt Loy					

The 3D Visualizer is displayed on the right side of the main window.



2 Select **RobotControlSettings** from the device list in the Multiview Explorer.



**3** Select **V+ Jog Control** from the **View** menu on the main window.

iew	Insert	Controller	Tools	Window	Help	
Mul	tiview Ex	Alt+1				
Project Shortcut View					Shift+1	
Tool	lbox	Alt+2	2			
3D	Visualizer	Alt+S	Shift+2			
Out	put Tab F	Page		Alt+3	3	
Wat	ch Tab Pa	age		Alt+4	1	
Wat	ch Tab Pa	age(Table)		Alt+S	Shift+4	
Cross Reference Tab Page				Alt+	Alt+5	
Build Tab Page				Alt+6	5	
Ever	nt Log					
Sea	rch and P	leplace Resul	ts Tab Pa	ge Alt+7		
Sim	ulation P	ane		Alt+8		
Diff	erential M	Aonitor		Alt+9		
Sma	art Projec	t Search		Ctrl+Shift+F		
Rec	ently Clo	sed Windows		Ctrl+	Shift+H	
Clea	r Recent	ly Closed Wir	ndows H	istory		
V+.	log Cont	rol		Alt+9	Shift+J	
Task	Status C	onuoi		AIT+S	shift+T	
Visi	on Windo	w		Alt+S	Shift+V	

The V+ Jog Control pane appears on the right side of the main window.



4 From the drop-down list of Jog Control on V+ Jog Control pane, select the coordinate system of World, Joint, or Tool.

When **World** is selected, positions of the robot can be specified in the robot coordinate system, and when **Joint** is selected, the position can be set in the coordinate system of the joint. Select **Tool** for specifying the position in the coordinate system of the tool center point. In this example, select **World**.



5

Click one of the lamps of **Jog Control** in the **V+ Jog Control** pane.

The lamp clicked turns green. The robot can be moved along the coordinate axis of the illuminated lamp.

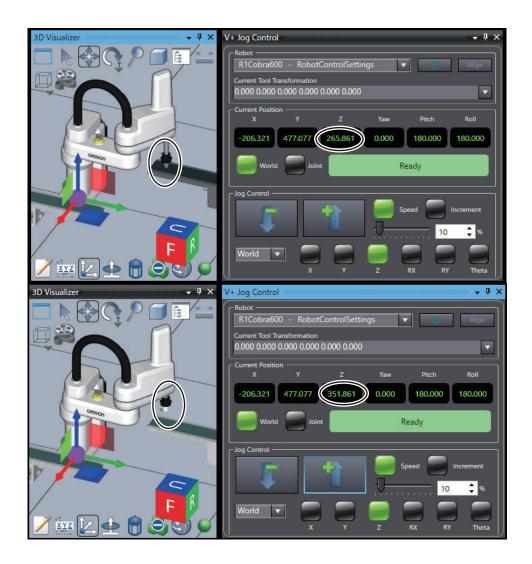
Select the Z lamp in this example.



6 Press and hold the arrow button labeled and or for for for the specified coordinate system. For example, the arrow in the figure below indicates positive direction in the robot coordinate system.



While the arrow button is kept pressed, the robot moves along the specified axis of the coordinate system.



7 Take step 4 to 6 again to move the robot to the position and posture you want to specify.

Now the robot position has been configured.

# **Saving Current Positions to Variables**

The current positions of the robot set by teaching must be saved in the V+ variables.

The procedure to save the current position of the robot to the already created V+ variable is described below.

V+ position variables that need to be saved are listed in the table below.

Name of position (Name of variable)	Description
gl.wait	Robot wait position
gl.pick	Workpiece pick-up position
gl.place	Workpiece place position

Save a current position to the variable *gl.wait* as an example. Save current positions to two other variables in the same manner.

1 Click Location in the V+ Jog Control pane.



The field to set the position variable is displayed.



**2** Selects a variable that you want to set the current position or an element of the array variable from the drop-down list.



The variable name and values set in the selected variable are displayed.



Select the variable *gl.wait*.



Click the Here button of Location in the V+ Jog Control pane.



The current position is registered to the value of the selected variable.



Now you have registered the current position of the robot to the V+ variable.

# 

### Additional Information

When the sequence control program controls the robot operation, the variable copy program "loccopy" copies the position variables of the V+ program to the shared variables of the sequence control program.

# 3-3-8 Setting up Automatic Loading of V+ Programs and Variables at Power ON

The V+ programs that you created and V+ global variables are not automatically loaded to the Robot Integrated CPU Unit by default settings of the project when power to the Robot Integrated CPU Unit is turned ON.

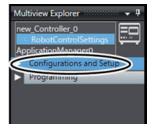
This section describes the setting procedure for automatically loading the V+ programs and V+ global variables to the Robot Integrated CPU Unit when its power is turned ON.

If you want to control the operation with the sequence control program, step 4 to 6 are unnecessary.

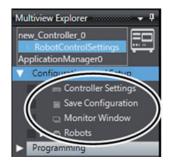
**1** Select **RobotControlSettings** from the device list in the Multiview Explorer.



2 Click Configurations and Setup in the Multiview Explorer.



Setting items are displayed under Configurations and Setup in the tree.



## **3** Double-click **Save Configuration**.



The Save Configuration tab page is displayed in the Edit Pane.

📓 New Project - RobotControlSettings - Sysmac Studio (64bit)	- 🗆 X
File Edit View Insert Controller Tools Window Help	
X 4 6 6 5 C 6 回 A X 5 6 6 8 4 9 ゴ 9 9 % A X =	a m • • ≏ ₽
Multiview Explorer Save Configuration	Toolbox • 1 <search>    Simulation • 1   Simulation • 1   Story Spe</search>
[Emulation Mode] Access Level: Engineer	

When the V+ programs are used to control the operation, proceed to step 4. If the system is controlled by the sequence control program, proceed to step 7.

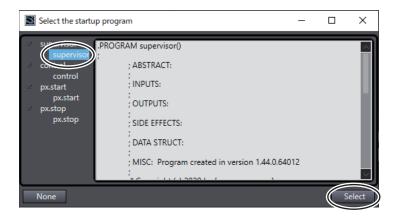
**4** Make sure that *supervisor* is not selected for **Program to Execute** and click the button on the right.



The Select the startup program dialog box appears.

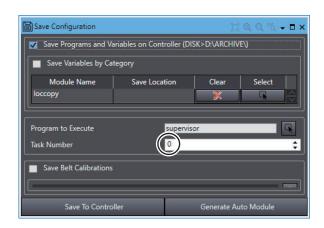
5

Select supervisor under supervisor and click the Select button.



6

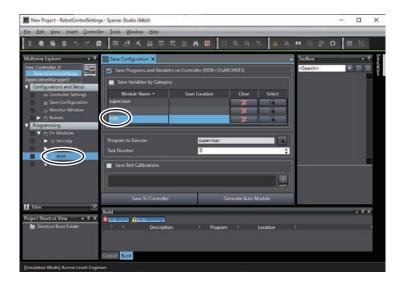
Enter 0 to Task Number.



7 Click the Generate Auto Module button in the Save Configuration tab page.

Save Configuration	joj	@@"& → □ ×		
Save Programs and Va	iriables on Controller (Dl	SK>D:\ARCHIV	EV)	
Save Variables by Cat	tegory			
Module Name	Save Location	Clear	Select	
Іоссору		×		
Program to Execute	supervis	supervisor		
Task Number	0		\$	
Save Belt Calibrations				
Save To Contro		Generate Au	ito Module	

The module name **auto** is added to the module list in the **Save Configuration** tab page. In the tree of the Multiview Explorer, **V+ Modules - auto** are added under **Programming**.



8 Select Save from the File menu.

3

3-3-9 Running the Program and Checking Operation

File	Edit	View	Insert	Contro
Clo	ose			
Sa	ve		Ct	trl+S
Sat	ve As			
Sa	ve As N	lew Nur	nber	

The Robot Integrated CPU Unit is now configured to automatically load the V+ programs and V+ global variables when it is powered ON. The program **auto** starts automatically when the Robot Integrated CPU Unit is powered ON and reads the saved V+ programs and V+ global variables.

The program **auto** is created in a form called command program, which is different from the V+ program. For details about the command program, refer to the eV+3 User's Manual (Cat. No. 1651).

## 3-3-9 Running the Program and Checking Operation

This section describes the procedure to run and simulate the sequence control program created in *3-3-3 Creating a Sequence Control Program* on page 3-22.

You can run the program by changing the global variable *gStart* in the sequence control program from FALSE to TRUE in the Watch Tab Page.

The V+ program is called from the sequence control program executed in this procedure.



### Precautions for Correct Use

When you perform this procedure, check that the project file has been opened in EMULATION mode. Refer to *Enabling Robot Simulation Function* on page 3-65 for the checking procedure.



### Additional Information

Refer to the Sysmac Studio Version 1 Operation Manual (Cat. No. W504) and Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for details on the debugging function of the program.

When you control the operation with the V+ programs, start from step1.

To control the operation with the sequence control programs, start with step 3.

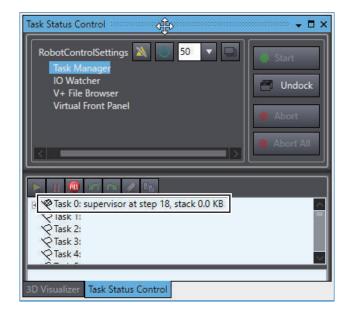
**1** Select **RobotControlSettings** from the device list in the Multiview Explorer.

Multiview Explorer	
RobotControlSettings	
new Controller 0	
RobotControlSettinas	<u> </u>
Ployioning	-

2 On the Multiview Explorer, select **Programming** – **V+ Modules** – **supervisor** - **supervisor** and right-click on it, and then select **Execute on Task** – **Task 0**.

File Edit View Insert Co	ontroller Tools	Window	H Task 1
X 🛍 🛍 🖄 🔿 🖒	? 30	ふん	× Task 2
		L	Task 3
Multiview Explorer	- <b>1</b>		Task 4
Multiview Explorer			Task 5
RobotControlSettings			Task 6
ApplicationManager0			Task 7
Configurations and Set	tup		Task 8
Programming	_		Task 9
V+ Modules			Task 10
► 🕞 run			Task 11
V 🕞 supervisor			Task 12
L 🕞 superv	Edit		Task 13
	Add Program		Task 14
i Filter	Copy Program		Task 15
	Delete Program		— Task 16
Project Shortcut View	Rename		Task 17
Shortcut Root Folde	Kename		- Task 18
	Set as Module P	rogram	Task 10
	Execute on Task		
	Debug on Task		Task 20 Task 21

The V+ program supervisor starts to run in Task 0.



**3** In the Multiview Explorer, select **new\_Controller\_0** from the device list.





Select 3D Visualizer from the View menu on the main window of the Sysmac Studio.

View	Insert	Controller	Tools	Window	Help
Mul	tiview Ex	plorer		Alt+1	i
Project Shortcut View			Alt+Shift+1		
Toolbox				Alt+2	
3D Visualizer				Alt+S	Shift+2
Ever	nt Log	-			-

3

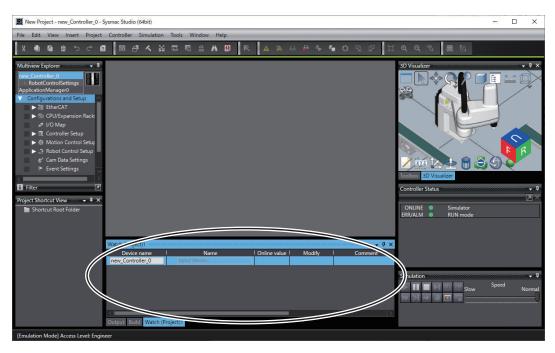
The 3D Visualizer is displayed on the right side of the main window.



**5** Select Watch Tab Page from the View menu on the main window.

/iew	Insert	Controller	Tools	Window	Help	
Mul	tiview Ex	plorer		Alt+1		
Project Shortcut View				Alt+Shift+1		
Toolbox				Alt+2		
3D Visualizer				Alt+Shift+2		
Output Tab Page				Δlt+3		
Watch Tab Page				Alt+4		
Wat	Watch Tab Page(Table)			Alt+S	Shift+4	

The Watch (Project)1 tab page appears at the bottom of the main window.



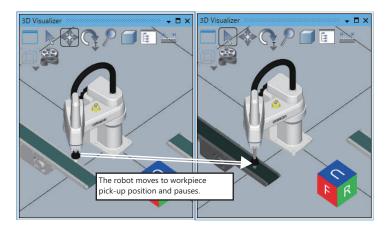
Type gStart in the Name column on the Watch (Project)1 tab page.
 The Online value column displays the current value of False for the internal variable gStart in Program0.

Device name	Name	L Online value	Modify	Comment
new_Controller_0	(IgStart	False	TRUE FALSE	Auto start Button
new_Controller_0	Input Name	$\mathbf{r}$		

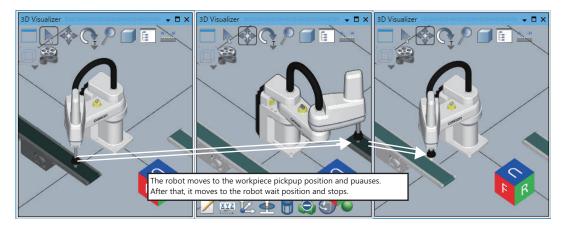
7 Click the **TRUE** button in the **Modify** column for the variable **gStart** in the **Watch** (**Project**)1 tab page.



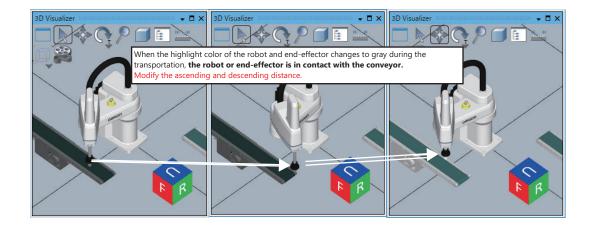
The robot starts to move and pauses at the workpiece pick-up position in the 3D Visualizer.



After that, the robot restarts operation from the workpiece pick-up position, moves to the robot wait position via the workpiece place position, and stops.



During operation, check that the robot does not turn gray in locations other than the workpiece pick-up position and workpiece place position. If the color changes to gray, the robot and the conveyor are interfering with each other. In that case, refer to *Manipulating the Robot in the* **V**+ *Jog Control Pane* on page 3-70 and move the workpiece pick-up approach point or the workpiece place approach point to a higher position by teaching.

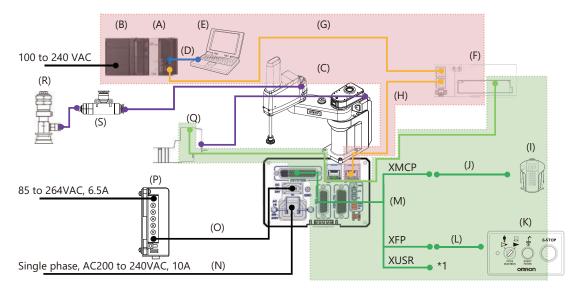


Now you finished checking operation of the sequence control program and V+ programs.

# **3-4 Installing and Wiring the System**

In the system configuration, you must wire the signal lines covered in the colored areas in the figure below and set the node address of the robot.

- Wiring between the Robot Integrated CPU Unit (A) and the EtherCAT Digital I/O Terminal (F)
- Wiring between the EtherCAT Digital I/O Terminal (F) and the robot (C)
- Wiring between the Robot Integrated CPU Unit (A) and the computer (E)
- Wiring between the robot (C) and the T20 pendant (I)
- Wiring between the robot (C) and the front panel (K)
- Wiring between the EtherCAT Digital I/O Terminal (F) and the solenoid valve (Q)



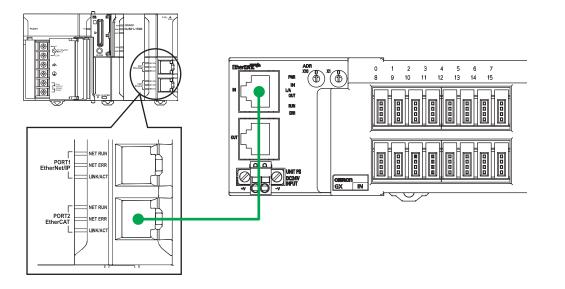
Refer to 1-3 System Configuration for Static Pick-and-place Equipment on page 1-4 for information on the parts used in the system configuration.

Refer to the manual for the specific product for details on power lines not covered in the colored area as well as for ducting from the robot.

## 3-4-1 Wiring the Robot Integrated CPU Unit and the EtherCAT Digital I/O Terminal

You must wire the Robot Integrated CPU Unit and the EtherCAT Digital I/O Terminal.

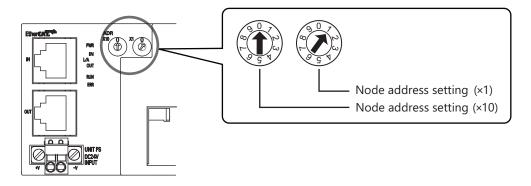
**1** Connect the EtherCAT port of the Robot Integrated CPU Unit and the EtherCAT IN port of the EtherCAT Digital I/O Terminal with an Ethernet cable.



## 3-4-2 Setting the Node Address of the EtherCAT Digital I/O Terminal

You must set the EtherCAT node address of the EtherCAT Digital I/O Terminal.

Use the switches on the EtherCAT Digital I/O Terminal to set the EtherCAT node address.To set the node address to 1, set the x10 switch to 0 and the x1 switch to 1.





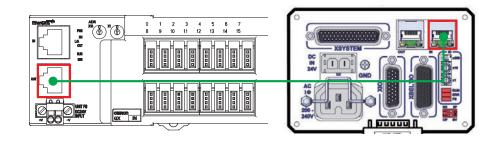
### **Precautions for Correct Use**

Set the EtherCAT node address of the EtherCAT Digital I/O Terminal to be the same as the node address set in *3-3-2 Creating the EtherCAT Network Configuration* on page 3-20.

## 3-4-3 Wiring the EtherCAT Digital I/O Terminal and the Robot

You must wire the EtherCAT Digital I/O Terminal and the robot.

**1** Connect the EtherCAT OUT port of the EtherCAT Digital I/O Terminal and the EtherCAT IN port on the interface panel of the robot with an Ethernet cable.





r M

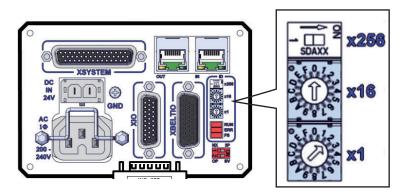
#### Precautions for Correct Use

Refer to the *NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual (Cat. No. W505)* for details on the Ethernet cable to be used.

### **3-4-4** Setting the EtherCAT Node Address of the Robot

You must set the EtherCAT node address of the robot.

1 Use the switches on the interface panel of the robot to set the EtherCAT node address. To set the node address to 2, set the x256 switch to OFF, the x16 switch to 0, and the x1 switch to 2.



**Precautions for Correct Use** 

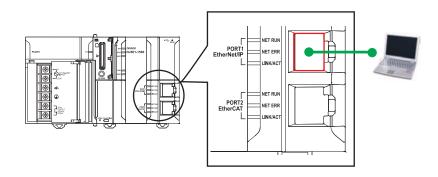
Set the EtherCAT node address of the robot to be the same as the node address set in *3-3-2 Creating the EtherCAT Network Configuration* on page 3-20.

Refer to the manual for your robot on how to set the node address.

### 3-4-5 Wiring the Robot Integrated CPU Unit and the Computer

You must wire the Robot Integrated CPU Unit and the computer.

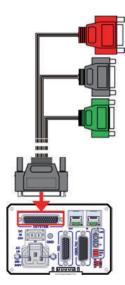
**1** Connect the built-in EtherNet/IP port of the Robot Integrated CPU Unit and the computer with an Ethernet cable.



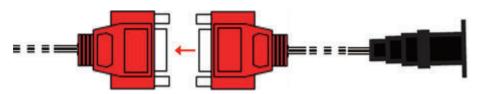
# **3-4-6** Wiring the Robot, T20 Pendant and the Front Panel

You must wire the robot and the T20 pendant, as well as the robot and the front panel. Use an XSYS-TEM cable assembly, a T20 adapter cable, and a front panel cable for wiring.

**1** Connect the robot and the XSYSTEM cable assembly.



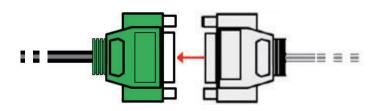
2 Connect the XMCP connector (Red) of the XSYSTEM cable assembly and the T20 adapter cable.



**3** Connect the T20 adapter cable to the T20 pendant.

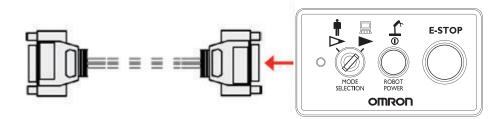


**4** Connect the XFP connector (Green) of the XSYSTEM cable assembly and the front panel cable.



**5** (

Connect the front panel cable and the front panel.



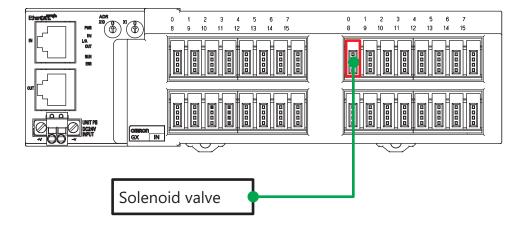
## 3-4-7 Wiring the EtherCAT Digital I/O Terminal and Solenoid Valve

You must wire the EtherCAT Digital I/O Terminal and the solenoid valve. Refer to the manuals for the EtherCAT Digital I/O Terminal and the solenoid valve for details on the cable wiring, and make the cable appropriately in accordance with the wiring diagrams and specifications.

1 Make the cable so that the solenoid valve will behave as shown in the table below.

Output value of Digital I/O Terminal	Solenoid valve behavior
FALSE	Duct is closed
TRUE	Duct is open

**2** Wire the EtherCAT Digital I/O Terminal and the solenoid valve.



# **3-5 Setup Procedure for Actual System**

This section describes the procedures for checking operation and adjusting the system on the actual system.

Check operation with the simulation function before you check operation on the actual system.



#### Precautions for Correct Use

When you operate the robot in MANUAL mode with the T20 pendant, you must plug the iCS Commissioning Jumper into the XBELTIO connector and change the setting for the Teach Restrict. Refer to the *eCobra 600 and 800 Robot with EtherCAT User's Guide (Cat. No. 1653)* for details.

### 3-5-1 Connecting Online

The computer and the Robot Integrated CPU Unit are connected online.

- **1** Turn ON the power supplies to the Robot Integrated CPU Unit and the robot.
- 2 Click **new\_Controller\_0** from the device list in the Multiview Explorer of the Sysmac Studio.



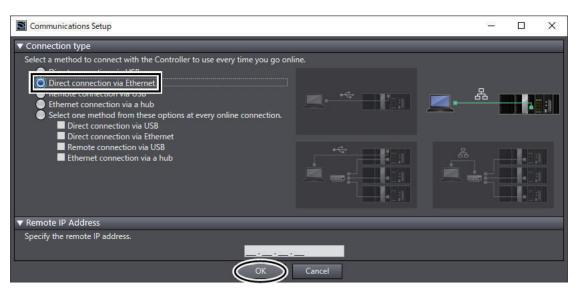
**3** Select **Controller** - **Communications Setup** from the menu bar in the main window.

Project	Controller	Simulation	Tools	Window	Help	
C 12	Commun	ications Setup	$\geq$			
	Change L	Jevice				

The Communications Setup dialog box is displayed.



**4** Click the **Direct connection via Ethernet** from the Communication type, and then click the **OK** button.



The Communications Setup dialog box is closed.

5 Click the **Disable emulation mode** icon in the toolbar.



The confirmation dialog box for Disable emulation mode is displayed.



### 6 Click the OK button.

The main window is displayed again after the Sysmac Studio returns to the menu screen.



Controller	Simulation	Tools	Window	Help
Commun	ications Setup	)		
Change [	Device			
Online	)		Ctr	·l+W
Offline			Ctr	1+Shift+W



### Precautions for Correct Use

Depending on the status of the connected Robot Integrated CPU Unit, the dialog box for writing the CPU Unit name or checking the serial ID is displayed. Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for details.

When it is online, the yellow line is displayed on the top of the edit pane.

3

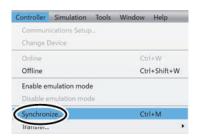
3-5-1 Connecting Online

Eile	Edit	View	Insert	⊆ontroller	Jools	Window	Help
V.	-	-					×
	_			_		_	$\geq$
Mult	Wew e	хрютен					
<u> </u>		Control	Settin 🔻				
- 0	onfigu	rations a	ind Setup				
10	- Ce	ontroller	Settings				

## **3-5-2** Transferring Settings and Programs

The settings and programs in the project file are transferred from the Sysmac Studio to the Robot Integrated CPU Unit.

**1** Select **Controler - Synchronize** from the menu bar on the Sysmac Studio.



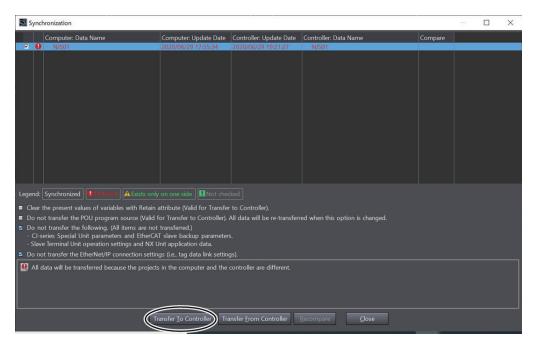
The comparison of the user program and parameter settings between the Sysmac Studio and the Controller is started.



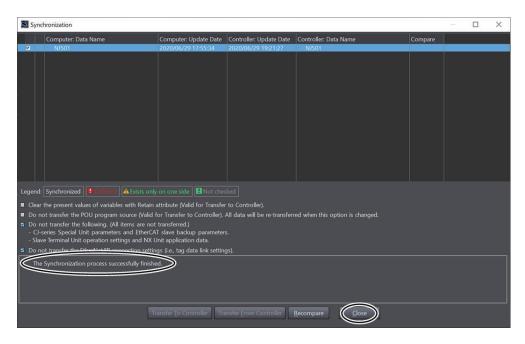
Synchronization						×
Computer: Data Name	Computer: Update Date 2020/06/29 17:55:34	Controller: Update Date 2020/06/29 19:21:27	Controller: Data Name NJ501	Compare		
egend: Synchronized Different A Exist	ts only on one side 🛛 🔛 Not che					
Clear the present values of variables with R						
Do not transfer the POU program source (		All data will be re-transfer	red when this option is changed.			
Do not transfer the following. (All items and - CJ-series Special Unit parameters and Et - Slave Terminal Unit operation settings and	herCAT slave backup parameter					
<ul> <li>Slave terminal one operation seconds and</li> <li>Do not transfer the EtherNet/IP connection</li> </ul>		as).				
All data will be transferred because the p						
	rojecis in the computer and the					
	Transfer To Controller Tra	ansfer <u>F</u> rom Controller	Recompare Close			

When the comparison is completed, the Synchronization dialog box is displayed.

2 Click the **Transfer to Controller** button.



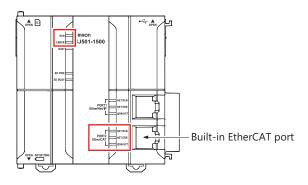
**3** Confirm that "The Synchronization process successfully finished." is diaplayed, and then click the **Close** button.



**4** Confirm that the Robot Integrated CPU Unit is turned ON normally. The status of indicators for normal operation is given below.

Indicators	Status
RUN indicator	Lit green

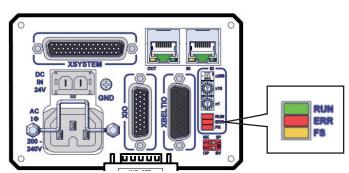
Indicators	Status
ERROR indicator	Not lit
NET RUN	Lit green
NET ERR	Not lit
LINK/ACT	Flashing





Confirm that the robot is turned ON normally. The status of indicators for normal operation is given below.

Indicators	Status
RUN indicator	Lit green
ERR indicator	Not lit



# 3-5-3 Teaching

A robot is operated actually to check and correct teaching data.

Move the robot to the teaching position set in the simulation operation actually, and adjust the position if necessary. The teaching position data is saved in the SD Memory Card so that the data is retained after the power supply to the Robot Integrated CPU Unit is turned OFF.

The T20 pendant is used for teaching. Refer to the *Teaching Pendant T20 User's Manual (Cat. No. 1601)* for information on the specifications of the T20 pendant.

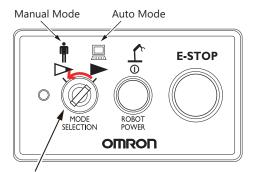
Place a workpiece where you plan to pick it up before performing the teaching operation.

# **Turning Robot High Power ON**

The robot high power is turned ON.



Change the operating mode switch on the front panel to Manual Mode.



Operating mode switch

**2** Press the enable switch on the T20 pendant to Position 2 (half-way).



**3** Press the Robot Power button while the enable switch is kept in Position 2 (half-way).



The Robot Power button on the front panel flashes.

Press the Robot Power button on the front panel.The robot high power is turned ON and the Robot Power button is lit.

If you release the enable switch (Position 1) or press the enable switch further from Position 2 (half-way) to Position 3, the robot high power will be turned OFF.

### Precautions for Correct Use

If it is necessary to move the robot, follow the procedure above to turn ON the high power.

# **Adjusting Teaching Position in Simulation Operation**

The teaching position that is set in setup procedure with the simulation operation is adjusted to match the actual place position. The robot actually moves to the teaching position set in the simulation operation, and correct the position if there are differences between teaching position and expected position. Use the following procedure to adjust position according to the travel route of the robot. You must adjust the wait position and approach position more than once.

Position name (Variable name)	Description	Order of adjustment
gl.wait	Robot wait position	1, 4
gl.pick	Workpiece pick-up position	2
gl.place	Workpiece place position	3

#### Precautions for Correct Use

ПЛ

Perform the adjustment in the above order in the table. If the adjustment is performed in different order, the robot may move to the unintended travel route and contact to the equipments such as a conveyor, and then the devices may be damaged.

**1** Confirm that the T20 pendant displays the **HOME1** screen.



**2** Press the F4 button (Next>) twice.



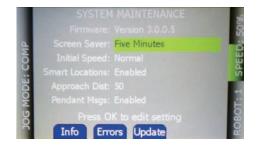
The HOME3 screen is displayed.



**3** Press the F1 button (Maint).



The SYSTEM MAINTENANCE screen is displayed.



**4** Press the up or down arrow button to select **Approach Dist** field.





**5** Press the OK button.



**6** Press the up or down arrow button to change the value of **Approach Dist** field. You can select the height to rise and fall in the range of 1 to 200 mm.



Assume that the value of height to rise and fall is 40 in this step.



7 Press the OK button.





Press the MENU button to back to HOME1 screen.





Press the F2 button (Loc).



The **AVAILABLE LOCATIONS** screen is displayed.



**10** On the **AVAILABLE LOCATIONS** screen, use the arrow buttons to select the teaching position from the list of locations.

READY gl.pick	AILABLE LOCATIONS JOINT ZERO gl.piace	
gl.wait		
		100
		1

**11** Press the F4 button (Next>).



The display for the soft keys changes on the bottom of the screen.

JOINT	READY gl.pick gl.wait	AVAILABLE	LOCATIONS JOINT ZERO gl.place	PEED: 50%
JOG MODE:	Jog	То Аррго	Align Next	V ROBOT: 1

**12** If the variable selected in step 10 is *gl.pick* or *gl.place*, press and hold the F2 button (Appro).



The robot moves linearly to the top of the selected position.



**13** Press and hold the F1 button (JogTo).

The robot moves linearly to the selected position.

- **14** When the robot moves to the selected position, release the F1 button (JogTo). If there is no problem with the position and posture after the move, proceed to step 20. If you adjust the position and posture, perform step 15 and later.
- **15** Press the F4 button (Next>) and then F2 button (Teach).



The **TEACH** screen for the selected location is displayed.

X	yaw
357.103	0.000
Y	pitch
9.757	180.000
Z	roll
231.919	10.649

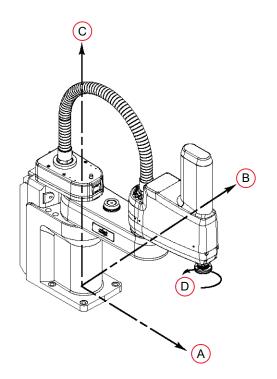
**16** Press the Jog Mode button until the desired mode is displayed in the Jog Mode Indicator area. Assumes that the adjustment of the position in World Mode is performed in this step, and press the button until **WORLD** is displayed.

X		yaw
357.1	03 0	.000
Y		oitch
9.75	7 18	0.000
Z		roll
231.9	19 1	0.649
Press "	OK" to Teach	Position

**17** Press the JOINT/AXIS CONTROL button to move the robot to the desired position and posture.

The following table shows the relationship between coordinate axes in World Mode and JOINT/ AXIS CONTROL button.

Letter	Description	JOINT/AXIS CONTROL button
А	+X (X direction)	Х
В	+Y (Y direction)	Y
С	+Z (Z direction)	Z
D	+RZ, CCW (RZ rotation)	RZ







The value of position is updated to the current robot position.

X	yaw
333.368	0.000
Y	pitch
90.115	180.000
Z	roll
265.543	10.650

**19** Press the F2 (Loc) button and then F4 button (Next>). The **AVAILABLE LOCATIONS** screen is displayed again.



**20** If the variable selected in step 10 is *gl.pick* or *gl.place*, press and hold the F2 button (Appro).



The robot moves linearly to the top of the selected position.

**21** If there are still positions left to adjust, return to step 10.

# Saving Teaching Position to the SD Memory Card

Save the teaching position data to the SD Memory Card so that it is retained even after the power supply to the Robot Integrated CPU Unit is turned OFF.

The procedure varies depending on the version of Sysmac Studio. Please check the version of Sysmac Studio and then perform the following steps.



### **Precautions for Correct Use**

If the power supply to the Robot Integrated CPU Unit is turned OFF without saving the position data to the SD Memory Card, the adjusted position data will be lost and the robot may operate unintentionally the next time the CPU Unit is started. If you have performed teaching using the robot and the CPU Unit, perform the following steps.

# • Sysmac Studio Ver.1.54 or higher

**1** Click **RobotControlSettings** from the device list in the Multiview Explorer of the Sysmac Studio.

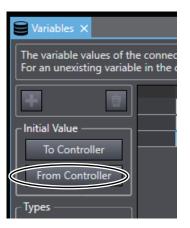


2

In the Multiview Explorer , select **Programming – V+ Modules – Variables**.



**3** Click the **From Controller** button in the **Variables** tab page.



4 Click the **Yes** button.

From Contro	ller
1?	This operation updates all the variable values transferred to the controller, shown in [Initial Values], with the values in [Online Values]. [Online Values]. Do you want to continue?
	Yes No



Select **Configurations and Setup - Save Configuration** in the Multiview Explorer.



**6** Click the **Save To Controller** button in the **Save Configuration** tab page.

Save Configuration ×	) Save Configuration ×						
Save Programs and Variables on Controller (DISK>D:\ARCHIVE\)							
Save Variables by Category							
Module Name	Save Location	Clear	Select				
run		×					
auto		×					
Program to Execute							
Task Number	1						
Save Belt Calibrations							
			F				

7 Click File - Save from the menu bar.



- Sysmac Studio Ver.1.53 or lower
  - 1 Click **RobotControlSettings** from the device list in the Multiview Explorer of the Sysmac Studio.



2 Click the **Pull from V+ Memory** icon in the toolbar of the Multiview Explorer.



3-5 Setup Procedure for Actual System

3

3-5-3 Teaching

**3** Select Configurations and Setup - Save Configuration in the Multiview Explorer.



4 Click the Save To Controller button in the Save Configuration tab page.



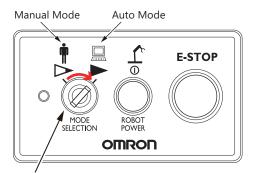
5 Click File - Save from the menu bar.



### 3-5-4 Executing Program to Check Operation

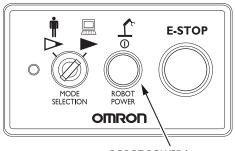
The robot operation before the automatic operation is checked according to the program.

**1** Change the operating mode switch on the front panel to Auto Mode.



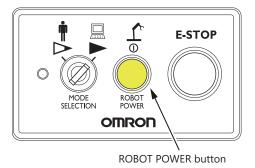
Operating mode switch

**2** Press the Robot Power button on the front panel.



**ROBOT POWER button** 

The Robot Power button flashes. Press the Robot Power button again. Then, the Robot Power button lights up and the robot high power turns ON.



**3** Select **View** - **Watch Tab Page** from the menu bar in the main window of the Sysmac Studio on the computer.

View	Insert	Project	Controller	Simulation	Tools
Mul	tiview Ex	Alt+1			
Proj	ect Short	cut View		Alt+Shift	+1
Tool	box			Alt+2	
3D \	Visualizer	5		Alt+Shift	+2
Out	nut Tah P	ane		Alt+3	
Wat	Watch Tab Page		Alt+4		
Wat	ch Tab Pa	age(Table)		Alt+Shift	+4

The Watch tab page is displayed under the main window.

Device name	Name	Online value	Modify	I Comment	Data type	
new_Controller_0	gStart			Auto-operation start button	BOOL	
new_Controller_0						

4 Click the **TRUE** button in the **Modify** column for **gStart**.

Watch (Project)1					
Device name	Name	Online value	dify	Comment	Data type
new_Controller_0	gStart	False	TRUE	Auto-run start button	BOOL
new_Controller_0	Input N		$\smile$		

The robot performs pick-and-place operation according to the program.

If you use this program actually, write a program so that you can operate gStart variable from the HMI.



### **Precautions for Correct Use**

If the operation is controlled with the V+ program and the operating mode of the Robot Integrated CPU Unit is switched from RUN mode to PROGRAM mode, and then to RUN mode again, press the Robot Power button on the front panel to make sure that the light of the button is OFF, and then press the button again to confirm that it is lit before executing the above procedure.

# Implementation Example of Dynamic Pick-and-place Equipment

This section describes the implementation example of the dynamic pick-and-place equipment.

4

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4-2	Basic	Startup Procedures	4-12
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	4-5-4	Setting up the Camera	
	4-5-5	Running a Sequence Control Program and V+ Program	
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4

4-1-1 Program Structure

# 4-1 Program Specifications for Dynamic Pick-and-place Equipment

This section describes the program specifications to control the dynamic pick-and-place equipment. For information on how to create a program, refer to *4-3 Programming and Simulation Procedures* on page 4-15.

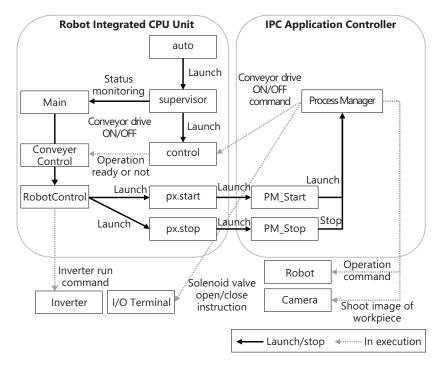
# 4-1-1 Program Structure

This section describes the specifications of the program to control the dynamic pick-and-place equipment.

The program consists of the following programs.

Program Name	Language	Description
Main	Sequence control program (Ladder di- agram)	Main program
ConveyerControl	Sequence control program (Ladder di- agram)	Operating program for the conveyor
RobotControl	Sequence control program (Ladder di- agram)	Program for automatic operation of the robot
px.start	V+ program	A program to call C# program for starting
px.stop	V+ program	A program to call C# program for stopping
supervisor	V+ program	Status monitoring program for the robot
control	V+ program	Regular processing program for the robot operation
auto	V+ program	Startup processing program for the robot operation
PM_Start	C# program	Startup program of the Process Manager
PM_Stop	C# program	Stop program of the Process Manager

The role of each program and peripheral devices are as follows.



In this equipment, Pack Manager sample is used to program the pick-and-place operation. If you use the Pack Manager sample, you can operate the robot by using the Process Manager function of the IPC Application Controller. It eliminates the need to create complex programs for processing to work with peripheral devices. However, you need to make the V+ programs and C# programs to start or stop the Process Manager.

Process Manager can be started or stopped by calling the C# program, which is executed by the IPC Application Controller, from the V+ program that is running on the Robot Integrated CPU Unit. Process Manager's solenoid valve opening/closing instruction is written to outputs of V+ Digital I/O. They are assigned to the contacts of the EtherCAT I/O Slave by the V+ Digital I/O Settings function and are output from those contacts.

Process Manager's conveyor drive ON/OFF instruction is written to the output of V+ Digital I/O. The V + program for regular processing, "control", polls for the status of the conveyor drive ON/OFF instruction and writes it to the shared variable. In addition, the sequence control program "ConveyerControl" polls for the shared variables, converts them to operational instructions (ON/OFF instructions, velocity command, and rotational directions), and outputs them to the inverter.

# Sequence Control Program

This section describes the sequence control program to control the dynamic pick-and-place equipment.

In the sequence control program, register global variables and create three programs, "Main" (main program), "ConveyerControl", and "RobotControl".

### Global Variables

Register the global variables that are used in the sequence control program.

Name	Data type	Comment
E002_Command	WORD	Inverter run command
E002_Frequency_reference	UINT	Inverter target frequency
E002_Status	WORD	Inverter status
E002_Output_frequency_monitor	UINT	Inverter frequency monitor
E002_Sysmac_Error_Status	BYTE	Inverter Sysmac error

The following variables are automatically generated in the I/O Map tab page.

Register the variables below yourself.

Name	Data type	Comment
e_conveyor_dir	BOOL	Conveyor revere command
e_conveyor_run	BOOL	Conveyor run command
e_conveyor_spd	BOOL	Conveyor fast run command
e_is_run_mode	BOOL	Operation mode
gRC_Err	BOOL	Robot control error
gReset	BOOL	Auto-operation stopped
gStart	BOOL	Auto-operation started
gSysOK	BOOL	Operation ready
eBool_exeT1	BOOL	supervisor in execution
gEnableT1	BOOL	supervisor executable

4

4-1-1 Program Structure

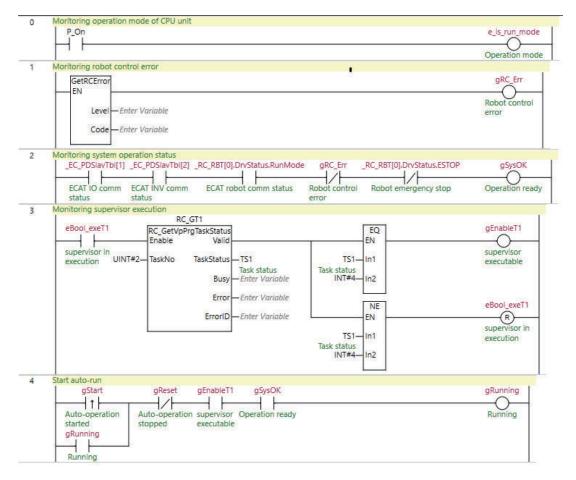
The following variables are automatically generated when a robot is added to the system configuration.

Name	Data type	Comment	
RC_Robot001	_sRC_RBT_REF	iX4 650H	
RC_Robot001_IO	_sRC_RBT_IO_REF	iX4 650H I/O	

### Main program (Main)

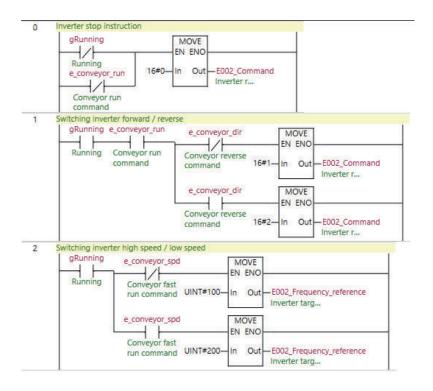
"Main" (main program) is used to monitor the status of the robot and judge whether the automatic operation can start.

An example of a program is provided below.



# • Operating Program (ConveyerControl)

"ConveyerControl" (operating program) makes the inverter start running on receiving a command. During automatic operation, the ON/OFF command is sent to the Inverter according to the conveyor drive ON/OFF instruction from the Process Manager. An example of a program is provided below.



### • Operating Program (RobotControl)

"RobotControl" (operating program) runs automatically on receiving a command. An example of a program is provided below.

gRunning _RC_	gRunning _RC_RBT[0].DrvStatus.PowerEnabled			
Running R	obot operation mode	Robot power ON	Robot operatio ready	
Calling C# program	Calling C# program to start			
ExecuteStartCommand RobotOK RC ExecVpPrgTask				
	Execute	Done		
Robot operation ready	UINT#1— TaskNo	Busy — Enter Variable		
	'px.start'— PrgName C	CommandAborted — Enter Variable		
	Enter Variable— PrgParam	Error — Enter Variable		
	INT#1— CycleNumber	ErrorID — Enter Variable		
	UDINT#0— StartStep			
Calling C# program				
RobotOK		opCommand VpPrgTask		
	Execute	Done		
Robot operation ready	UINT#1— TaskNo	Busy — Enter Variable		
	'px.stop'— PrgName C	CommandAborted — Enter Variable		
	Enter Variable— PrgParam	Error Enter Variable		
	INT#1—CycleNumber	ErrorID Enter Variable		
	UDINT#0-StartStep			

# V+ Program

This section describes the V+ program to control the dynamic pick-and-place equipment.

In this section, you create five V+ programs: "px.start" to call the C# program for starting the Process Manager, "px.stop" to call the C# program for stopping the Process Manager, the status monitoring program "supervisor", the regular processing program "control", and the startup processing program "auto".

## • V+Digital I/O

Communications between multiple V+ programs or between V+ programs and external EtherCAT Digital I/O Terminals are performed via V+ Digital I/Os.

The I/O number to be used is shown below. Set No.4001 from the V+Digital I/O Settings.

Range		Number	Applications
1-96	Outputs	Not used	
1001-1096	Inputs	1001	Latch number
2001-2999	Soft Signals	2001	Run the belt conveyor
		2002	Switch fast/slow control of the belt conveyor
		2003	Run the belt conveyor backward
3001-3004	Robot Signals	Not used	
4001-4032	External	4001	Solenoid valve open (GX-MD3218 OUT0)

### • Program to Call C# Program for Starting (px.start)

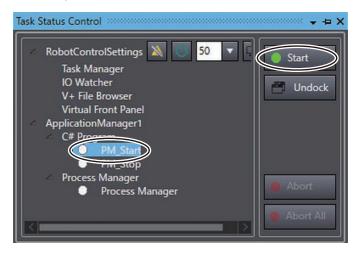
This section describes the program to call the C# programs for starting the Process Manager. An example of a program is provided below.



### Additional Information

You cannot use the program with Sysmac Studio version 1.42. Use the program with Sysmac Studio version 1.43 or higher.

On Sysmac Studio ver.1.42, go online with the IPC Application Controller, select **ApplicationManager1 - C# Program - PM\_Start** and click the **Start** button on the **Task Status Control** pane.



.PROGRAM px.start() GLOBAL \$ip AUTO REAL status TYPE "Start PM\_Start"

```
CALL rm.execute3($ip, "/ApplicationManager1/PM_Start", "Execute", 0, $arg
s[], 3, status)
IF status < 0 THEN
TYPE "Failed to execute: error code ", status
END
.END
```

### • Program to Call C# Program for Stopping (px.stop)

This section describes the program to call the C# program for stopping the Process Manager. An example of a program is provided below.



#### Additional Information

You cannot use the program with Sysmac Studio version 1.42. Use the program with Sysmac Studio version 1.43 or higher.

On Sysmac Studio ver.1.42, go online with the IPC Application Controller, select **ApplicationManager1 - C# Program - PM\_Stop** and click the **Start** button on the **Task Status Control** pane.



```
.PROGRAM px.stop()

GLOBAL $ip

AUTO REAL status

TYPE "Start PM_Stop"

CALL rm.execute3($ip, "/ApplicationManager1/PM_Stop", "Execute", 0, $arg

s[], 3, status)

IF status < 0 THEN

TYPE "Failed to execute: error code ", status

END

.END
```

### Status Monitoring Program (supervisor)

The status monitoring program (supervisor) monitors the regular processing program "control" to ensure that the program does not stop abnormally while the sequence control is in RUN mode. When it detects sequence control going into PROGRAM mode, it stops the regular processing control program "control" and the Application Manager.

4

4-1-1 Program Structure

### 4 Implementation Example of Dynamic Pick-and-place Equipment

An example of a program is provided below.

The variable ebool\_exet1 is a flag that indicates that the V+ program is executable. The sequence control program monitors the status of this variable, and starts automatic operation when the V+ program is ready to run.

```
.PROGRAM supervisor()
        EXTERNAL e is run mode, ebool exet1
        AUTO REAL p_is_run_mode
        GLOBAL $ip
        sip = "127.0.0.1"
        p_is_run_mode = e_is_run_mode
        WHILE TRUE DO
            IF e is run mode THEN
                IF TASK(1,3) <> 4 THEN
                    EXECUTE 3 control()
                END
                ebool exet1 = TRUE
            ELSE
                IF TASK(1,3) <> 0 THEN
                    ABORT 3
                    CYCLE.END 3
                    KILL 3
                END
                IF p_is_run_mode THEN
                    BRAKE
                    CALL px.stop()
                END
            END
            p_is_run_mode = e_is_run_mode
            WAIT
        END
.END
```

#### • Regular Processing Program (control)

Regular processing program is a program that performs a routine processing. If it fails to start, it automatically restarts. The routine processing includes the process of writing values of V+ digital I/O signals to the shared variables with the sequence control program. A program is described below.

```
.PROGRAM control()

EXTERNAL e_conveyor_run

EXTERNAL e_conveyor_spd

EXTERNAL e_conveyor_dir

WHILE TRUE DO

e_conveyor_run = SIG(2001)

e_conveyor_spd = SIG(2002)

e_conveyor_dir = SIG(2003)
```

```
RELEASE
END
.END
```

### Startup Processing Program (auto)

The startup processing program, auto, reads the V+ programs and global variables from the SD Memory Card to the main memory and starts the status monitoring program. Since this program is automatically generated, you don't need to write a program.

# **C# Programs**

This section describes the C# programs to control the dynamic pick-and-place equipment.

#### Startup Program of Process Manager (PM\_Start)

This program launches the Process Manager. An example of a program is provided below.

```
using Ace.Server.Xpert.PackXpert;
using Ace.Services.NameLookup;
using Ace.Client.ApplicationManager.AutoConnect;
using Ace.Server;
using System;
using System.Collections.Generic;
using System.Diagnostics;
namespace Ace.Custom {
     public class Program {
          public INameLookupService ace;
          public void Main() {
               Trace.WriteLine("Script Starting");
               IProcessManager processManager = (IProcessManager) ace[
                   "/ApplicationManager1/Process Manager"];
               processManager.Start();
          }
     }
}
```

#### Stop Program of Process Manager (PM\_Stop)

This program stops the Process Manager.. An example of a program is provided below.

```
using Ace.Server.Xpert.PackXpert;
using Ace.Services.NameLookup;
using Ace.Client.ApplicationManager.AutoConnect;
using Ace.Server;
using System;
using System.Collections.Generic;
```

## 4 Implementation Example of Dynamic Pick-and-place Equipment

### Precautions for Correct Use

The contents of the text string "/ApplicationManager1/Process Manager" in each C# program differ depending on the language used when you created the project file. Select **ApplicationManager1** from the device list in the **Multiview Explorer** and select **Configurations and Setup - Process - Process Manager**. Drag and drop it onto the C# editor, and an appropriate text string is automatically selected.

4

# 4-2 Basic Startup Procedures

This section gives an overview of the basic startup procedures to build a dynamic pick-and-place system.

First, program a machine operation, configure and check the settings using the simulator, and then run the system for fine-tuning the operation.

No.	Procedure		Description	Reference
1	Programming and Simulation Proce-	Creating a project	Create a project file in the Sysmac Studio.	page 4-15
2	dures	Creating the network configuration	Create the EtherCAT network config- uration and register an EtherCAT Digital I/O Terminal, an inverter, and a robot on the network.	page 4-16
3		Writing V+ programs	Create the V+ programs.	page 4-19
4		Writing a sequence control program	Create a sequences control pro- gram.	page 4-23
5		Placing 3D shape data	Place 3D shape data and make the operating range of the robot visible on the 3D Visualizer.	page 4-30
6	-	Creating a Pack Man- ager sample	Configure the robot settings, camera settings, and conveyor settings by using the simulation function and perform teaching.	page 4-53
7		Writing C# programs	Create the C# programs.	page 4-81
8		Running the program (Simulation)	Run the sequence control program on the simulator of the Sysmac Stu- dio.	page 4-87

No.	Pro	cedure	Description	Reference
9	Installing and Wiring the System	Wiring the Robot Inte- grated CPU Unit and EtherCAT Digital I/O Terminal	Wire the Robot Integrated CPU Unit and the EtherCAT Digital I/O Termi- nal.	page 4-94
10		Setting the node ad- dress of the EtherCAT Digital I/O Terminal	Set the EtherCAT node address of the EtherCAT Digital I/O Terminal.	page 4-94
11		Wiring the EtherCAT Digital I/O Terminal and Inverter's EtherCAT communications unit	Wire the EtherCAT Digital I/O Termi- nal and the EtherCAT communica- tions unit of the Inverter.	page 4-95
12		Setting the node ad- dress of the Inverter's EtherCAT communica- tions unit	Set the EtherCAT node address of the EtherCAT communications unit of the Inverter.	page 4-95
13		Wiring the Inverter's EtherCAT communica- tions unit and robot	Wire the EtherCAT communications unit of the Inverter and the robot	page 4-95
14	_	Setting the EtherCAT node address of the ro- bot	Set the EtherCAT node address of the robot.	page 4-96
15		Wiring the robot, T20 pendant, and front pan- el	Wire the robot and the T20 pendant, as well as the robot and the front panel. Use an XSYSTEM cable as- sembly, a T20 adapter cable, and a front panel cable for wiring.	page 4-96
16	-	Wiring the robot and encoder	Wire the robot and the encoder.	page 4-98
17		Wiring the EtherNet/IP Port on the Robot Inte- grated CPU Unit	Wire between the Robot Integrated CPU Unit and the industrial Ethernet switch, between the industrial Ether- net switch and the computer, and be- tween the industrial Ethernet switch and the IPC Application Controller.	page 4-99
18		Wiring the IPC Applica- tion Controller and dis- play and camera	Wire between the IPC Application Controller and the display, and be- tween the IPC Application Controller and the camera.	page 4-100
19		Wiring the camera and robot	Wire the camera and the robot.	page 4-100
20		Wiring the EtherCAT Digital I/O Terminal and solenoid valves	Wire the EtherCAT Digital I/O Termi- nal and the solenoid valves.	page 4-101

4

No.	Procedure		Description	Reference
21	Operation Check on the Actual System	Communication set- tings	Configure the communication set- tings for connecting Sysmac Studio on the computer and the devices.	page 4-103
22		Going online	Connect Sysmac Studio online with the Robot Integrated CPU Unit.	page 4-110
23		Transferring settings and programs	Download the programs and settings in the Sysmac Studio project file to the Robot Integrated CPU Unit and the IPC Application Controller.	page 4-111
24		Camera settings	Set the properties of the camera.	page 4-115
25		Running the sequence control program and V+ program	Run the sequence control program and V+ programs.	4-5-5 Running a Sequence Con- trol Program and V+ Pro- gram on page 4-126
26		Turning robot high pow- er ON	Turn ON the robot high power.	<i>Turning Robot High Power ON</i> on page 3-96
27	-	Calibrating the belt	Perform belt calibration.	4-5-7 Calibrat- ing the Belt on page 4-130
28	-	Sensor calibrations	Calibrate the sensor.	4-5-8 Calibrat- ing the Sensor on page 4-135
29	-	Setting the Locator	Set the Locator.	4-5-9 Setting the Locator on page 4-146
30		Teaching idle, pick, and place positions (On ac- tual equipment)	Operate the robot actually to check and correct teaching data.	page 4-151
31		Running the programs (On actual equipment)	Check the operation of the system before starting the automatic opera- tion.	page 4-154

# 4-3 Programming and Simulation Procedures

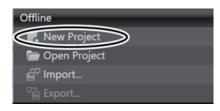
This section describes the procedure for creating project files, programing, and setting and checking operation in simulation.

The simulation function allows you to check the equipment operation before purchasing actual equipment.

# 4-3-1 Creating a Project File

Create a project in the Sysmac Studio.

**1** Start the Sysmac Studio and click **New Project** in the Start page.



The Project Properties dialog box is displayed.

2 In the **Project Properties** dialog box, enter the **Project name**, **Author**, and **Comment**, and select the **Category**, **Device**, and **Version** as shown in the figure below.

Bill Select Device				
Category	Controller		•	
Device	NJ501	▼ - R300	•	
Version	1.43		•	

**3** Select the **Open in Emulation Mode** check box, and click the **Create** button.



4

New Project - new\_Controller\_0 - Systmac Studio (64bit)

File Edit View Insert Project Controller Simulation Tools Window Help

Multiview Explorer

Configurations and Setup
Programming
Programming
Programming
Programming
Programming
Programming
Programming
Description
Program
Description
Descript

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

# 4-3-2 Creating the EtherCAT Network Configuration

Create the EtherCAT network configuration and register an EtherCAT Digital I/O Terminal, an inverter, and a robot on the network.

1 Click Configurations and Setup in the Multiview Explorer.



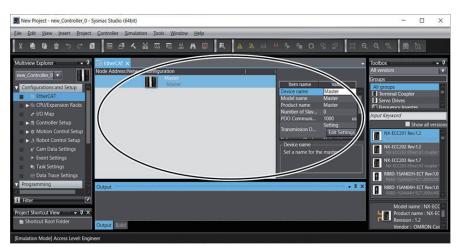
Setting items are displayed under Configurations and Setup in the tree.



2 Double-click EtherCAT under Configurations and Setup in the Multiview Explorer. Or rightclick EtherCAT under Configurations and Setup and select Edit from the menu.



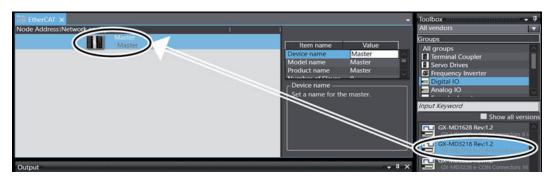
The EtherCAT Master is displayed in the EtherCAT tab page.



**3** From the **Toolbox**, select the group of **Digital IO**.



4 Click and drag the digital I/O to use and drop it on the EtherCAT Master in the EtherCAT tab page. In this example, select **GX-MD3218**.



A **GX-MD3218** is registered under the EtherCAT Master.

EtherCAT 🗙	
Node Address   Network	configuration
	Master Master
1	E001 GX-MD3218 Rev:1.2

- **5** F
  - From the **Toolbox**, select the group of **Frequency Inverter**.

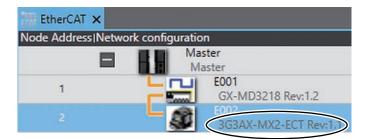


6

Select and drag the inverter to use and drop it on the **GX-MD3218** in the EthercAT tab page. In this example, select **3G3AX-MX2-ECT**.



A 3G3AX-MX2-ECT is added under the GX-MD3218.

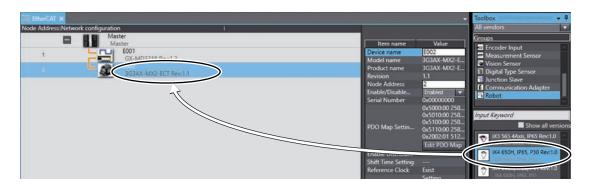


7 From the **Toolbox**, select the group of **Robot**.





Select and drag the robot to use and drop it on the **3G3AX-MX2-ECT** in the EthercAT tab page. In this example, **iX4 650H, IP65, P30** is selected.



An iX4 650H, IP65, P30 is added under the 3G3AX-MX2-ECT in the EtherCAT tab page.

🚟 EtherCAT 🗙	
Node Address  Netw	vork configuration
	Master Master
1	E001 GX-MD3218 Rev:1.2
2	
3	E003 iX4 650H, IP65, P30 Rev:1 0

### 4-3-3 Creating V+ Programs

This section provides the procedure for creating the V+ programs. For details on the program to create and allocation of V+ digital I/Os, refer to V+ *Program* on page 4-6.

## V+Digital I/O Settings

To control EtherCAT Slaves by V+ programs, you must assign V+ digital I/Os.

**1** Ir

In the Multiview Explorer, select **new\_Controller\_0** from the device list.

Multiview Explore	r	• 1
new_Controller_0		
new_Controller_(	0	
RobotContro Programming	DISettings	-1



Click the **b** icon to the left of **Robot Control Setup** in the Multiview Explorer.



The setting items are displayed in the tree view as shown below.





Double-click Robot Common Settings.



The Robot Common Settings tab page is displayed.

📄 Robot Co	mmon Settings	×			•
****	V+	Digital I/O Settings			
		Device	Port	V+Digital I/O	
	+				

4 Click the + button in the **Robot Common Settings** tab page.



A row for registering a new V+ digital I/O is added.

📡 Robot Co	ommon Settir	igs 🗙					
	😴 V+Digital I/O Settings						
		Device	1	Port	T	V+Digital I/O	
	<not< th=""><th>assigned&gt;</th><th>Not ass</th><th>igned&gt;</th><th></th><th></th></not<>	assigned>	Not ass	igned>			

**5** Click the drop-down list for **Device** in the newly added row, and then select **Node:1 GX-MD3218(E001)**.

Device	
<not assigned=""></not>	
<not assigned=""></not>	
Node : 1 GX-MD3218(8	001)

**6** Click the drop-down list for **Port** in the same row, and select **Out Bit00**.



7 Enter 4001 for V+Digital I/O.



## Writing V+ Programs

This section describes the procedure to create V+ programs.

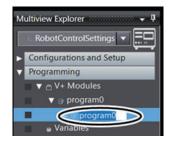
**1** Select **RobotControlSettings** from the device list in the Multiview Explorer.



2 Right-click V+ Modules under Programming in the Multiview Explorer, and select Add New Module from the menu.

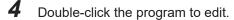


In the tree of the Multiview Explorer, **program0 - program0** are added under **V+ Modules**, which allows you to edit the name of the V+ program.



**3** Enter the name of the V+ program. The name of the V+ program is changed.



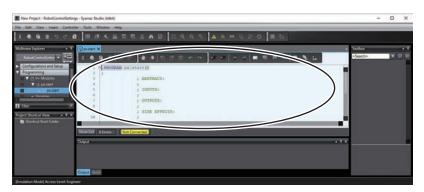




4

4-3-4 Writting a Sequence Control Program

A tab page to edit the V+ program is displayed in the Edit Pane.



- **5** Create the program in the Edit Pane. For details on the program to create, refer to *V*+ *Program* on page 4-6.
- **6** Go back to step 2 and create another V+ program by repeating the sequence of operations.

## 4-3-4 Writing a Sequence Control Program

This section provides the procedure for creating a sequence control program.

For details on the program to create and allocation of V+ digital I/Os, refer to Sequence Control Program on page 4-4.

# **Creating Device Variables**

Create device variables to control the inverter.

1

In the Multiview Explorer, select new\_Controller\_0 from the device list.

Multiview Explorer
new_Controller_0
new_Controller_0
Programming



Double-click I/O Map under Configurations and Setup in the Multiview Explorer.



The **I/O Map** tab page is displayed in the Edit Pane.

Res       Max       M	New Project - new_Controller_0	Sysme: Studio (Adbit)	2	o ×
Willow lighter     Io     I	File Edit View Insert Project		_	
Non-Construint     Not     Decorption     Not     Decorption       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Exact Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Exact Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Exact Configuration and Start     * Configuration and Start     * Configuration and Start     * Configuration and Start       * Exa	X 8 8 8 5 C	◎ 同語人致同意並A Ø A ▲ A A A A A A A A A A A A A A A A		
Count and	Constanting W     Constan	Nutlinit         Decorption         KW         Data Type         Wandle         Wandle Connect           Rock 1         © CR ACCUS         Image: Care ACCUS         Image: Ca		
Cupy And				
Sector Se				
[Emulation Mode] Access Level: Engineer	-			

**3** In the I/O Map tab page, click the icon to the left of **3G3AX-MX2-ECT** in the **Port** column.

Position	Port	Description	R/W
	🔻 💐 EtherCAT Network Configuration		
Node1	GX-MD3218		
Node2	3G3AX-MX2-ECT		
Node3	iX4 650H, IP65, P30		
	V CPU/Expansion Racks		3
CPU Rack	CPU Rack 0		

Setting items are displayed under **3G3AX-MX2-ECT** in the tree.

Position	Port	Description	R/W	Data Type	Variable
	EtherCAT Network Configuration				
Node1	GX-MD3218				
Node2	3G3AX-MX2-ECT				
	Command	This object gives an operat	w	WORD	
	Frequency reference	This object gives an output	w	UINT	
	Status	This object gives the preser	R	WORD	
	Output frequency monitor	This object gives the outpu	R	UINT	
	Sysmac Error Status	Indicate Sysmac error statu	R	BYTE	
NOUCS	IA4 0300, IP03, P30				
	🔻 💐 CPU/Expansion Racks			1	
CPU Rack	CPU Rack 0			1	

**4** Right-click on the **3G3AX-MX2-ECT** in the **Port** column of the **I/O Map** tab page and select **Create Device Variable** from the menu.

Position	Port		Description	R/W	Data Type	Variable
	🔻 💺 EtherCAT Network Config	uration				
Node1	GX-MD3218					
Node2	3G3AX-MX2-ECT					
	Command		rat	w	WORD	
	Frequency reference	Сору	put	w	UINT	
	Status		sei	R	WORD	
	Output frequency ma		tpu	R	UINT	
	Sysmac Error Status		atu	R	BYTE	
Node3	iX4 650H, IP65, P30				1	
	V CPU/Expansion Racks	Search			-	
CPU Rack	CPU Rack 0	Expand/Collapse A	JI.,			
		Create Device Vari	able			
		Create Device Vari	able with Drofor			

The device variable is created.

Position	Port	Description	R/W	Data Type	Variable
	▼ EtherCAT Network Configuration				
Node1	GX-MD3218				
Node2	3G3AX-MX2-ECT				
	Command	This object gives an operat	w	WORD	E002_Command
	Frequency reference	This object gives an output	w	UINT	E002_Frequency_r
	Status	This object gives the preser	R	WORD	E002_Status
	Output frequency monitor	This object gives the outpu	R	UINT	E002_Output_freq
	Sysmac Error Status	Indicate Sysmac error statu	R	BYTE	E002_Sysmac_Erro
Node3	iX4 650H, IP65, P30				
	CPU/Expansion Racks			2	
CPU Rack	CPU Rack 0				

# Defining Global Variables

Define global variables used as the position data in the sequence control program.

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

Programming	
V 🖞 POUs	
▼ in Programs	
► 🔤 Program0	
∟ : Functions	
L SE Function Blocks	
🔻 🎟 Data	Output
∟ 5€ Data Types	
Global V Edit	
► m Tasks	

The global variable table is displayed.

le Edit View Insert Project Contri				_	_	_		_		_	
X 41 41 11 12 12 12 12 12 12 12 12 12 12 12 12		い日本王	11 民 🛕				e n e	Q 14			
fultiview Explorer 👻 🖣 🛛 🕞	bal Variables 🗙		_						-	Toolbox	 * ĝ
new_Controller_0 V Group	Filter 🝸 (No grou	(9				_		_		<search></search>	PX
Programming	~	Data Type	Initial Value	AT	Retain	Constant	Network Publi	sh	C		
POUs	_Mobot001	_sRC_RBT_REF		RC://_RC_RBT[0]	140	*	Do not publish	*			
	RC_Robot001_IO	_sRC_RBT_JO_REF		RC://_RC_RBT_IO[0			Do not publish	*			
	E002_Command	WORD		ECAT://node#2/Co			Do not publish	Ψ.			
	E002_Frequency_refer		8	ECAT://node#2/Fre			Do not publish	*			
► 🕅 Tasks	E002_Status	WORD		ECAT://node#2/Sta			Do not publish	Ψ			
	Dutput_frequen	UINT		ECAT://node#2/Ou			Do not publish	Ŧ			
Filter									121		
Outpu				_					- 0 X		
roject Shortcut View 🔹 🤻 🗙										-	
Shortcut Root Folder											

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

Gro	up Filter 🝸 (No gro	oup) 🔻			
	Name	Data Type	Initial Value	AT	Retain
	RC_Robot001	_sRC_RBT_REF		RC://_RC_RBT[0]	
	RC_Robot001 IO	-00 007 10 015		DO U DO BRT IOIO	
	E002 Create	New		Insert	>

3

Enter or select setting for each item and press the **Enter** key.

terri G	Global Variables 🗙							
Gro	up Filter 🍸 (No group	p) 🔻						
	Name	Data Type	Initial Value	AT	Retain	Constant	Network Publish	Comment
	RC_Robot001	_sRC_RBT_REF		RC://_RC_RBT[0]		×	Do not publish 🔍	
	RC_Robot001 IO	PC PRT IO PTC		new_ne_ne_			2	
$\ll$	e_conveyor_dir	BOOL					Do not publish 🔻	Conveyor reverse commo
	E002_Command	TUNE		ECAT. //anda#2/Ca			B	
	E002 Erequency refer	LIINT		ECAT://node#2/Ere			Do not publish	

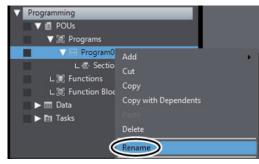
Refer to Sequence Control Program on page 4-4 for the global variables to register.

The global variable is registered.

### **Creating Ladder Diagram Programs**

This section describes how to create the ladder diagram programs.

**1** Right-click **Program0** under **Programming - POUs - Programs** in the Multiview Explorer and select **Rename** from the menu.



This allows you to edit the name of the sequence control program.





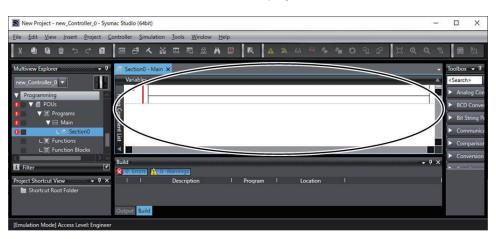
Enter the name of the sequence control program. The name of the sequence control program is changed.



**3** Double-click the section to edit.



The variable table and Ladder Editor are displayed in the Edit Pane.



4 Enter the program in the Ladder Editor. Internal and external variables are automatically registered when they are entered in the program.

For details on the program to create, refer to Sequence Control Program on page 4-4.

To create more than one sequence control program, perform the following steps.

5

Right-click **Programs** under **Programming** - **POUs** in the Multiview Explorer, and then select **Add** - **Ladder** from the menu.



Program0 is added under Programs.



**6** Click the icon displayed to the left of **Program0** under **Programming - POUs - Programs** in the Multiview Explorer.



#### Section0 is added under Program0.

Programming
🖉 🔮 POUs
V 🕅 Programs
🗸 🔤 Main
L 쿕· Section0
Program0
L 🗟 Section()

**7** Returns to step 1 and repeat the above steps.

## **Assigning Programs to Tasks**

In this section, assign the ladder diagram programs to tasks of the Robot Integrated CPU Unit. In this guide, multiple ladder diagram programs are used to control the dynamic pick-and-place equipment, so it is necessary to assign the programs to tasks.

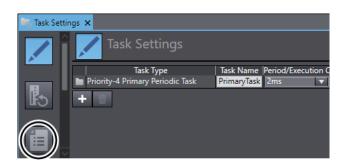
When the equipment is controlled by the V+ Program, only one ladder diagram program is used and you do not need to perform the steps in this section.





The Task Settings tab page is displayed.

**2** Click the **Program Assignment Settings** button (**1**) in the Edit Pane.



**3** Click the **+** button.

🔚 Task Settin	gs ×			
Ń	Program A	ssignment	Settings	
k	1 Main	Program name	Initial status Run	<b>_</b>

A new row is added for the program to assign.

Task Settin	ngs X			
Ń	Program	Assignment	Settings	
	🔻 🖿 PrimaryTask			
		Program name	Initial status	
LES .	Main	<b>T</b>	Run	
			Run	
		Ū		

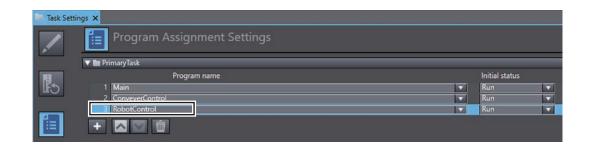
**4** Select a name of the program to use from the list of the **Program name**.

Task Sett	ings ×		
	Program Assignment Settings		
	🔻 🖿 PrimaryTask		_
18	Program name	Initial status	
E5	1 Main	Run	-
	ConveyerControl KobolControl	Run	

The name of the selected program is displayed.

Task Setti	ngs ×		
	Program Assignment Settings		
	🔻 🖿 PrimaryTask		
間.	Program name		Initial status
FS	1 Main		Run 🔻
	2 ConveyerControl	<b>▼</b>	Run 🔻
	+		

**5** Perform step 3 and later for **RobotControl**.



### 4-3-5 Placing 3D Shape Data

## Making the Robot Motion Range Visible

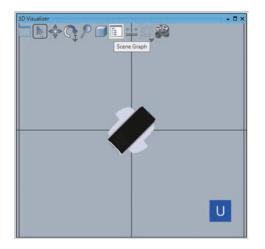
You can make the operating range of the robot visible on the 3D Visualizer. Making the operating range visible makes it easier to set the position of the robot.

**1** Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

File Edit	View Insert	Controller	Tools	Window	Help
X 🖷	Multiview Exp	plorer		Alt+1	I.
~	Project Short	cut View		Alt+9	Shift+1
Multiview I	Toolbox			Alt+2	2
Robo	3D Visualizer	>		Alt+S	Shift+2
KODO	Output Tab P	age		Alt+3	3
Configu	Watch Tab Pa	ige		Alt+4	1
Program	Watch Tab Pa	ge(Table)		Alt+S	Shift+4
I					

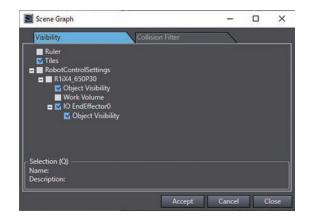


In the 3D Visualizer, click the Scene Graph icon.



Note The 3D Visualizer is in Float mode in this procedure. For information on Float mode, refer to A-2-1 Set the 3D Visualizer to the Float Mode on page A-21.

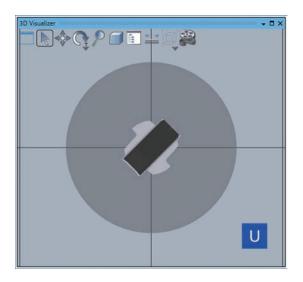
The Scene Graph dialog box is displayed.



**3** In the **Visibility** tab page, select the **Work Volume** check box located under **RobotControlSettings - R1iX4\_650P30**.

Scene Graph		-	×
Visibility	Collision Filter		
Ruler			
Tiles			
RobotControlSetti R1iX4_650P30			
Chiect Visib	ility		
Work Volum			
	010		
🗹 Object Vi	sibility		
Selection (Q)			
Name:			
Description:			
Description.			

The 3D Visualizer illustrates the robot's operating range in gray.





Click the Close button on the Scene Graph dialog box.

Scene Graph		-		×
Visibility	Collision Filter			
Ruler     Tiles     RobotControlSettings     With RiX4_650P30     Object Visibility     Work Volume     VI O EndEffector0     Object Visibility				
- Selection (Q) Name: Description:				
	Accept	Cancel	0	lose

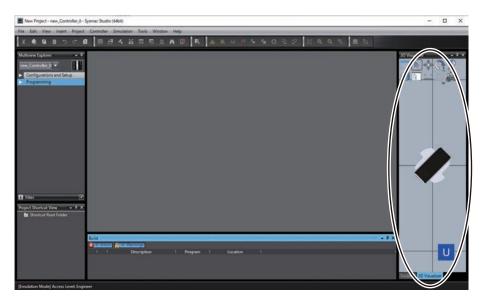
# Placing the Robot on the 3D Visualizer

Place the robot in the appropriate position on the 3D Visualizer.

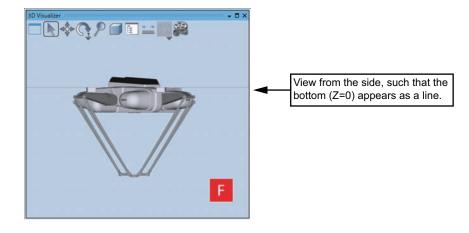
**1** Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

File	Edit	View	Insert	Controller	Tools	Window	Help
x	4	Mul	tiview Ex	plorer		Alt+1	I.
^	-	Proj	ect Shor	tcut View		Alt+5	Shift+1
Multiv	iew B	Tool	lhov			Alt+2	2
		3D I	Visualize	$\supset$		Alt+S	Shift+2
- 8	lobot	Out	put Tab I	Page		Alt+3	3
> Co	nfigu	Wat	ch Tab P	age		Alt+4	1
V Pro	gran	Wat	ch Tab P	age(Table)		Alt+5	Shift+4
	( al						

The 3D Visualizer is displayed on the right side of the main window.



**2** Make the 3D Visualizer get into Float mode, and move the viewpoint as shown below.





#### Additional Information

For information on how to change the viewpoint in the 3D Visualizer, refer to the A-2 How to Use 3D Visualizer on page A-21.

Move the mouse cursor onto the robot and right-click it. The menu commands are displayed.



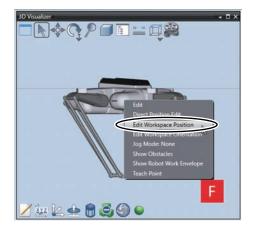
3

#### **Additional Information**

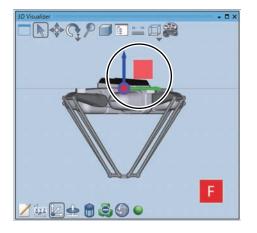
When the mouse cursor is moved onto the robot, the name of the 3D shape data / **RobotControlSettings/R1iX4\_650P30** is displayed.



4 Select Edit Workspace Position from the menu.



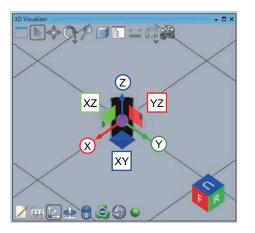
The Move icon consisting of colored arrows, a purple circle, and faces is displayed on the origin of the 3D shape data.



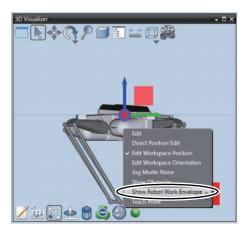


#### **Additional Information**

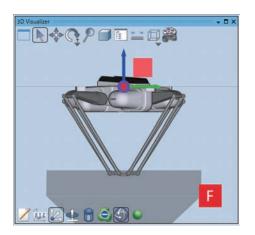
The Move icon has red, green, and blue arrows, which represent the X-axis, Y-axis, and Z-axis, respectively. The red face shows the YZ plane, the green face shows the ZX plane, and the blue face shows the XY plane.



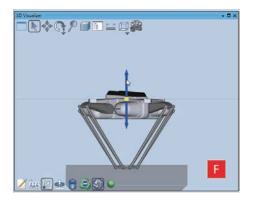
You can drag an arrow to move the 3D shape data along the axis. Or, use the face icon to move the 3D shape data on the corresponding plane. You can also move the 3D shape data independently from the axis direction by dragging the purple circle. **5** Move the mouse cursor onto the robot and right-click it, and select **Show Robot Work Envelope** from the menu.



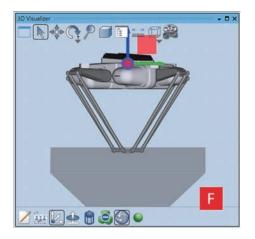
The robot's operating range is colored in gray in the 3D Visualizer.



**6** Click the blue arrow and drag upward to pull the robot upward in Z-axis direction from the origin.



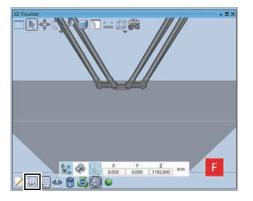
Move it so that the operating range is above the bottom surface.





#### **Additional Information**

You can zoom in on the 3D Visualizer to see the operating range more clearly. You can also check the position on the X, Y, and Z axes in numbers by clicking the **Direct Position Edit** icon.



For information on how to zoom in or zoom out in the 3D Visualizer, refer to the A-2-4 Zoom-in and Zoom-out on page A-26.

## Importing 3D CAD Data and Placing It on the 3D Visualizer

Import the 3D CAD data of the conveyors as 3D shape data to the Sysmac Studio. This section describes the procedure to import the 3D CAD Data of Conveyor A and Conveyor B to be used as equipment models and place them on the 3D Visualizer.

**1** Select **Application Manager** from the **Insert** menu on the main window of the Sysmac Studio.



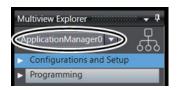
The Add Device dialog box is displayed.



2 Select an item from the drop-down list of **Category**, **Device**, and **Version** as shown in the figure below, and then click the **OK** button.

Add Device	×
Select Devi	ice
Category	Application Manager 🔹
Device	AM101 🔻 - 1000 🔻
Version	3.00 🔻
(	OK Cancel

ApplicationManager0 is added to the drop-down list at the top of the Multiview Explorer



_	
_	
-	
_	-11.11

#### Additional Information

Application Manager added by this operation can only be used for simulation. Do not use it for actual device.

**3** Click **Configurations and Setup** in the Multiview Explorer.



Setting items are displayed under **Configurations and Setup** in the tree.

Mul	tiview Explorer 🚽 🗸
Ap	plicationManager0 🔻
$\mathbf{v}$	Configurations and Setup
1	III Settings
	3D Visualization
1	🗇 Robot Vision Manager
	🗂 Cameras
	Configuration
	Feeders
1	Process
	🖻 Vision Tools

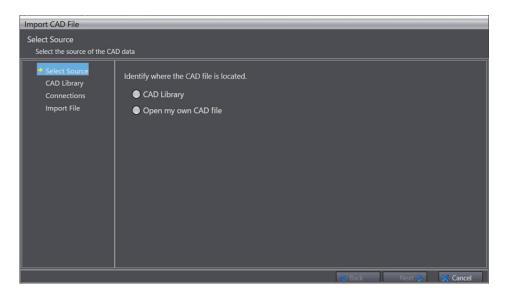
## **4** Right-click **3D Visualization**.

The menu commands are displayed.

**5** From the menus, select **Add** - **CAD Data**.

	w Explorer ationManager0 🔻	- <del>-</del>			
V Con	figurations and Setup				
	III Settings				
	3D Visualization	A DEC	1.000		
	Robot Vision Ma	Add		Box	
	Cameras			Cylinder	
	Configuration	Add Shortcut	_(	CAD Data	

The Import CAD File wizard starts.





Select Open my own CAD file check box.

7 Click the **Next** button.

Import CAD File	
Select Source Select the source of the CA	Ŋ data
CAD Library CAD Library Connections Import File	Identify where the CAD file is located.  CAD Library  Open my own CAD file
	Back Next S Cancel

### 8 Click the Open File button.

Import CAD File	
Import File Import the selected CAD f	e
<ul> <li>✓ Select Source</li> <li>✓ CAD Library</li> <li>✓ Connections</li> <li>✓ Import File</li> </ul>	Select the file which should be imported.          File Name       +90 Yaw       +90 Pitch

The **Open** dialog box is displayed.

S Open								×
← → ∽ ↑ 🚺	🕨 > This P	C > 3D Objects		¥	υ	Search 3D Objects		٩
Organise • Ne	w folder					<b>E</b>	- 🗆	0
📕 x64	^		No items match your search.					
🗸 🍠 This PC								
> 🗊 3D Objects								
> Desktop								
> 🖹 Documents								
> 🖊 Downloads								
> 👌 Music								
S Dictore	~							
1	File <u>n</u> ame:	SVKN-100-1000-25-T100-IM-9-H-A.stp			~	STEP File (*.stp;*.ste	ep)	~
						Open	Can	100

1		L
ų	<u> </u>	

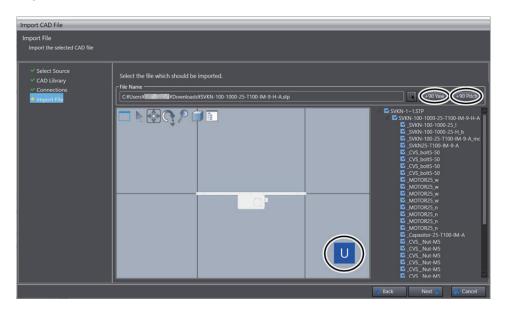
Select a 3D CAD data to import, and then click the **Open** button. In this example, you select the conveyor of MISUMI Corporation whose model number is SVKN-100-1000-25-T100-IM-9-H-A for the Conveyor A. You can import the 3D CAD data with the file name extension "stp".

S Open					>
← → × ↑	🕽 > This	PC > 3D Objects	~ U	Search 3D Objects	م
Organise • N	ew folder			II -	. 0
📜 хб4	^	SVKN-100-1000-25-T100-IM-9-H-A.stp			
SThis PC					
3D Objects					
Desktop					
Documents					
Downloads					
Music					
Dictures	~				
	F. Cname	e: SVKN-100-1000-25-T100-IM-9-H-A.stp	v	STEP File (*.stp;*.step)	~
	0		(	Open 0	ancel

The Open dialog box is closed and import of 3D CAD data starts automatically.



When the import completes, the assemblies of the imported 3D CAD data is displayed in the **Import CAD File** wizard.





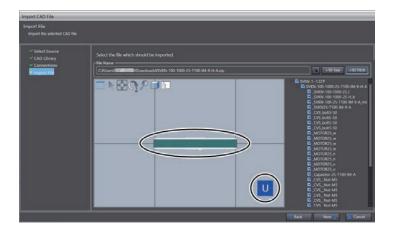
#### Additional Information

Align the conveyor top to the U face. Click the **+90 Yaw** button or **+90 Pitch** button to change the orientation of the conveyor.

If you use positioned and oriented CAD data, this operation is not necessary.

**10** Click the buttons in the following order; **+90 Yaw**, **+90 Pitch**, **+90 Yaw**, **+90 Pitch** and **+90 Pitch** 

The conveyor top comes to the U face.



**11** Select the parts to add for simulation, and click the **Next** button.

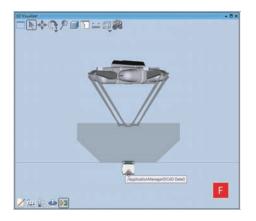
Import CAD File		
Import File Import the selected CAD file		
Select Source     CAD Library     Connections     Import File	Select the file which should be imported. File Name C-Videes/Participation - 1000-25-7100-IM-9-H-Astp	+90 Yaw +90 Pitch
		U V SVRN 1002-25-1100-1M-94-A SVRN 1002-25-1100-1M-94-A SVRN 1002-25-1100-1M-94-A CVS-bolt 0 CVS-bolt 0 C
		Sack Next > X Cancel

The **Import CAD File** wizard is closed and the main window is displayed again.

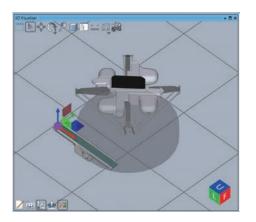
12 Check that CAD Data0 is added under Configurations and Setup - 3D Visualization in the Multiview Explorer.



**13** Place the conveyor A in the same manner as in *Placing the Robot on the 3D Visualizer* on page 4-32.

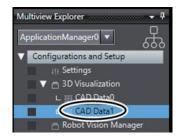


Place the conveyor A in a position where the robot can pick up the workpiece within the operating range of the robot.

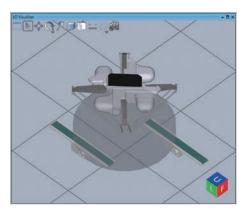


**14** Perform step 4 and later for the Conveyor B.

In the Multiview Explorer, CAD Data1 is added under Configurations and Setup - 3D Visualization.



Place the conveyor B within the operating range of the robot, where the robot can place the workpiece.



Now import of the 3D CAD data for Conveyor A and Conveyor B and their placement are completed.

# **Activating Collision Detection Function**

The collision detection function detects the contacts in simulation that may occur between the robot and other 3D shape data, such as objects imported as 3D CAD data. If the robot may contact with other 3D shape data, you need to change the layout of the robot or the 3D shape data or modify the movement of the robot.

In this section, the setting procedure to detect a contact between the robot, Conveyor A and Conveyor B is given. Because the collision detection function checks whether 3D shape data may collide between groups, you create two groups; Group 0, which includes the robot, and Group 1, which includes Conveyor A and Conveyor B.

#### Precautions for Correct Use

In this guide, the target of collision detection is the robot. When the 3D shape data is placed at the tool center point, collision detection of that 3D shape data is also required. For information on collision detection operation in which the 3D shape data attached to the tool center point is subject to the collision detection, refer to the Sysmac Studio 3D Simulation Function Operation Manual (Cat. No. W618).

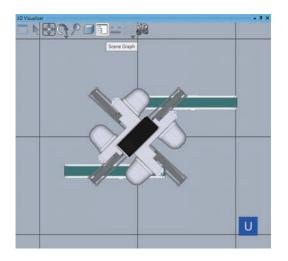
1 Select 3D Visualizer from the View menu on the main window of the Sysmac Studio.

View	Insert	Controller	Tools	Window	Help
Mul	tiview Ex	plorer		Alt+1	1
Proj	ect Short	cut View		Alt+S	Shift+1
Tool	box			Alt+2	2
3D \	/isualizer	5		Alt+9	Shift+2
Ever	nt Log		-		

The 3D Visualizer is displayed on the right side of the main window.

🧱 New Project - Application/Manageri) - Sysmac Studio (54bit)	- 0 ×
File Edit View Insert Controller Tools Window Help	
Mathiew Explorer 🔹 🔍	30 Visualizer + # X
ReplicationManagerd • CCO	TRACP
Configurations and Setup	
In Settings	
L III CAD David	
L III CAD Deta1	
○ Robot Vision Manager ○ Cameras	
_ cartoss Configuration	
_ Feeders	
<ul> <li>Process</li> <li>Valen Tools</li> </ul>	
E Vision Loos	
II Filter 🕜	
Project Shortcut View • 8 X	
Shortrut Root Folder	
h.ad .	1 x
S Internet Avenuera	
I Description I Program I Location I	
	U
Delpad Build	Solitone 3D Visualizer
Encodering Market Access Lands Encodered	

2 In the 3D Visualizer, click the Scene Graph icon.



The Scene Graph dialog box is displayed.

Scene Graph		1		×
Visibility	Collision Filter			
<ul> <li>Ruler</li> <li>✓ Tiles</li> <li>✓ ApplicationManager0</li> <li>✓ CAD Data0</li> <li>✓ CAD Data1</li> <li>✓ Object Visibility</li> <li>✓ CAD Data1</li> <li>✓ Object Visibility</li> <li>■ RobotControlSettings</li> <li>■ Rixt4_550930</li> <li>✓ Object Visibility</li> <li>■ Work Volume</li> <li>■ V Io EndEffector0</li> <li>✓ Object Visibility</li> </ul>				
Selection (Q) Name: Description:				
	Accept	Cancel	CI	lose

**3** Click the **Collision Filter** tab.

Scene Graph		2000	×
Visibility Collision Filter			
■ ☑ ApplicationManager0 ■ ☑ CAD Data0			
G Object Visibility			
a 🖸 CAD Data 1			
Solution State Sta			
BobstControlSettings			
■ ■ R1iX4_650P30 South State			
Work Volume			
■ VI DEndEffector0			
Solution State Sta			
Selection (Q)			
Description:			
	Accept	Cancel	lose

4 Click the + button in the Collision Filter Group Items column for the Collision Filter Group.

Scene Graph	6	-		×
Visibility Collision Filter				
Set collision filter groups. Collisions between the 3D shapes in the same group will not be dete Note that if you hide an object included in the collision detection gr		and the	n save t	he pro
Valid   Collision Filter Group Name   Collision Filter Group Iten Collision Filter Group 0-item collection	Falling	Reset	fallin	
Accept	t Ca	ncel	a	ose

A new row with the **Collision Filter Group Name** set as **Group0** is added on the **Scene Graph** dialog box.

Scene Graph		-	- 0	×
Visibility	lision Filter			
Set collision filter groups. Collisions between the 3D shapes in the Note that if you hide an object included			nd then sav	e the pro
Valid   Collision Filter Group Name	Collision Filter Group Items	Falling	Reset fallir	H
Collicion Eilter Group	1-item collection +			
Group0	1-item collection +			
			Execute	
				1
	Accept	Car	icel	Close

**5** Repeat step 4 above.

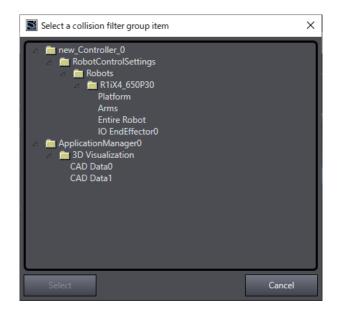
A new row with the **Collision Filter Group Name** set as **Group1** is added on the **Scene Graph** dialog box.

Scene C	Graph		-	- 🗆	×
Visibilit	y Col	lision Filter			
Collisions				nd then sav	e the pro
Valid	Collision Filter Group Name	Collision Filter Group Items	Falling	Reset fallin	
	Collision Filter Group	2-item collection +			
	▲ Group0	1-item collection +			
	101			Execute	
	▲ Group1	2-item collection + 1-item collection + 1-item collection + Exe			
				Execute	
		Accept	Car	ncel	Close

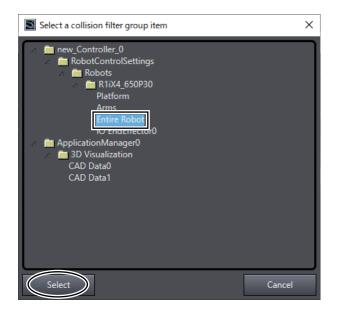
6 Click the ... button in the Collision Filter Group Items column for Group 0 - [0].

Scene G	iraph			- 0	×
Visibility	y Col	lision Filter			
Collisions I		same group will not be detecte in the collision detection group		nd then save	e the pro
Valid	Collision Filter Group Name	Collision Filter Group Items	Falling	Reset falling	
		2-item collection +			
	✓ Group0	1-item collection +			
	[0]	( ) ·		Execute	
	▲ Group1	1-item collection +			
	[0]			Execute	
					2.0
		Accept	Car	ncel	Close

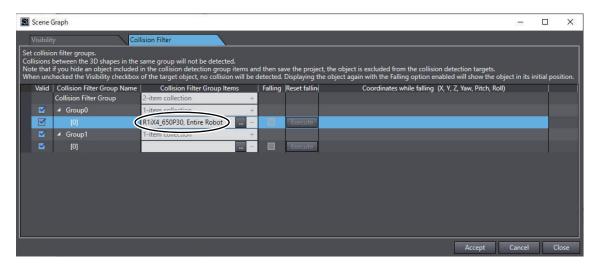
The Select a collision filter group item dialog box is displayed.



7 Select new\_Controller\_0 - RobotControlSettings - Robots - R1iX4\_650P30 - Entire Robot in the tree, and then click the Select button.



The **Select a collision filter group item** dialog box closes and the **Scene Graph** dialog box is displayed again. **R1iX4\_650P30, Entire Robot** is registered in the **Collision Filter Group Items** column for **Group0 - [0]**.



8 Click the + button in the Collision Filter Group Items column for Group 0.

Scene G	Graph					1200		×
Visibility	y Col	lision Filter						
ollisions l ote that i	if you hide an object included	same group will not be detected. in the collision detection group items ar of the target object, no collision will be	nd then sa detected.	ave the project, the Displaying the obj	object is excluded from the collision detection targets. ject again with the Falling option enabled will show the objec	ct in its i	nitial po	sitior
	Collision Filter Group Name	Collision Filter Group Items 2-item collection	Falling	Reset fallin	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)			_
	Collision Filter Group Group0	1-item collection +	2					
	[0]	R1iX4_650P30, Entire Robot		Execute				
	▲ Group1	1-item collection +						
	[0]			Execute				
								_

Scene Graph × \_ Ventros Set collision filter groups. Collisions between the 3D shapes in th Note that if you hide an object include Men unchecked the Visibility checkbe Clear Group Nam iame group will not be detected. In the collision detection group items and then save the project, the object is excluded from the collision detection targets. of the target object, no collision will be detected. Displaying the object again with the Falling option enabled will show the object in its initial p Valid | Collision Filter Group Name **Collision Filter Group Items** Falling Reset fallin Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll) 2-item collectio R1iX4\_650P30, Entire Robot -item collection

#### A new row [1] is added under Group 0.

9 Click the ... button in the Collision Filter Group Items column for Group 0 - [1].

S S	Scene (	Graph					200		×
V	/isibilit	y Col	lision Filter						
Colli Note	isions l e that i	if you hide an object included	same group will not be detected. in the collision detection group items an of the target object, no collision will be c	d then sa letected.	ive the proje Displaying t	ct, the object is excluded from the collision detection targets. he object again with the Falling option enabled will show the objec	t in its in	itial po	sition.
	Valid	Collision Filter Group Name Collision Filter Group	Collision Filter Group Items 2-item collection +	Falling	Reset falling	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)			
		✓ Group0	2-item collection +						
		[0]	R1iX4_650P30, Entire Robot		Execute				
					Execute				
		✓ Group1	1-item collection +						
		[0]	···		Execute				
						Accept	Cancel		Close

Select a collision filter group item

 Image: Select a collision filter group item
 X

 Image: Select a collision filter group item
 X
 <

The Select a collision filter group item dialog box is displayed.

**10** Select new\_Controller\_0 - RobotControlSettings - Robots - R1iX4\_650P30 - IO EndEffector0 in the tree, and then click the Select button.

Select a collision filter group item	×
<ul> <li>new_Controller_0</li> <li>RobotControlSettings</li> <li>Robots</li> <li>Relived 650P30</li> <li>DEndEffector0</li> <li>ApplicationManageru</li> <li>3D Visualization CAD Data0</li> <li>CAD Data1</li> </ul>	
Select Cano	el

The Select a collision filter group item dialog box closes and the Scene Graph dialog box is displayed again. IO End effector 0 (R1iX4\_650P30) is registered in the Collision Filter Group Items colimn for Group0 - [1].

5	Scene (	Graph			200		×
	Visibilit	y Col	ision Filter				
Co	llisions te that	if you hide an object included	same group will not be detected. In the collision detection group items and then save the project, the object is excluded from the falling of the target object, no collision will be detected. Displaying the object again with the falling	ne collision detection targets. option enabled will show the objec	t in its ir	iitial po	sition.
	Valid	Collision Filter Group Name	Collision Filter Group Items   Falling  Reset fallin  Coordinates whil 2-item collection +	e falling (X, Y, Z, Yaw, Pitch, Roll)			
		✓ Group0	2-item collection +				
		[0]	R1iX4 650020 Entire Dabat				
		m 🤇	IO EndEffector0 (R1iX4_650P30)				
		▲ Group1	1-item conection +				
		[0]	Execute				
				Accept (	Cancel	0	Close

11 Click the ... button in the Collision Filter Group Items column of the row whose Collision Filter Group Name is Group 1 - [0].

Visibilit		lision Filter							
lisions		same group will not be detected.		noraber eret ein "ab er	and the second second descent all as second second				
	hecked the Visibility checkbox	in the collision detection group items ar of the target object, no collision will be Collision Filter Group Items	detected.			abled will show the obje	ct in its i	nitial po	ositi
Valid	Collision Filter Group	2-item collection +		Reset family	Coordinates while failing (	, 1, 2, 1aw, Fitch, Kolly			
	▲ Group0	2-item collection +							
	[0]	R1iX4_650P30, Entire Robot 🛛 –		Execute					
	[1]	IO EndEffector0 (R1iX4_650P30)		Execute					
	▲ Group1	1-item collection +							
	[0]			Execute					
		9							

The Select a collision filter group item dialog box is displayed.

12 Select ApplicationManager0 - 3D Visualization - CAD Data0 from the tree, and then click the Select button.



The Select a collision filter group item dialog box closes and the Scene Graph dialog box is displayed again. CAD Data0 is registered to the Collision Filter Group Items column for Group 1 - [0].

Scer	e Graph					1.00		×
Visib	ility Col	lision Filter						
Collision Note th	at if you hide an object included	same group will not be detected. in the collision detection group items and of the target object, no collision will be d	l then sa etected.	we the project Displaying the	, the object is excluded from the collision detection targets. • object again with the Falling option enabled will show the objec	ct in its in	itial po	sition.
Val		1	Falling	Reset fallin	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)			
	Collision Filter Group	2-item collection +						
	▲ Group0	2-item collection +						
	[0]	R1iX4_650P30, Entire Robot 🛛 –		Execute				
	[1]	IO EndEffector0 (R1iX4_650P30)		Execute				
	▲ Group1	1 ·· ···· +						
	[0]	CAD Data0		Execute				
					Accept	Cancel	C	lose

**13** Click the + button in the **Collision Filter Group Items** column for **Group 1**.

collisio	on filter groups.								
lisions l	between the 3D shapes in the	same group will not be detected.							
e that en uncl	If you hide an object included hecked the Visibility checkbox	In the collision detection group iter of the target object, no collision wi	ms and Il be d	a then sa letected.	Displaying the object	object is excluded from the collision detection targets. ct again with the Falling option enabled will show the object	t in its in	tial posi	itior
	Collision Filter Group Name				Reset fallin	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)			
	Collision Filter Group	2-item collection	+						
	▲ Group0	2-item collection	+						
	[0]	R1iX4_650P30, Entire Robot	. 121		Execute				
	[1]	IO EndEffector0 (R1iX4_650P30)			Execute				
	▲ Group1	1-item collection	(+)	)					
	[0]	CAD Data0	. –		Execute				

A new row [1] is added under Group 1.

5	Scene (	Graph					200		×
	Visibilit	ty Col	lision Filter						
Co No	lisions te that	if you hide an object included	same group will not be detected. in the collision detection group items and of the target object, no collision will be d	d then si letected	ave the projec Displaying th	t, the object is excluded from the collision detection targets. e object again with the Falling option enabled will show the objec	t in its ir:	iitial po	osition.
F	Valid	Collision Filter Group Name	Collision Filter Group Items	Falling	Reset falling	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)			
		✓ Group0	2-item collection +						_
		[0]	R1iX4_650P30, Entire Robot 🛛 🔐 —		Execute				
		[1]	IO EndEffector0 (R1iX4_650P30)		Execute				
	V	🔺 Group1	2-item collection +						
			CAD Data0		Execute				
		(m)			Execute				
		•							
							2	1	
						Accept	Cancel		Close

**14** Follow the step 8 to 10 to register CAD Data1 for Group 1 - [1].

CAD Data1 is registered to the Collision Filter Group Items column for Group 1 - [1].

and the second se	ly Col	llision Filter					
	on filter groups.						
		same group will not be detected. in the collision detection group items an	d then sa	ve the project, the	object is excluded from the collision detection targets.		
hen unc	hecked the Visibility checkbox	of the target object, no collision will be o	detected.	Displaying the obje	ect again with the Falling option enabled will show the obj	initial po	ositi
Valid	and the second se		Falling	Reset fallin	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)		
	Collision Filter Group	2-item collection +					
	▲ Group0	2-item collection +					
	[0]	R1iX4_650P30, Entire Robot		Execute			
	[1]	IO EndEffector0 (R1iX4_650P30)		Execute			
	▲ Group1	2-item collection +					
	[0]	CAD Data0		Execute			
		CAD Data1 -		Execute			
a dente							

**15** Check that the **Valid** check boxes are all selected. If there is a check box not selected, click it to select.

Scene Graph					2000		>
Visibility	Collision Filter						
ote that if you hide an obj	napes in the same group will not be detected. ect included in the collision detection group iter ty checkbox of the target object, no collision wi	ms and then sa ill be detected.	ve the project, the Displaying the ob	e object is excluded from the collision detection targets. ject again with the falling option enabled will show the obje	ct in its ir	iitial po	ositio
Valid   Collision Filter G			Reset fallin	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)		Í	
Collision Filter G	oup 2-item collection	+					
🗹 🖌 Group0	2-item collection	+					
<b>[</b> 0]	R1iX4_650P30, Entire Robot		Execute				
<b>I</b> [1]	IO EndEffector0 (R1iX4_650P30)		Execute				
🗹 🖌 Group1	2-item collection	+					
[0]	CAD Data0		Execute				
II [1]	CAD Data1	🗌	Execute				
$\lor$							
				Accept	Cancel		Clos

## **16** Click the Accept button.

A collision filter configuration is saved.

17 Click the Close button in the Scene Graph dialog box.

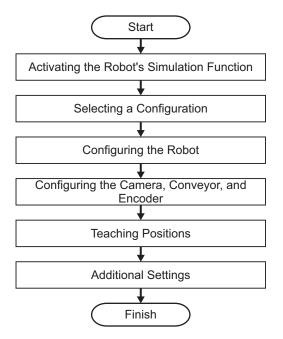
Visibilit	ty Col	lision Filter						
llisions te that	if you hide an object included	same group will not be detected. in the collision detection group items a of the taraet object. no collision will be	nd then sa	ve the project, the Displaving the obj	: object is excluded from the collision detection targets. ject again with the falling option enabled will show the obje	ct in its ir	nitial po	sitio
Valid				Reset fallin	Coordinates while falling (X, Y, Z, Yaw, Pitch, Roll)			
	Collision Filter Group	2-item collection +						
	✓ Group0	2-item collection +						
	[0]	R1iX4_650P30, Entire Robot		Execute				
	[1]	IO EndEffector0 (R1iX4_650P30)		Execute				
	▲ Group1	2-item collection +						
	[0]	CAD Data0		Execute				
	[1]	CAD Data1	-	Execute				

The Scene Graph dialog box is closed.

Now, the settings for checking for collision between the robot and Conveyor A, and between the robot and Conveyor B have been completed.

#### 4-3-6 Creating a Pack Manager Sample

This section describes the procedure to create a Pack Manager sample. The operations flow is as follows.



## **Enabling Robot Simulation Function**

Enable the simulation function of the Sysmac Studio.

To simulate the operation of the robot, open the project file in EMULATION mode.

4

If you want to know whether the project file opened on the Sysmac Studio is in EMULATION mode or not, check the status bar on the main window. When you see **[Emulation Mode] Access Level: Engineer** on the status bar, the project is opened in EMULATION mode.

New Project - ApplicationManager0 - Sysmac Studio (64bit)	1 <u>220</u>		×
File Edit View Insert Controller Tools Window Help	_	_	
Multiview Explorer       ↓         ApplicationManager0       ↓         ✓ Configurations and Setup       ↓         ↓↓ Settings       ↓ <td>Toolbo <sear< td=""><td>ox ch≻</td><td>+ 1 •</td></sear<></td>	Toolbo <sear< td=""><td>ox ch≻</td><td>+ 1 •</td></sear<>	ox ch≻	+ 1 •
Project Shortcut View ••••••••••••••••••••••••••••••••••••			
[Emulation Mode] Access Level: Engineer Emulation Mode [Emulation Mode] Access Level: Engineer Access Level: Engineer			

If the project is opened in a different mode, click the **Enable emulation mode** icon on the toolbar to change to EMULATION mode.



1 In the Multiview Explorer, select **new\_Controller\_0** from the device list.



2 Select Run from the Simulation menu.

The screen below is displayed while the simulator is starting.



After this screen is closed, the lower part of the toolbar in the main window turns yellow-green.

File	Edit	View	Inse	ert	Proje	ect	Con	trolle	er	S
X	4	6	ė ·	\$	¢	2		3D	đ	1
<										≥

# Selecting a Configuration

Select the configuration of the robot and peripheral devices.

Decide whether to use the pallet function, belt encoder, and camera in pick-and-place operation. Details of the features and information on how to select them are given below.

In this guide, pick operation uses the belt encoder and camera, and the pallet function is not used.

Letter	Opera- tion	Function	Content
A	Pick	Pallet	You can choose whether the pick position is considered a palette or not. If this function is selected, a workpiece can be picked from each row/column of the palette.
В	Pick	Encoder	You can choose whether to use the belt encoder for adjusting the pick position. Select this to pick a workpiece that flows on the belt conveyor.
С	Pick	Camera	You can choose whether to use the camera for adjusting the pick position. Select this to pick a workpiece on the conveyor and the posture of the workpiece is not constant.
D	In con- veyance	Camera	You can choose whether to adjust the placing position by using the camera in an upward-facing position. Select this to place workpieces in the same orientation on the unloading side conveyor.
E	Place	Pallet	You can choose whether the placing position is considered a palette or not. If this function is selected, workpieces can be placed in each row/column of the palette.
F	Place	Encoder	You can choose whether to use the belt encoder for adjusting the placing posi- tion. Select this to place workpieces in an evenly spaced alignment on the unloading side conveyor.
G	Place	Camera	You can choose whether to use a camera for adjusting the placing position. Select this to place workpieces to fit a particular pattern.

The table below lists the pick configurations.

A, B, and C in the table above represent pick operations.

Selections		າຣ	Configuration			
Α	В	С	Configuration name			
Yes	Yes	Yes	No configuration available Create a Pack Manager sample and change the Process Manager settings by referenc- ing the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595).			
Yes	Yes	None	At a pallet located by a belt latch sensor			
Yes	None	Yes	No configuration available Create a Pack Manager sample and change the Process Manager settings by referenc- ing the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595).			
Yes	None	None	At a fixed pallet			
None	Yes	Yes	On a belt located with a camera			

4

Selections		າຣ	Configuration nome
Α	В	С	Configuration name
None	Yes	None	With a fixed mounted camera
None	None	Yes	With a belt latch sensor
None	None	None	At a fixed position

The table below lists the configurations for correction after picking.

D in the table above represents operation after picking.

Selections	Configuration name					
D	Configuration name					
Yes	No, do not refine the position of the part.					
None	Yes, refine the position of the part using a camera.					

The table below lists the configurations for placing.

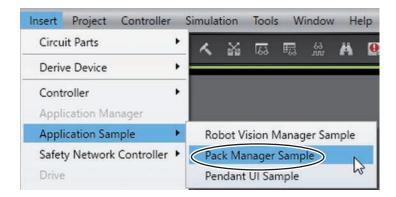
E, F, and G in the table above represent placing operations.

Selections		าร	Configuration name			
Е	F	G	Configuration name			
Yes	Yes	Yes	No configuration available			
			After creating the Pack Manager sample, refer to Sysmac Studio Robot Integrated			
			System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No.			
			W595) and change the Process Manager settings.			
Yes	Yes	None	At a pallet located by a belt latch sensor			
Yes	None	Yes	No configuration available			
			ter creating the Pack Manager sample, refer to Sysmac Studio Robot Integrated			
			System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No.			
			W595) and change the Process Manager settings.			
Yes	None	None	At a fixed pallet			
None	Yes	Yes	On a belt located with a camera			
None	Yes	None	With a fixed mounted camera			
None	None	Yes	With a belt latch sensor			
None	None	None	At a fixed position			

1 Click **new\_Controller\_0** from the device list in the Multiview Explorer of the Sysmac Studio.

Multiview Explorer	1
new_Controller_0 🔻	ļ,
new_Controller_0	
Programming	h

2 Select Application Sample - Pack Manager Sample from the Insert menu on the main window of the Sysmac Studio.

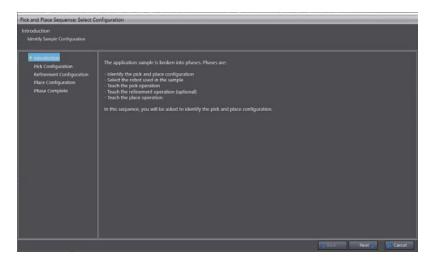




#### **Precautions for Correct Use**

If the configuration of the **Pack Manager Sample** is not completed until the last teaching or it is canceled, you need to start over from the first step of the flow to create the **Pack Manager Sample**. If **ApplicationManager1** has been registered in the device list of the Multiview Explorer through the execution of the **Pack Manager sample**, delete **ApplicationManager1** once with the Delete key and start the procedure again.

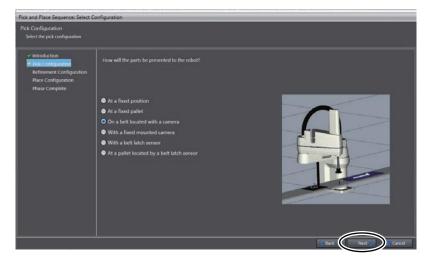
Pick and Place Sequence: Select Configuration dialog box is displayed.



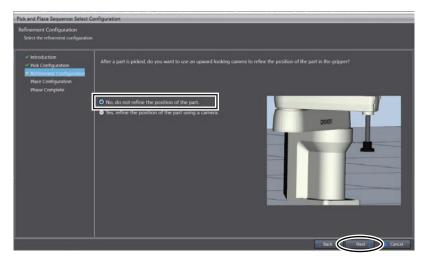
**3** Click the **Next** button at the bottom right of the dialog box.



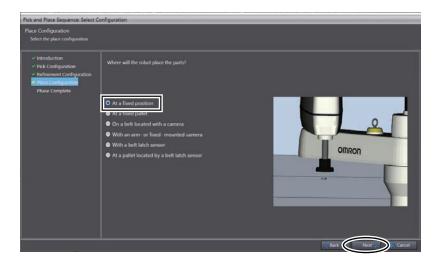
4 Select **On a belt located with a camera** and click the **Next** button.



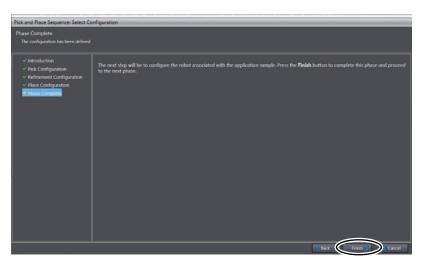
**5** Select No, do not refine the position of the part. and click the Next button.



- 6
- Select At a fixed position and click the Next button.



7 Click the Finish button.



The dialog box closes and **Pick and Place Sequence: Phase 1/3 - Select Robot** dialog box is displayed.

# Configuring the Robot

In this section, select the robot and end effector to use for the Pack Manager and teach the wait positions.



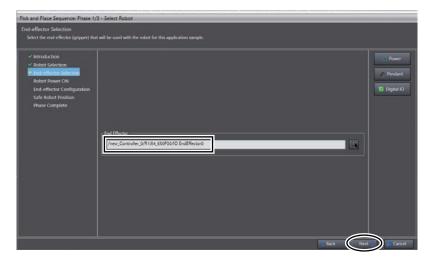
In the Introduction page, click the Next button.



2 In the Select Robot page, confirm that R1iX4\_650P30 is selected and click the Next button.

Pick and Place Sequence: Phase 1	/3 - Select Robot			
Robot Selection Click the icon in Robot section to se				
<ul> <li>Introduction</li> <li>End-effector Selection</li> <li>End-effector Selection</li> <li>Robot Paver ON</li> <li>End-effector Configuration</li> <li>Safe Robot Pootion</li> <li>Phase Complete</li> </ul>	Todot Freez Controller_0(#1924_610030)	]		Pondert
			C Back Next	Careed C

**3** In the **Select the End-Effector** page, confirm that **IO EndEffector0** is selected and click the **Next** button.



4 The **Robot Power ON** dialog box may appear. In that case, click the **Power** button and select the **Next** button at the bottom right of the dialog box.

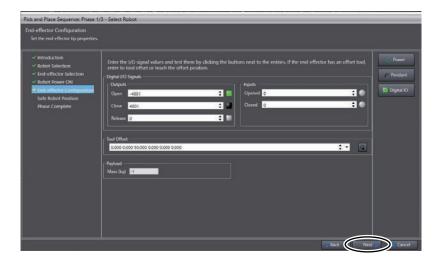
Pick and Place Sequence: Phase 1/	3 - Select Robot	
Robot Power ON Turn on the robot high powers.		
<ul> <li>Introduction</li> <li>Abbot Selection</li> <li>Gobot Selection solution in relater toware to a relater to a relation of the relation selection of the relation of the relation phase Complete</li> </ul>	If nabot high power is OFF (red icon in the Power button), click Power to turn on high power. A green Power icon indicates high Power is ON. Click Next to proceed to the next step. In later steps you will click Pendant to open the Robot log Control, so you can move the robot.	Pover
	t Beck	Cancel

5 Register the signal number of the robot built-in I/Os which are used to control the vacuum pad. Enter the value -4001 to Open and 4001 to Close in the Outputs field of the Digital I/O Signals. They are Open signals of the solenoid valve that was allocated in V+Digital I/O on page 4-7.

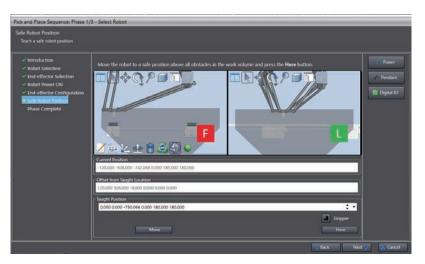
Pick and Place Sequence: Phase 1/	3 - Select Robot	
End-effector Configuration Set the end effector tip properties.		
<ul> <li>Introduction</li> <li>Indext Selection</li> <li>End effector Selection</li> <li>Robot Follower CM</li> <li>Ender Interdet Configuration</li> <li>Safe Robot Position</li> <li>Phase Complete</li> </ul>	Enter the UO signal values and test them by clicking the buttons next to the entires. If the end-effector has an offset tool, enter to not other or nouth the other postors.  Coperat UO Signal  Parker 1  Coperat 0  Parker 1  Coperat 0  Coperat	© Power © Pondant To Digital IO
	Sack. Nex	t 🔰 👷 Cancel

**6** Set 50mm as the offset value from the TCP to the vacuum pad tip in the Z direction. Enter 0.000 0.000 50.000 0.000 0.000 in the **Tool Offset**.

ck and Place Sequence: Phase	1/3 - Select Robot	
nd-effector Configuration Set the end effector tip properties		
<ul> <li>✓ Introduction</li> <li>✓ Robel Selection</li> <li>✓ Ind-effector Selection</li> <li>✓ Ind-effector Selection</li> <li>✓ Ind-effector Coll</li> <li>✓ Robel Prever Coll</li> <li>✓ Robel Prever Coll</li> <li>✓ Select Prever Coll</li> <li>✓ Select Prever Coll</li> <li>✓ Select Prever Coll</li> <li>✓ Phase Complete</li> </ul>	Enter the I/O signal values and test them by clicking the buttons next to the entries. If the end-effector has an effect tool, enter to tool offset or teach the offset position. Digrafs Open 4001 Chore 2001 Release 6 Chore 2001 Release 6 Position Position Release 6 Position Position Release 6 Position Position Release 6 Position Release 6 Position Release 7 Position Release 7 Positi	<ul> <li>Power</li> <li>Pendant</li> <li>Dignal KO</li> </ul>
	Gat Net >	S Cancel



**7** To temporarily determine the wait position, operate the robot on the **3D Visualizer**. Set the robot's wait position above an approximate pick position on the conveyor.



#### **Precautions for Correct Use**

If the wait position is specified out of the belt window set in Configuring the Camera, Conveyor, and Encoder on page 4-65, a belt window violation error will occur during tracking and the tracking will fail. Assume the approximate position of the belt window, and determine the wait position above the position that fits within the belt window.

After completing the tentative setting of the wait position, proceed to the next step.

8 Click the Here button at the bottom right of the dialog box.

Pick and Place Sequence: Phase 1/	3 - Select Robot	
Safe Robot Position Teach a safe robot position		
Introduction     Robot Selection     Robot Selection     Conference Selection     Robot Power ON     Selection Configuration     Selection Configuration     Phase Complete	Move the robot to a safe protion above all obstacles in the work volume and press the Here button.	Power
	Offset floor Tangle Location 120.000 500.000 -6.000 0.000 0.000	
	Lunght Rosiden     Docto 1000 - 1750.046 3.000 180.000 180.000     Mover     Mover     Mover     Mover     Mover     Mover     Mover	S Cancel

The value in the Taught Position is changed to the value of the current position.

Pick and Place Sequence: Phase 1/	3 - Select Robot			
Safe Robot Position Teach a safe robot position				
✓ Introduction ✓ Robot Selection ✓ Endot Selection ✓ Endot effector Selection ✓ End effector Configuration ■ Sale Robot Floation Phase Complete	Move the robot to a safe position above all obtacles	n the work volume and pros the Here but		Pour Pour
	0.000 0.000 -750.066 0.000 180.000 180.000		Gripper Here	
			🔮 Back Next )	Cancel



9

Click the **Next** button at the bottom right of the dialog box.

4



V Robot Power ON	ick and Place Sequence: Phase 1/	3 - Select Robot	
Robot Selection     Robot Power CN     Selection     Selection     Selection     Robot Selection     Selectio			
	<ul> <li>✓ Robot Selection</li> <li>✓ End-effector Selection</li> <li>✓ Robot Power ON</li> <li>✓ End-effector Configuration</li> <li>✓ Safe Robot Position</li> </ul>	The next step will be to teach the pick configuration. Press the <b>Finish</b> button to complete this phase and proceed to the next phase.	Power

Pick and Place Sequence: Phase 1/3 - Select Robot dialog box closes and Pick Configuration dialog box pops up.



## Configuring the Camera, Conveyor, and Encoder

Click the Next button at the bottom right of the dialog box.

1

- Pick Instructions

   Pick Instructions

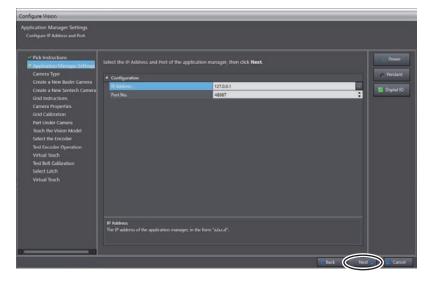
   Pick Instructions

   Application Manager String Controls New Stritech Comera Gradinations

   Cratte a New Black Comera Gradinations

   Text Under Comera Text Under Comera Stateation

   Part Under Comera Text Beck Calibration Select Lath Virtual Texch
- 2 In the Application Manager Settings dialog box, confirm that the IP Address is set to 127.0.0.1 and click the Next button.

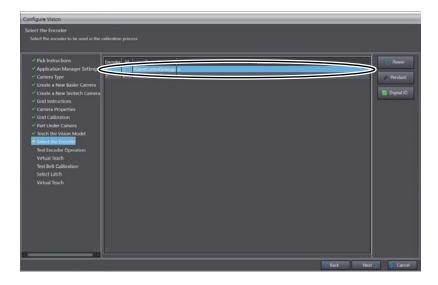


**3** In the system configuration of this guide, the 24114 Basler camera is used. Make sure that **Basler Camera** is selected and click the **Next** button at the bottom right of the dialog box.



Configure Vision		
Create a New Camera Object Select a camera device.		
Pick Instructions Application Manager Settings Cancers System Cancers System Cancers System Cancers Applications Cancers Systems Cancers Applications Cancers Applications Cancers Applications Cancers Applications Part Under Canners Tack the Vision Model Select the Encoder Test Encoder Operations Virtual Teach Select Laborations Select Laboratio	Select the camera from the Available Devices lot, then dick Next, the camera object and its virtual camera object will be contact. If you do not need to select a down. You can press Next to remain a matching of the select and the time, you do not need to select a down. You can press Next to camera a down and the time of the select and the time of the select a down and the select and the time of the select a down and the select as the select a down and the select as the select a down and the select as	Pendert
	Sack Next >	Cancel

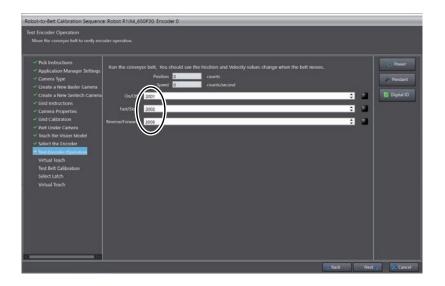
**5** Select a row for the encoder **0** from the list as determined in this guide. Encoder No. 1 of the wiring connector corresponds to encoder **0** on this dialog box. For information on wiring, refer to the 4-4-8 Wiring the Robot and Encoder on page 4-98.



Configure Vision				
Select the Encoder Select the encoder to be used in the				
Pick Instructions     Application Manager Settings     Caneta Aree Masker Camera     Create a New Banker Camera     Create a New Sentech Camera     Sente In Encoder     Sente In Encoder     Text Becker Cameration     Virtual Teach	Construkter and Constructions of a second se	Encoder Position		Power Prindert 15 Digital 10
			t Back	Canon C

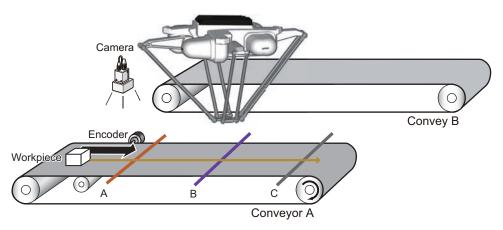
7 Allocate the operation signals of the conveyor, assigned by V+ Digital I/O Settings in this guide. Enter values in the On/Off, Fast/Slow, and Reverse/Forward fields in the center of the window.

Set 2001 to **On/Off**, 2002 to **Fast/Slow**, and 2003 to **Reverse/Forward**. For allocation of V+ digital I/Os, refer to V+*Digital I/*O on page 4-7.

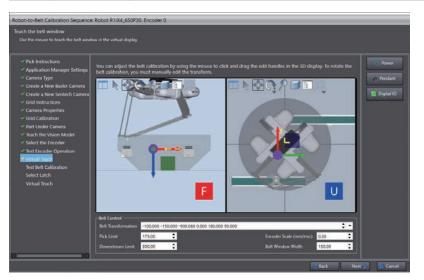


Robot-to-Belt Calibration Sequence	e: Robot R1iX4_6	0P30. Encoder 0	
Test Encoder Operation Move the conveyor belt to verify enc			
Pick Instructions     Application Manage Settings     Canera Type     Create a New Bioler Camera     Create a New Setted Camera     Create Setted S		or bell. You should see the Position and Velocity values change when the belt moves. Spend Towns 2001 2003	 Poner Pondart 15 Ogual 10
19 19		्र इ.स.	Cancel

**9** Determine the position of the conveyor, Upstream Limit, Pick Limit, Downstream Limit, and Belt Width.



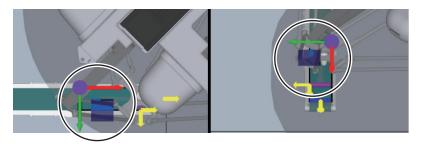
Letter	ltem	Description
A	Upstream Limit	The limit position upstream of the conveyor to make a pick operation. The robot does not pick at the conveyor position upstream from the <b>Upstream</b>
		Limit.
В	Pick Limit	The reference limit position downstream of the conveyor to make a pick opera- tion. When the placement is completed, the robot specifies the next workpiece to pick and calculates the pick position. At that time, workpieces that exist downstream from the <b>Pick Limit</b> are excluded from the pick target.
С	Down- stream Lim- it	The limit position downstream of the conveyor to make pick operation. The robot does not pick at the conveyor position downstream from the <b>Downstream Limit</b> .



You can set the points by a drag and drop operation on the 3D Visualizer or by directly entering data in numeric entry fields of **Belt Control**. Set the points in either way.

Dragging and Dropping on the 3D Visualizer
 Refer to A-2 How to Use 3D Visualizer on page A-21 and the Sysmac Studio Robot
 Integrated System Building Function with IPC Application Controller Operation Manual (Cat. No. W621) for operation procedure of the 3D Visualizer.

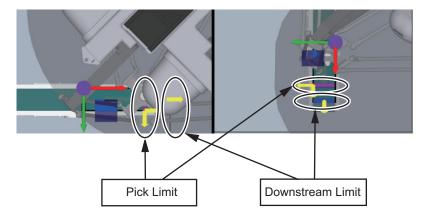
The conveyor can be moved by dragging and dropping the green, red, and blue arrows.



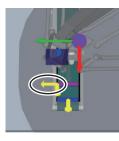
The **Upstream Limit** is the position indicated by the purple point and the green arrow (origin of **Belt Transformation** and Y-axis).

The **Pick Limit** is indicated by a purple line and the **Downstream Limit** by a blue line. The **Pick Limit** and **Downstream Limit** can be moved by dragging and dropping the yellow arrow.

Position them within the operating range of the robot.



The belt width can be changed with the yellow arrow indicated in the frame in the figure below.



• Directly entering data in the fields of Belt Control



The **Upstream Limit** is the same point as the origin of Belt Transform. Therefore, enter offset distance from the world coordinate in the input fields of **Belt Transformation**. Enter relative distance from the **Upstream Limit** in mm to **Pick Limit** and **Downstream Limit** input fields.

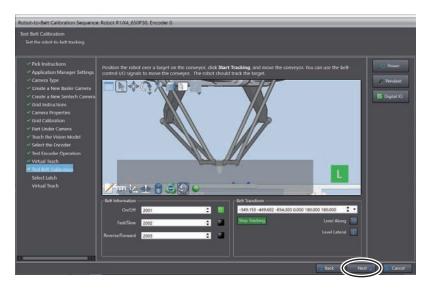
Input Belt Width to the Belt Window Width input field in mm.

Enter the value of encoder scale (mm/encoder) in the **Encoder Scale** input field.

**10** Click the **Next** button at the bottom right of the dialog box.



**11** Click the **ON/OFF** button to turn it ON, and then click the **Start Tracking** button to check that the robot can successfully track along the conveyor. If no problem was found, click the **Next** button at the bottom right of the dialog box.

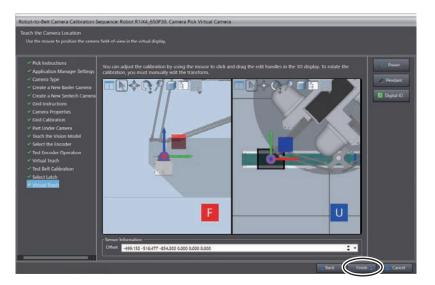


**12** Make sure that the right latch number has been selected , and then click the **Next** button.

4

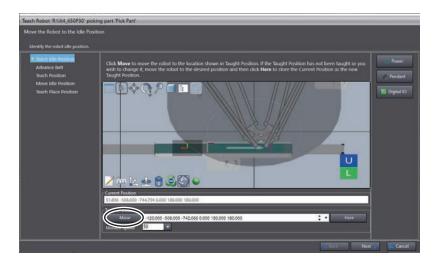


13 Click the  ${\sf Finish}$  button at the bottom right of the dialog box.



# **Teaching Positions**

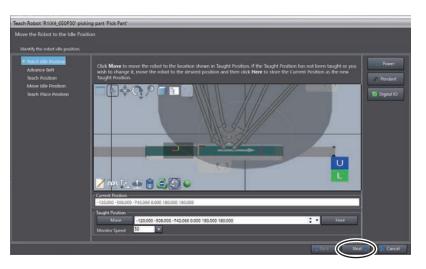
- Teaching Robot's Idle Positions
  - **1** Click the **Move** button at the lower part of the dialog box.



The robot moves to the robot's idle position.

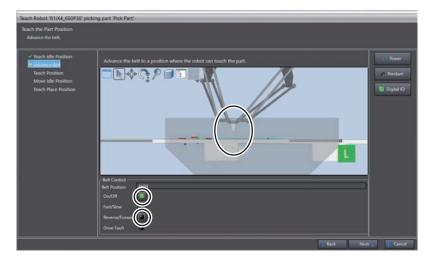
Teach Robot 'R1iX4_650P30' pick	ing part 'Pick Part'	
Move the Robot to the Idle Posi		
identify the robot idle position.		
Advance Belt Advance Belt Bach Position More life Position Teach Place Position	Click Meve to move the tokot to the location shown in Taught Position, if the Taught Position has not been taught or you tokot to change it, move the tokot to the desired position and then dick Here to store the Current Position as the new taught or you tokot to change it, move the tokot to the desired position and then dick Here to store the Current Position has not been taught or you taught Position. The Current Position has not been taught or you taught or you taught position has not been taught or you taught or you taught position has not been taught position has not been taught or you taught position has not been taught position h	<ul> <li>Power</li> <li>Pondert</li> <li>To Depend KO</li> </ul>
	C Back	Cancel

**2** Adjust it to a position from where the robot can be moved to the pick and place positions in linear interpolation. After the adjustment, click the **Here** button.



**3** Click the **Next** button at the bottom right of the dialog box.

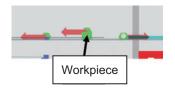
**4** Move the belt forward to a position where the robot can touch the part.



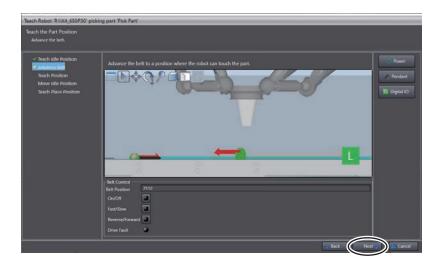
#### **5** Click the **Next** button.

Teach the Part Position Advance the belt.	
2 Back Mr. Bucking	
Example for     Advance the buff to a position where the robot can fourth the part.       Totach Position     Image: Advance the buff to a position where the robot can fourth the part.       More lide notion     Image: Advance the buff to a position where the robot can fourth the part.	Power endant gital 10
Ref: Control Ref:	Cancel

- Teaching Pick Position, Approach Height, and Depart Height
  - 1 Click the buttons for **ON/OFF** and **Reverse/Forward** in the **Belt Control** box at the lower part of the dialog box to move the green workpiece on the conveyor. After that, once stop the workpiece within the operating range of the robot and in the belt window.



**2** Click the **Next** button at the bottom right of the dialog box.



**3** Click the **Move** button at the lower part of the dialog box.

Teach Robot 'R1iX4_650P30' pi	cking part 'Pick Part'		_
Teach the Part Position Move the robot end-effector so			
<ul> <li>✓ Teach Idle Position</li> <li>✓ Advance Belt</li> <li>✓ Teach Position</li> <li>Move Idle Position</li> <li>Teach Place Position</li> </ul>	Align the robot with the item position and press the <b>Here</b> button to record the position.		Power Pendant Digital IO
	C Offset from Taught Location -3.500 0.000 -188.000 0.000 -188.000 / Taught Position		
	-153.553 -514.477 -454.303 0.000 180.000 0.000 Approxish Height 55	Cripper Here	
	Monter Spared	Back Next 3	Cancel

The robot moves so that the tool center point is at the lowermost part of the workpiece on the conveyor.

Teach Robot 'R1iX4_650P30' pic	king part 'Pick Part'	
Teach the Part Position Move the robot end-effector so		
✓ Teach kile Position     ✓ Advance Beit     ✓ Advance Position     Teach Place Position	Align the robot with the item position and press the Here button to record the position.	Perdert
	r Current Position - 153/52 - 516477 - 654.303 0000 180.000 - Offset from Twelph Location Roto nono ono nono nono - 180.000	
	Taught Position -153:533 -516-477 -454-308 0.000 180:000 0.000 Approach Height 35 Aproach Height 34 Aprox	Gripper
	Depart Hinght 35 C Akookine Agenaich Move Depart Monitor Speed 50 C	Hre
		🔮 Back Next 🌶 👷 Cancel



Move the robot in the Z-axis direction so that the end-effector tip is on the top of the workpiece.

4

Teach Robot 'R1iX4_650P30' pic	king part 'Pick Part'		
Teach the Part Position Move the robot end-effector so			
✓ teach tille Position ✓ Advance Belt ■ Indext Knellen More tille Position Teach Place Position	Align the robot with the item position and press the Here button to record the position.	_0	Power Andant
	Ciffuet from Twepfet Location     Control (1999)     Location     Locot 0.000 - 100.000     Location     Locot 0.000 - 100.000     Location     Location	Gripper	
	Approach Move Cripart Monitor Speed	Here C Back Next 2	Cancel

## **5** Click the **Here** button.

Teach Robot 'R1iX4_650P30' pi	cking part 'Pick Part'		
Teach the Part Position Move the robot end-effector so			
<ul> <li>✓ Teach Idle Position</li> <li>✓ Advance Belt</li> <li>Check Position</li> <li>Move Idle Position</li> <li>Teach Place Position</li> </ul>	Align the robot with the item position and press the Here botton to record the position.		Power Pendaet Digital IO
	- Offset from Twoff Ecution 0.000 0.000 -93.490 0.000 0.100.000 - Twoff Thursdon - 133.593 - 146.477 - 554.303 0.000 100.000 0.000	:•	
	Approach Height 25 C Absolute Depart Height 25 B Absolute Approach Move Depart Monitor Speed 50 V	Copper	)
		C Back Next	2 Scancel

6 Enter the elevation distance that the robot moves to or moves from the workpiece pick-up position in the **Approach Height** and **Depart Height** input fields of **Taught Position**.

Teach Robot 'R1iX4_650P30' pick	ing part 'Pick Part'	
Teach the Part Position Move the robot end-effector so th		
✓ Hach Life Position ✓ Advance Beit ✓ Advance Beit More till Position More till Position Teach Place Position	Align the robot with the item position and press the <b>Here</b> button to record the position.	Dever Pendent 10 Digital KO
	Taught Ruditor 195553 - 516477 - 445.653 0.000 180.000 180.000 Approxeh Heigh Depert Height Approxeh Montor Speed Montor Speed	e Si Si Cancel

Check the operation by moving the robot to the set heights by pressing the **Approach** and **Depart** buttons.



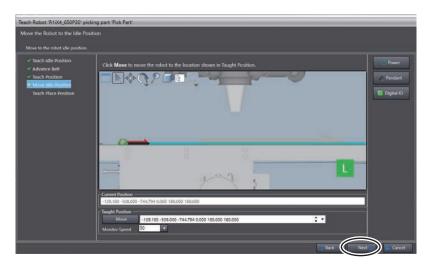
sch Robot 'R1iX4_650P30' pic	king part Pick Part		_
sich the Part Position Move the robot end-effector so t	but it touches the part.		
	Align the robot with the item position and press the Here button to record the position.		
Advance Belt     Teach Postban			Pendant
Move Idle Position			_
Teach Place Position			Digital IO
		THE OWNER WATER OF	
	🔀 🖮 🔽 🕁 🔒 🤤 🌑 🕒 👘 🔄 👘		
	Current Position		
	-153.553 -516.477 -815.063 0.000 180.000 180.000		
	Offset from Taught Location 0.000 -30.000 0.000 0.000 0.000		
	Taught Polition		
	-153.553 -516.477 -845.063 0.000 180.000 180.000	:•	
	Approach Height 20	Gripper	
	Depart Height 30 🗧 Absolute		
	Approach Move Depart Monitor Speed 50	Here	

## • Moving the Robot to the Idle Position

1 Click the **Move** button at the lower part of the dialog box.

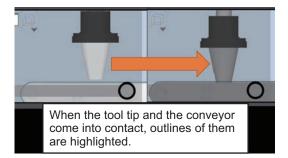


When the robot moves to the idle position, click the **Next** button at the bottom right of the dialog box.



- Teaching Place Position, Approach Height, and Depart Height
  - Operate the robot in the **3D Visualizer** and move it to the workpiece place position on the convener.

If the tool center point and the conveyor come into contact, the outlines of the tool center point and conveyor are highlighted. Determine the place position with reference to the highlighting.



2 Click the **Here** button at the bottom right of the dialog box.

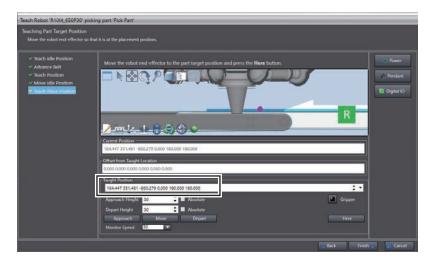
aching Part Target Position		
Move the robot end-effector s		
Teach Idle Position     Advance Belt     Teach Position     Move Idle Position	Move the robot end-effector to the part target position and press the Here button.	Power
🖉 Teach Place Position		Digital K
	Offset from Swelpt Location 0.000-0.000-0.000 0.000-0.000 <sup>-1</sup>	
	Taught Pocibion 164.447 351.481 -860.279 0.000 180.000 180.000	ī l
	Approach Height 30 Cripper Depart Height 30 C Absolute	
	Approach Move Depart Here	

1

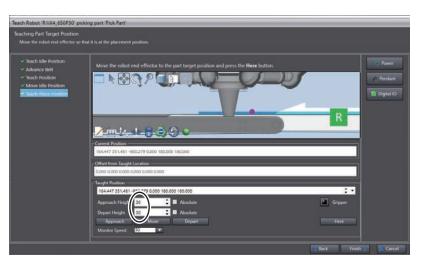
4

4-3-6 Creating a Pack Manager Sample

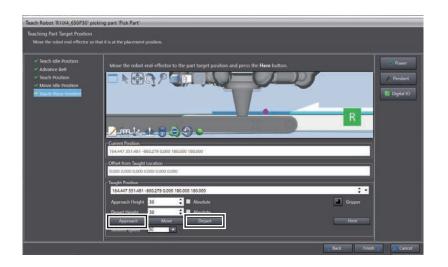
The values of the current position is set to the **Taught Position** box. If you want to fine tune the taught position, modify the value in the **Taught Position** and click the **Move** button to move the robot.



**3** Enter the elevation distance of the workpiece place approach point in the **Approach Height** and **Depart Height** input fields of **Taught Position**.

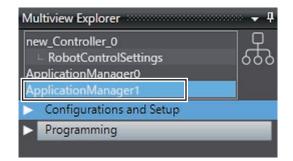


Check the operation by moving the robot to the set heights by pressing the **Approach** and **Depart** buttons.



Teach Robot 'R1iX4_650P30' pick	ing part 'Pick Part'	
Teaching Part Target Position Move the robot end effector so the		
<ul> <li>Teach Idle Position</li> <li>Advance Belt</li> <li>Teach Position</li> <li>More Idle Position</li> <li>More Idle Position</li> </ul>	Move the robot end effector to the part target position and press the Here button.	Power Pendant To Digital Ko
	Current Publices 164-047 331-041-302079-0.000 180.000 ( Offert from Europh Location	
	0.000 0.000 -30.000 0.000 0.000 Twight Polition 194.447 351.481 -660.279 0.000 180.000 180.000	
	Approach Height 30 Absolute Depart Height 30 Absolute Approach Move Depart Mover Depart Mover Here	
	Reck Fr	et 🔪 👷 Cancel

Teaching dialog box closes and **ApplicationManager1** is added to the drop-down list of the Multiview Explorer.

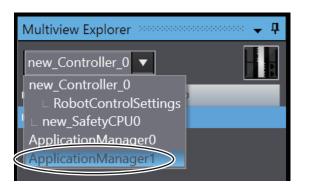


## **Additional Settings**

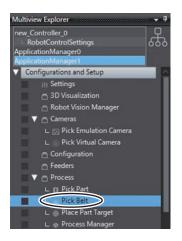
## • Setting for Active Control

To activate the conveyor control from the Pack Manager, perform the following.

1 In the Multiview Explorer, select **ApplicationManager1** from the device list.



2 Select Configurations and Setup - Processes in the Multiview Explorer and double-click Pick Belt.



**3** Select the Active Control check box for Belt Control.

$\supset$	
-	
2001	Fast
2002	\$ Slow
2003	:
0	
	2002

#### 4-3-7 Creating C# Programs

This section describes the procedure to create C# programs. For details on the program to create, refer to C# *Programs* on page 4-10.



In the Multiview Explorer, select ApplicationManager1 from the device list.

new_Controller_0	<b>P</b>
RobotControlSettings	660
ApplicationManager0	
ApplicationManager1	
<ul> <li>Configurations and Setup</li> </ul>	
Programming	

- **2** Right-click **Programs** under **Programming** in the Multiview Explorer. The menu commands are displayed.
- **3** From the menu, select **Add C# Program**.

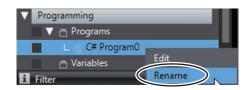


A new program C# Program0 is added under Programs.





Right-click the C# Program0 and select Rename from the menu.



This allows you to edit the name of the C# Program0.





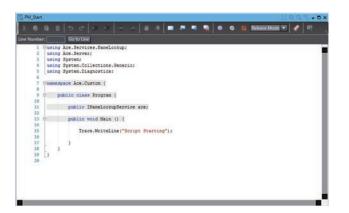
6

Enter *PM\_Start* for the program name and press the Enter key. The name of the C# program is changed to "PM\_Start".





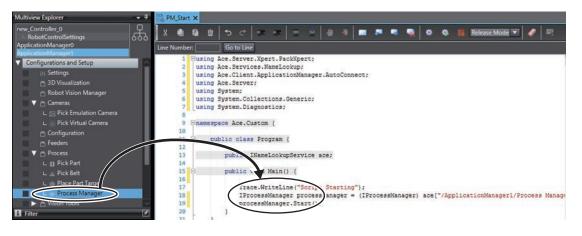
A tab page to edit the program is displayed in the Edit Pane.



**7** Repeat the operations from step 3 to step 6 to create the programs PM\_Start and PM\_Stop described in *C# Programs* on page 4-10.

#### Precautions for Correct Use

The contents of the text string that represents the Process Manager in each C# program differ depending on the language of OS used when you created the project file. Select **ApplicationManager1** from the device list in the Multiview Explorer, and then select **Configurations and Setup - Process - Process Manager**. Drag and drop it onto the C# editor, and an appropriate text string is automatically entered.



# 4-3-8 Setting up Automatic Loading of V+ Programs and Variables at Power ON

The V+ programs that you created and V+ global variables are not automatically loaded to the Robot Integrated CPU Unit by default settings of the project when power to the Robot Integrated CPU Unit is turned ON.

This section describes the setting procedure for automatically loading the V+ programs and V+ global variables to the Robot Integrated CPU Unit when its power is turned ON.

**1** Select **RobotControlSettings** from the device list in the Multiview Explorer.







Setting items are displayed under Configurations and Setup in the tree.



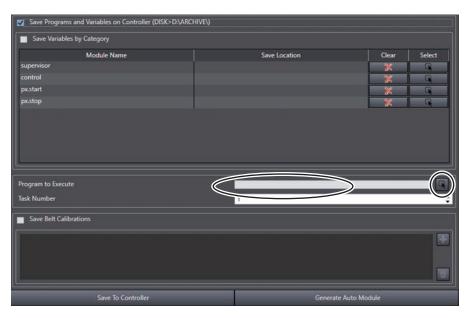
**3** Double-click **Save Configuration**.



The Save Configuration tab page is displayed in the Edit Pane.



**4** Make sure that *supervisor* is not selected for **Program to Execute** and click the button on the right.



The Select the startup program dialog box appears.

**5** Select **supervisor** under **supervisor** and click the **Select** button.

Select the startu	ip program —		×
<ul> <li>superviso</li> <li>control</li> <li>px.start</li> <li>px.stop</li> <li>px.stop</li> </ul>	PROGRAM supervisor() ; ABSTRACT: ; INPUTS: ; OUTPUTS: ; SIDE EFFECTS: ; DATA STRUCT: ; MISC: Program created in version 1.44.0.64012		
None		C	Select

## 6 Enter 2 to Task Number.

Save Configuration ×				
Save Programs and Variables on Controller (DISK>D:\AR	CHIVE\)			
Save Variables by Category				
Module Name	1	Save Location	Clear	Select
supervisor			×	
control			×	
px.start			×	
px.stop			×	G.
Program to Execute		supervisor		
Task Number	C			
				· ·
Save Belt Calibrations				
				Ŧ
Save To Controller		Generate	Auto Module	

7 Click the Generate Auto Module button in the Save Configuration tab page.

Save Configuration ×				
Save Programs and Variables on Controller (DISK>D:)	ARCHIVE\)			
Save Variables by Category				
Module Name supervisor		Save Location	Clear	Select
control px.start px.stop			×	
Program to Execute	Super	visor	×	
Task Number	2			:
Save Belt Calibrations				
Save To Controller		Generati	e Auto Module	-

The module name **auto** is added to the module list in the **Save Configuration** tab page. In the tree of the Multiview Explorer, **V+ Modules - auto** are added under **Programming**.

New Project - RobotControlSettings - Sysmac St	udio (64bit)		- 0	x
File Edit View Insert Controller Tools	Window Help			_
X @ @ @ > < @ @ #	* < 2 日 日 2 4 9 1 9 4 9 1 9 4 9 1 9 4 9 1 9 1 9 9 1 9 1			
Multiview Explorer 🔹 🛡	Save Configuration ×		<ul> <li>Task Status Control</li> </ul>	a x
Inew Controller 0	Save Programs and Veriables on Controller (DISK+DUAM) Save Variables by Category Module Name Supervisor reacted pcdart	Save Location	Clear Select	
♥ ⊕ pristep	Program to Execute Insk Number Save Belt Calibrations	supervisor 2	:	
Project Shortcut View • 3 X In Shortcut Root Folder				
	Save To Controller	Generate Auto Me	xdule	
	Build Statistical Antibuctionaria I Description I Program Doctput, Build	l Location I	- 7 X Toober 10 Vessel, Tat St Simulation	ustuur - B - SPI ->
[Emulation Mode] Access Level: Engineer				

8 Click File - Save from the menu bar.



The Robot Integrated CPU Unit is now configured to automatically load the V+ programs and V+ global variables when it is powered ON. The program **auto** starts automatically when the Robot Integrated CPU Unit is powered ON and reads the saved V+ programs and V+ global variables.

The program **auto** is created in a form called command program, which is different from the V+ program. For details about the command program, refer to the eV+3 User's Manual (Cat. No. 1651).

## 4-3-9 Executing Program to Check Operation

This section describes the procedure to run and simulate the sequence control program created in *4-3-4 Writing a Sequence Control Program* on page 4-23.

You can run the program by changing the global variable *gStart* in the sequence control program from FALSE to TRUE in the Watch Tab Page.

The V+ program is called from the sequence control program executed in this procedure.

#### Precautions for Correct Use

When you perform this procedure, check that the project file has been opened in EMULATION mode. Refer to *Enabling Robot Simulation Function* on page 3-65 for the checking procedure.



#### **Additional Information**

Refer to the Sysmac Studio Version 1 Operation Manual (Cat. No. W504) and Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for details on the debugging function of the program.

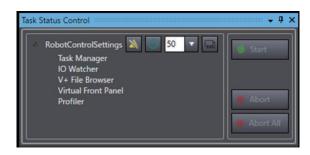
**1** Select **RobotControlSettings** from the device list in the Multiview Explorer.



2 Select Task Status Control from the View menu on the main window.

View	Insert	Controller	Tools	Window	Help	
Multiview Explorer				Alt+	1	
Project Shortcut View				Alt+S	Alt+Shift+1	
Toolbox				Alt+2	Alt+2	
3D Visualizer				Alt+S	Alt+Shift+2	
Output Tab Page				Alt+3	Alt+3	
Watch Tab Page				Alt+4	Alt+4	
Watch Tab Page(Table)				Alt+S	Alt+Shift+4	
Cross Reference Tab Page				Alt+	Alt+5	
Build Tab Page				Alt+6	5	
Eve	nt Log					
Search and Replace Results Tab Page				e Alt+7	Alt+7	
Sim	Simulation Pane				Alt+8	
Differential Monitor				Alt+9	Alt+9	
Smart Project Search				Ctrl+	Ctrl+Shift+F	
Recently Closed Windows				Ctrl+	Ctrl+Shift+H	
Clea	ar Recent	ly Closed Wir	ndows His	tory		
V+	V+ los Control			Alt+Shift+J		
Task	Task Status Control				Alt+Shift+T	
Visi	Vision window				Alt+Shift+V	

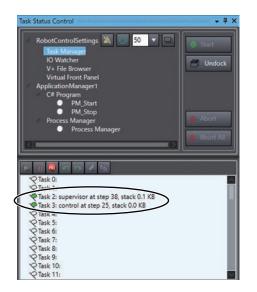
The Task Status Control pane appears on the right side of the main window.



**3** On the Multiview Explorer, select **Programming** - **V+ Modules** - **supervisor** - **supervisor** and right-click on it, and then select **Execute on Task** – **Task 2**.

		Task 0
		Task 1
	_	Task 2
		harter of
		Task 4
		Task 5
		Task 6
		Task 7
		Task 8
Mew Project - RobotCo	ontrolSettings - Sysmac Studio (64bit)	Task 9
File Edit View Inser	t Controller Tools Window He	Task 10
		Task 11
		Task 12
Multiview Explorer		Task 13
new_Controller_0		Task 14
RobotControlSetting		Task 15
ApplicationManager0	and the second s	Task 16
		1334.10
ApplicationManager1		Task 17
Configurations and Se	etup	
Configurations and Se Programming	etup	Task 17
Configurations and Se     Programming     V+ Modules	etup	Task 17 Task 18
Configurations and Se Programming	etup	Task 17 Task 18 Task 19
Configurations and Se Programming  V  V+ Modules  Second	visor	Task 17 Task 18 Task 19 Task 20
Configurations and Se Programming V D V+ Modules V B superviso	e visorEdit	Task 17 Task 18 Task 19 Task 20 Task 21
Configurations and Se Programming  Configurations  Programming  Configurations  Configuration	r r Edit sl Add Program	Task 17 Task 18 Task 19 Task 20 Task 21 Task 22
Configurations and Se  Programming  V - Modules  V - Modules  V - superviso  L - superviso  L - control  L -	r Sisor Edit Copy Program	Task 17 Task 18 Task 20 Task 21 Task 21 Task 22 Task 23
Configurations and So Programming V → Modules V → Superviso L → Superviso C → Control L → Control	r r r stat Edit Edit Copy Program Copy Program Pelete Program Rename	Task 17 Task 18 Task 19 Task 20 Task 21 Task 22 Task 23 Task 24
<ul> <li>Configurations and St</li> <li>Programming</li> <li>V + Modules</li> <li>♥ supervisio</li> <li>U = supervisio<td>r r pl Add Program Copy Program Delete Program p</td><td>Task 17 Task 18 Task 19 Task 20 Task 21 Task 21 Task 22 Task 23 Task 24 Task 25</td></li></ul>	r r pl Add Program Copy Program Delete Program p	Task 17 Task 18 Task 19 Task 20 Task 21 Task 21 Task 22 Task 23 Task 24 Task 25
<ul> <li>Configurations and S</li> <li>Programming</li> <li>▼ I+ Modules</li> <li>▼ I+ superviso</li> <li>■ superviso</li> <li>■ control</li> <li>□ contro</li></ul>	risor Edit al Add Program Copy Program Polete Program Rename Set as Module Program	Task 17 Task 18 Task 19 Task 20 Task 21 Task 22 Task 23 Task 24 Task 25 Task 26

The V+ program supervisor starts to run in Task 2 and the control launches in Task 3.



4

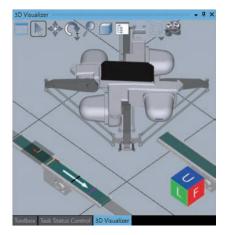
In the Multiview Explorer, select **new\_Controller\_0** from the device list.

Multiview Explorer	• 1
new_Controller_0 🔻	T
new_Controller_0	
V Programming	ľ

5

Select **3D Visualizer** from the **View** menu on the main window of the Sysmac Studio.

View	Insert	Controller	Tools	Window	Help
Mul	tiview Ex	plorer		Alt+1	1
Proj	Project Shortcut View			Alt+Shift+1	
Tool	Toolbox			Alt+2	
3D \	3D Visualizer			Alt+9	Shift+2
Ever	nt Log				

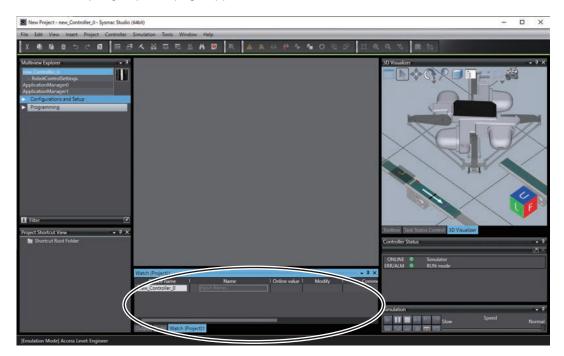


The 3D Visualizer is displayed on the right side of the main window.

6 Select Watch Tab Page from the View menu on the main window.

/iew	Insert	Controller	Tools	Window	Help	
Mul	tiview Ex	plorer		Alt+1	1	
Proj	ect Short	cut View		Alt+S	Shift+1	
Toolbox				Alt+2		
3D Visualizer				Alt+Shift+2		
Output Tab Page				Alt+3		
Wat	Watch Tab Page			Alt+4		
Wat	ch Tab Pa	ge(lable)		Alt+S	Shift+4	

The Watch (Project)1 tab page appears at the bottom of the main window.



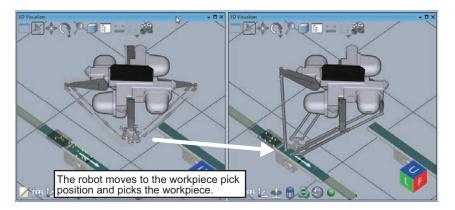
Type gStart in the Name column on the Watch (Project)1 tab page.
 The Online value column shows the current value False for the internal variable gStart in Program0.



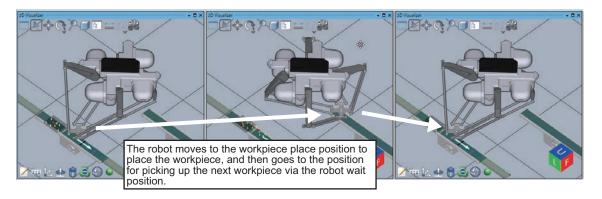
8 Click the **TRUE** button in the **Modify** column for the variable **gStart** in the **Watch** (**Project**)1 tab page.

Device name	Name	Online value	Modify	Comment
ew_Controller_0	gStart	False	TRUE	Auto start Button
ew_Controller_0	gstart	Faise		Auto start Butto

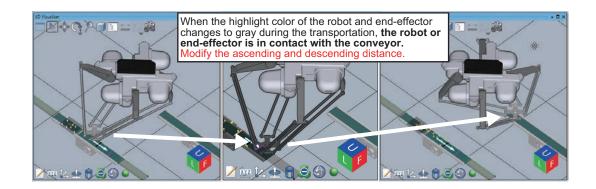
The robot starts operating and picks the part in the 3D Visualizer.



After that, the robot moves to the robot wait position via the workpiece place position, and performs pick and place operation repeatedly.



During operation, check that the robot does not turn gray in locations other than the workpiece pick-up position and workpiece place position. If the color changes to gray, the robot and the conveyor are interfering with each other. In that case, refer to *Teaching Pick Position, Approach Height, and Depart Height* on page 4-74 and move the workpiece pick-up approach point or the workpiece place approach point to a higher position by teaching.

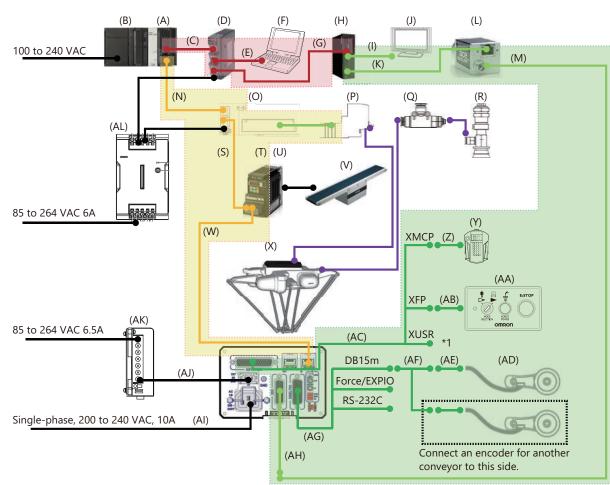


Now you can run the sequence control program on the actual equipment.

# 4-4 Installing and Wiring the System

In the system configuration, you must wire the signal lines covered in the colored areas in the figure below and set the node address of the robot.

- Wiring between the Robot Integrated CPU Unit (A), EtherCAT Digital I/O Terminal (O), EtherCAT communications unit of the Inverter (T), and robot (X)
- Wiring between the Robot Integrated CPU Unit (A), industrial Ethernet switch (D), computer (F), and IPC Application Controller (H).
- Wiring between the robot (X), T20 pendant (Y), front panel (AA), and encoder (AD)
- Wiring between the IPC Application Controller (H), display (J), and camera (L).
- Wiring between the EtherCAT Digital I/O Terminal (O) and robot (C)
- Wiring between the camera (L) and robot (X)
- Wiring between the EtherCAT Digital I/O Terminal (O) and solenoid valve (P)



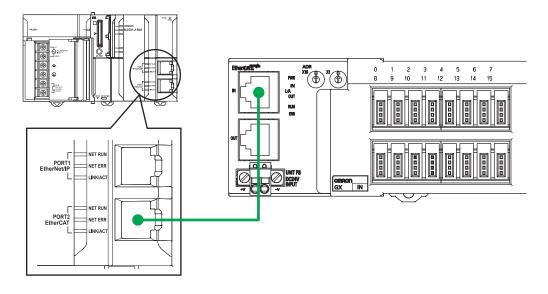
Refer to 1-5 System Configuration for Dynamic Pick-and-place Equipment on page 1-8 for information on the parts used in the system configuration.

Refer to the manual for the specific product for details on power lines not covered in the colored area as well as for ducting from the robot.

### 4-4-1 Wiring the Robot Integrated CPU Unit and the EtherCAT Digital I/O Terminal

You must wire the Robot Integrated CPU Unit and the EtherCAT Digital I/O Terminal.

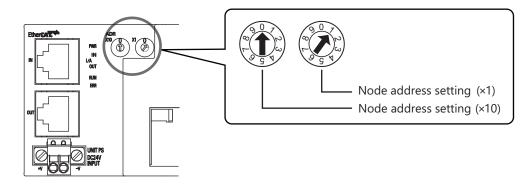
**1** Connect the EtherCAT port of the Robot Integrated CPU Unit and the EtherCAT IN port of the EtherCAT Digital I/O Terminal with an Ethernet cable.



## 4-4-2 Setting the Node Address of the EtherCAT Digital I/O Terminal

You must set the EtherCAT node address of the EtherCAT Digital I/O Terminal.

**1** Use the switches on the EtherCAT Digital I/O Terminal to set the EtherCAT node address. To set the node address to 1, set the x10 switch to 0 and the x1 switch to 1.



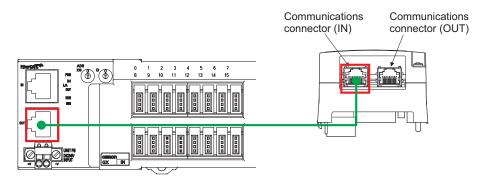
#### Precautions for Correct Use

Set the EtherCAT node address of the EtherCAT Digital I/O Terminal to be the same as the node address set in *3-3-2 Creating the EtherCAT Network Configuration* on page 3-20.

# 4-4-3 Wiring the EtherCAT Digital I/O Terminal and Inverter's EtherCAT Communications Unit

Wire the EtherCAT Digital I/O Terminal and EtherCAT Communications Unit of the Inverter.

**1** Connect the EtherCAT OUT port of the EtherCAT Digital I/O Terminal and the EtherCAT IN port on the EtherCAT Communications Unit with an Ethernet cable.

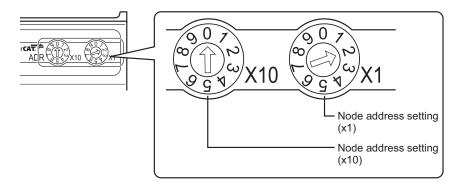


## 4-4-4 Setting the Node Address of Inverter's EtherCAT Communications Unit

This section describe the settings of the EtherCAT node address of the EtherCAT Communications Unit of the inverter.

**1** Set the switches for the EtherCAT node address on the EtherCAT Communications Unit of the inverter.

To set the node address to 2, set the x10 switch to 0 and the x1 switch to 2.





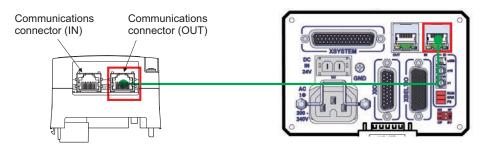
#### Precautions for Correct Use

Set the EtherCAT node address of the inverter to be the same as the node address set in *3-3-2 Creating the EtherCAT Network Configuration* on page 3-20.

## 4-4-5 Wiring the Inverter's EtherCAT Communications Unit and Robot

In this section, wire the EtherCAT communications unit of the inverter and the robot.

**1** Connect the EtherCAT OUT port of the EtherCAT Communications Unit and the EtherCAT IN port on the interface panel of the robot with an Ethernet cable.





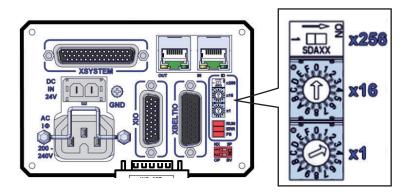
#### Precautions for Correct Use

Refer to the *NJ/NX-series CPU Unit Built-in EtherCAT Port User's Manual (Cat. No. W505)* for details on the Ethernet cable to be used.

## 4-4-6 Setting the EtherCAT Node Address of the Robot

Set the EtherCAT node address of the robot.

Set the EtherCAT node address with the switches on the interface panel of the robot.
 To set the node address to 3, set the x256 switch to OFF, the x16 switch to 0, and the x1 switch to 3.





#### **Precautions for Correct Use**

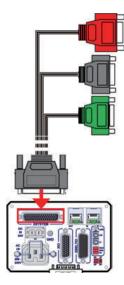
Set the EtherCAT node address of the robot to be the same as the node address set in *4-3-2 Creating the EtherCAT Network Configuration* on page 4-16.

Refer to the manual for your robot on how to set the node address.

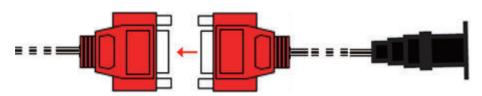
### 4-4-7 Wiring the Robot, T20 Pendant and the Front Panel

You must wire the robot and the T20 pendant, as well as the robot and the front panel. Use an XSYS-TEM cable assembly, a T20 adapter cable, and a front panel cable for wiring.





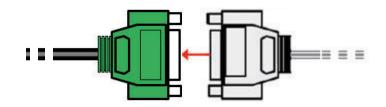
2 Connect the XMCP connector (Red) of the XSYSTEM cable assembly and the T20 adapter cable.



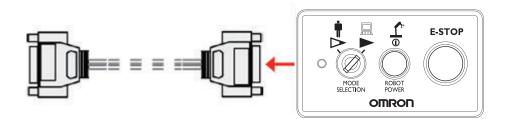
**3** Connect the T20 adapter cable to the T20 pendant.



**4** Connect the XFP connector (Green) of the XSYSTEM cable assembly and the front panel cable.



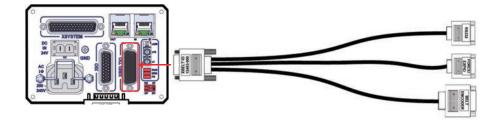
**5** Connect the front panel cable and the front panel.



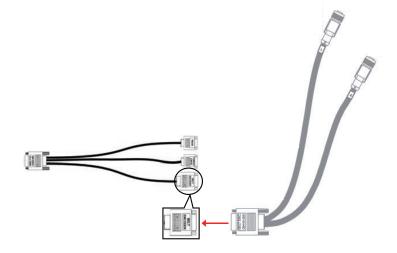
## 4-4-8 Wiring the Robot and Encoder

Wire the robot and the encoder. Use a XBELTIO cable, a Y-adapter cable, and an encoder extension cable for wiring.

**1** Connect the XBELTIO cable to the robot.

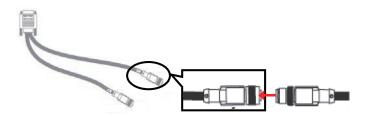


**2** Connect the XBELTIO cable's DB connector and the Y-adapter cable.



3

Connect the encoder extension cable to the connector labeled [1] of the Y-adapter cable.



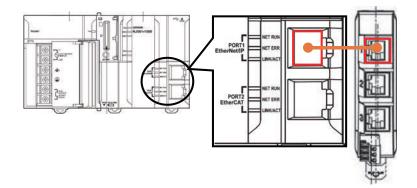
**4** Connect the encoder and the encoder extension cable.



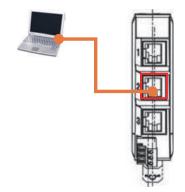
## 4-4-9 Wiring the EtherNet/IP Port on the Robot Integrated CPU Unit

Wire between the Robot Integrated CPU Unit and the industrial Ethernet switch, between the industrial Ethernet switch and the computer, and between the industrial Ethernet switch and the IPC Application Controller. Use Ethernet cables for connection.

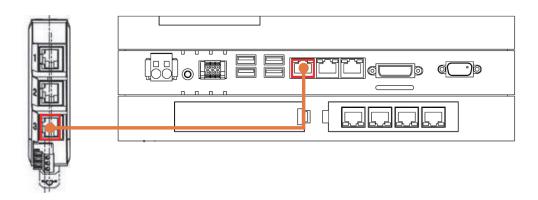
**1** First, wire the Robot Integrated CPU Unit and the industrial Ethernet switch.



**2** Connect the industrial Ethernet switch and the computer.



**3** Connect the industrial Ethernet switch and the IPC Application Controller.



# 4-4-10 Wiring Between the IPC Application Controller, Display, and Camera

Wire between the IPC Application Controller and the display, and between the IPC Application Controller and the camera. Use a DVI cable and a camera cable for wiring.



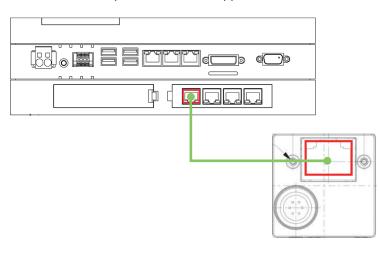
## Connect the DVI ports on the IPC Application Controller and the display with a DVI cable.



#### **Precautions for Correct Use**

Refer to the *IPC Application Controller User's Manual (Cat. No. 1632)* for information on the DVI cable.

**2** Connect the PoE ports on the IPC Application Controller and the camera with a camera cable.

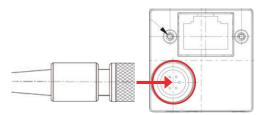


### 4-4-11 Wiring the Camera and Robot

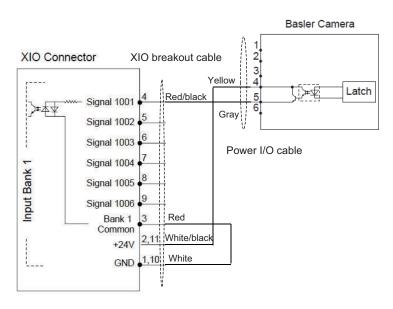
Wire the camera and the robot. Use a power I/O cable and a XIO breakout cable for wiring.



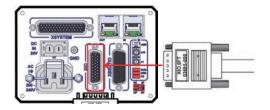
Connect the camera and the power I/O cable.



**2** Wire the power I/O cable and the XIO breakout cable. Make a connector or relay with a terminal block as shown in the following wiring diagram.



**3** Connect the XIO breakout cable and the robot.





#### **Precautions for Correct Use**

Refer to *Configuring the Camera, Conveyor, and Encoder* on page 4-65 for the installation location of the camera. You must install the camera between the upstream limit set by the software and the entrance of the conveyor.

## 4-4-12 Wiring the EtherCAT Digital I/O Terminal and Solenoid Valve

You must wire the EtherCAT Digital I/O Terminal and the solenoid valve.

Refer to the manuals for the EtherCAT Digital I/O Terminal and the solenoid valve for details on the cable wiring, and make the cable appropriately in accordance with the wiring diagrams and specifications.



Make the cable so that the solenoid valve will behave as shown in the table below.

Output value of Digital I/O Terminal	Solenoid valve behavior
FALSE	Duct is closed
TRUE	Duct is open

- Image: Contraction of the second s
- **2** Wire the EtherCAT Digital I/O Terminal and the solenoid valve.

# 4-5 Operation Check on the Actual System

This section describes the procedures for checking operation and adjusting the system on the actual system.

Check operation with the simulation function before you check operation on the actual system.



#### **Precautions for Correct Use**

When you operate the robot in MANUAL mode with the T20 pendant, you must plug the iCS Commissioning Jumper into the XBELTIO connector and change the setting for the Teach Restrict. Refer to *iX4 650 H/HS and 800 H/HS Robot with EtherCAT User's Guide (Cat. No. 1656)* for details.

### 4-5-1 Communications Setup

## Setting Up Sysmac Studio to Communicate with the Robot Integrated CPU Unit

Set up Sysmac Studio installed on your PC to communicate with the Robot Integrated CPU Unit. In this section, IP address of the EtherNet/IP port on the Robot Integrated CPU Unit to connect to the computer is set to 192.168.250.1.

Also set the IP address of the camera to the IPC Application Controller in advance. For procedure to set the IP address of the camera to the IPC Application Controller, refer to Appendix A of the *Automation Control Environment (ACE) Version 4 User's Manual (Cat. No. 1633)*.

- **1** Boot up the Sysmac Studio.
- **2** Clear the **Open in Emulation Mode** check box at the bottom left of the start page.



**3** Click the **Open Project** tab.



A list of created projects is shown in the **Projects** window.

Name Search Project name Project name W Project 1 WProject 2 WProject 2 WCell 11ControlBase WCell 11ControlBase WCell 11ControlBase	l Comment	Last Modified ▼ 2020/12/05 17:28 2020/12/05 16:59 2020/12/05 16:33 2020/12/04 20:00	Created 2020/12/01 14:56- 2020/12/05 11:15- 2020/11/18 14:46- 2020/11/18 14:46-	Projects Count Author User Name User Name 010200039
w Project w Project_1 wProject2 wProject wCall 11ControlBase wCall 11ControlEnglish	Comment	2020/12/05 17-28 2020/12/05 16-59 2020/12/05 16-33 2020/12/04 20:00	2020/12/01 14:56 2020/12/05 11:15 2020/11/18 14:46	User Name User Name
w Project_1 wProject2 wProject wCell11ControlBase wCell11ControlBase		2020/12/05 16:59 2020/12/05 16:33 2020/12/04 20:00	2020/12/05 11:15: 2020/11/18 14:46:	User Name
wProject2 wProject wCell11ControlBase wCell11ControlEnglish		2020/12/05 16:33 2020/12/04 20:00	2020/11/18 14:46:	
wProject wCell11ControlBase wCell11ControlEnglish		2020/12/04 20:00		010200039
wCell11ControlBase wCell11ControlEnglish				
		2020/12/02 19:26:	2020/11/18 14:46	010200039
		2020/12/02 15:36		
		2020/12/02 10:54	2020/08/31 14:25:	010880016
		2020/11/24 13:34:		010880016
artUpGuideDynamic3		2020/11/24 12:42:	2020/08/31 14:25:	010880016
				010880016
				010880016
				010880016
				010880016
				010880016
ertUpGuideDynamic				010880016
irtUpGuideDynamic4				010880016
boStartUpGuide3		2020/09/25 14:56:		010880016
boStartUpGuide		2020/09/15 11:39:	2020/08/26 11:21:	010880016
	811ControlTake2 811ControlTake1 811ControlTake2 811ControlTake2, Recovered 811ControlTake2, Recovered 811ControlTake2, Recovered 810ControlTake4 80ControlTake4 80ControlTake3	II TControlTake2 II TControlTake2 II TControlTake1 II TControlTake2 II TControlTake2 II TControlTake2 Recovered II TControltake2 II TControltake2 II TControltake2 II TControltake2 II TControlTake2 II TControlTake2 II TCONTROLTAKE II TCONTROLTAKEI III TCONTROLTAKEI II T	B11ControlTake2         202011/24 907.15           B11ControlTake1         202011/24 92.61           B11ControlTake1         202011/17 16.601           B11ControlTake2         202011/17 16.001           B11ControlTake3         202001/17 16.16 <td>III ControlTake2         2020/11/24 907/15         2020/08/31 1425           III ControlTake1         2020/08/31 1425         2020/08/31 1425           III ControlTake1         2020/08/31 1425         2020/08/31 1425           III ControlTake2         2020/08/31 1425         2020/08/31 1425           III ControlTake2 Recovered         2020/11/11 1450         2020/08/31 1425           III ControlTake2 Recovered         2020/11/11 1450         2020/08/31 1425           III ControlTake2 Recovered         2020/10/26 11.31         2020/08/31 1425           ObstartUpGuideDynamic         2020/10/26 11.31         2020/08/31 1425           ObstartUpGuideDynamic4         2020/10/26 11.31         2020/08/31 1425           ObstartUpGuideDynamic4         2020/10/26 11.31         2020/08/31 1425</td>	III ControlTake2         2020/11/24 907/15         2020/08/31 1425           III ControlTake1         2020/08/31 1425         2020/08/31 1425           III ControlTake1         2020/08/31 1425         2020/08/31 1425           III ControlTake2         2020/08/31 1425         2020/08/31 1425           III ControlTake2 Recovered         2020/11/11 1450         2020/08/31 1425           III ControlTake2 Recovered         2020/11/11 1450         2020/08/31 1425           III ControlTake2 Recovered         2020/10/26 11.31         2020/08/31 1425           ObstartUpGuideDynamic         2020/10/26 11.31         2020/08/31 1425           ObstartUpGuideDynamic4         2020/10/26 11.31         2020/08/31 1425           ObstartUpGuideDynamic4         2020/10/26 11.31         2020/08/31 1425

4 Click the **New Project** on the project list, which you have created in *4-3-1 Creating a Project File* on page 4-15.

ine			
New Project	Projects		
	Project Name Search		Projects Count :
Open Project	New Project	2020/12/05 17:28 2020/12/01	1456User Name
		2020/12/03 17:20	14.30_ User reame
Export	NewProject2	2020/12/05 16:33 2020/11/18	14:46: 010200039
ine	NewProject	2020/12/04 20:00 2020/11/18	14:46:010200039
Connect to Device	NewCell11ControlBase	2020/12/02 19:26 2020/11/18	14:46 010200039
	NewCell11ControlEnglish	2020/12/02 15:36 2020/11/18	14:46: 010200039
ion Control	StartUpGuideDynamic2	2020/12/02 10:54 2020/08/31	14:25 010880016
Version Control Explorer	0X4Project	2020/11/24 13:34: 2020/11/24	12:42:010880016
nse	StartUpGuideDynamic3	2020/11/24 12:42 2020/08/31	14:25: 010880016
	Cell11ControlTake2	2020/11/24 9:07:15 2020/08/31	14:25: 010880016
	Cell11ControlTake1	2020/11/24 8:26:17 2020/08/31	14:25:010880016
	Cell 11 Control Base	2020/11/16 16:01 2020/08/31	14:25 010880016
	Cell11ControlTake2_Recovered	2020/11/12 14:00: 2020/08/31	14:25 010880016
	Cell11Current	2020/11/11 14:52: 2020/11/11	
	RoboStartUpGuide2	2020/10/29 16:10 2020/08/26	
	StartUpGuideDynamic	2020/10/26 15:36: 2020/08/31	14:25: 010880016
	StartUpGuideDynamic4	2020/10/26 14:36 2020/08/31	
	RoboStartUpGuide3	2020/09/25 14:56: 2020/08/26	
	RoboStartUpGuide	2020/09/15 11:39	11:21: 010880016

The clicked row is highlighted.

## **5** Click the **Open** button in the **Projects** window.

fline				
	Projects			
New Project				
Open Project	Project Name Search			Projects Count :
	Project name	I Comment	Last Modified VI Created 2020/12/05 17:28 2020/12/01 14	Author
	New Project 1		2020/12/05 16:59 2020/12/05 11:	Stends Restrictions
È Export	NewProject2		2020/12/05 16:33 2020/12/05 11	
line	NewProject		2020/12/04 20:00 2020/11/18 14:	
	NewCell11ControlBase		2020/12/02 19:26 2020/11/18 14:	
Connect to Device	NewCell11ControlEnglish		2020/12/02 15:36 2020/11/18 14	
sion Control	StartUpGuideDynamic2	-	2020/12/02 10:54 2020/08/31 14:	
Version Control Explorer	iX4Project		2020/11/24 13:34:	
	StartUpGuideDynamic3		2020/11/24 12:42 2020/08/31 14:	
ense in	Cell11ControlTake2		2020/11/24 9:07:15 2020/08/31 14:	
License	Cell11ControlTake1	-	2020/11/24 826:17 2020/08/31 14:	
	Cell11ControlBase	-	2020/11/16 16:01 2020/08/31 14:	
	Cell11ControlTake2 Recovered		2020/11/12 14:00 2020/08/31 14:	
	Cell11Current		2020/11/11 14:52 2020/11/11 14:	
	RoboStartUpGuide2		2020/10/29 16:10 2020/08/26 11:	
	StartUpGuideDynamic		2020/10/26 15:36 2020/08/31 14:	
	StartUpGuideDynamic4	-	2020/10/26 14 36 2020/08/31 14	
	RoboStartUpGuide3		2020/09/25 14:56: 2020/08/26 11:	
	RoboStartUpGuide		2020/09/15 11:39 2020/08/26 11:	21:010880016

The main window of Sysmac Studio is displayed.

NewProject - new_Controller_0 - Sysm		- 0 ×
	iontroller Simulation Tools Window Help 교관·수 삶 죠 큔 늪 A 및 R A 요 우 우 들 이 및 문 법 및 및 B 원	
	Toolbo	
new_Controller_0 ¥	Search and the sea	rch> 💌 🕅 🛛
Configurations and Setup Programming		
I Filter	7	
Project Shortcut View 🗸 🕴		
In Shortcut Root Folder		
	Buld • • 9 × Stateron Automotion	
	I Description I Program I Location I	
	Output, Build	
ccess Level: Engineer		

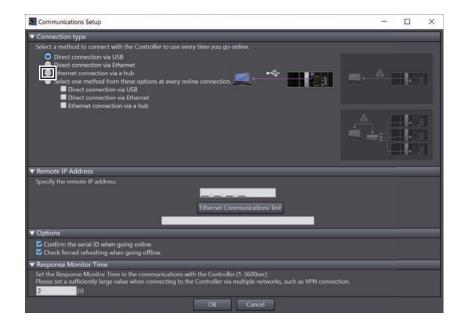
6 Select Controller - Communications Setup from the menu bar in the main window.

Project	Controller	Simulation	Tools	Window	Help
e 1	Commun	ications Setup	)		
~ 8	Change [	Device			
	Online			Ctr	l+W
	Offline			Ctr	l+Shift+W

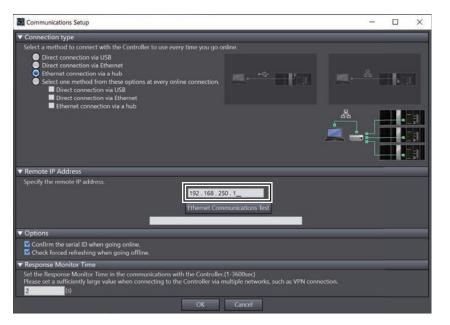
The Communications Setup dialog appears.

▼ Connection type	
Select a method to connect with the Controller to use every time you go online.	
Direct connection via US8     Direct connection via Ethernet	* * * * *
▼ Remote IP Address	
Specify the remote IP address.	Test
▼ Options	
Confirm the serial ID when going online. Check forced refreshing when going offline.	
▼ Response Monitor Time	
Set the Response Monitor Time in the communications with the Controller.(1-3600sec) Please set a sufficiently large value when connecting to the Controller via multiple netwo	rorks, such as VPN connection.
2 (s)	

7 Click the Ethernet connection via a hub button in the Connection type field.



8 Enter 192.168.250.1, the IP address of the Robot Integrated CPU Unit, in the Remote IP Address box



9

Click the **OK** button at the bottom

Communications Setup		-		×			
▼ Connection type			_				
Select a method to connect with the Controller to use every time you go o	nline.						
<ul> <li>Direct connection via USB</li> <li>Direct connection via Ethernet</li> <li>Ethernet connection via a hub</li> <li>Select one method from these options at every online connection.</li> <li>Direct connection via USB</li> <li>Direct connection via Ethernet</li> <li>Ethernet tomnection via a hub</li> </ul>	s · · ·	<u>ه</u> . م	H.				
Ethermet connection via a nuo	l						
▼ Remote IP Address							
Specify the remote IP address. 192.:168.:2 Ethernet Con	50 - 1 imunications Test						
▼ Options							
Confirm the serial ID when going online.							
▼ Response Monitor Time							
Set the Response Monitor Time in the communications with the Controller Please set a sufficiently large value when connecting to the Controller via o 2							
	Cancel						

The Communications Setup dialog is closed.

## Selecting the IPC Application Controller

Select the IP address of the IPC Application Controller you use.

In this section, the IP address for the IPC Application Controller is 192.168.250.201. Set the IP address of the IPC Application Controller before starting the following procedure.

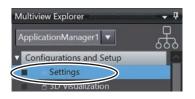
#### **Precautions for Correct Use**

ACE must have been running as a server in the IPC Application Controller in advance. Refer to *Automation Control Environment (ACE) Version 4 User's Manual (Cat. No. 1633)* for the ACE server instance.

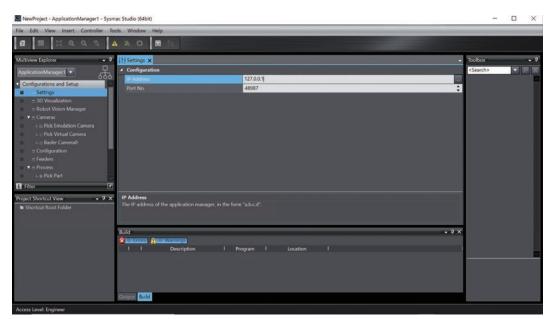
**1** Select **ApplicationManager1** from the device list in Multiview Explorer.



2 Double-click Settings under Configurations and Setup in Multiview Explorer.



The **Settings** tab page is displayed.

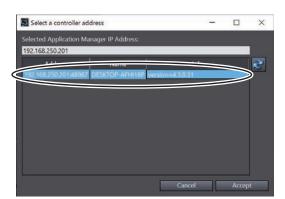


**3** Click the ... button on the right of the **IP Address** row.

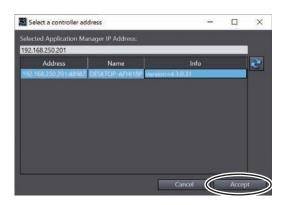


The Select a controller address dialog appears.

4 Click the row where the IP Address of the IPC Application Controller is listed.



**5** Click the **Accept** button.



The Select a controller address dialog is closed.

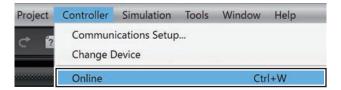
## 4-5-2 Online Connection

### Connecting Sysmac Studio to the Robot Integrated CPU Unit Online

Establish an online connection between Sysmac Studio and the Robot Integrated CPU Unit.



- 2 Click Controller Online from the menu bar.





1

#### Additional Information

Depending on the status of the connected Robot Integrated CPU Unit, the dialog box for writing the CPU Unit name or checking the serial number is displayed. Refer to *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for details.

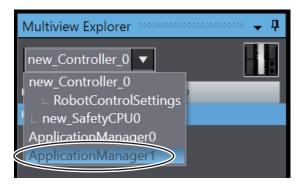
When it is online, the yellow line is displayed on the top of the Edit Pane.



## Going Online with the IPC Application Controller

Connect the IPC Application Controller and Sysmac Studio online.

**1** Select **ApplicationManager1** from the device list in Multiview Explorer.



2 Click Controller - Online from the menu bar.

Controller	Tools	Window	Help
Online		Ctrl	+W
Offline		Ctrl	+Shift+W

When it is online, the yellow line is displayed on the top of the Edit Pane.

Multiview Explorer	<b>~</b> ‡		
ApplicationManager1	Ъ.		
<ul> <li>Configurations and Setup</li> </ul>			
<ul> <li>Settings</li> </ul>			
3D Visualization			

### 4-5-3 Transferring Settings and Programs

To operate a conveyor belt programmatically, download programs and settings in the Sysmac Studio project file to the Robot Integrated CPU Unit.

1 In the Multiview Explorer, select **new\_Controller\_0** from the device list.



2 Click Controller - Mode - PROGRAM Mode from the menu bar.

Project	Controller Simulation Tools W	indow Help				
<* 12	Communications Setup Change Device		R A	××	69	<b>₽</b> 5
	Online	Ctrl+W				
	Offline	Ctrl+Shift+W				
	Enable emulation mode					
	Disable emulation mode					
	Synchronize	Ctrl+M				
	Transfer	•				
	Mode	3 <b>.</b>	RUN M	lode	0	Itrl+3
	Monitor	(	PROGR	RAM Mo	ode (	trl+1

**3** Follow the instructions in the confirmation dialog, then click the **Yes** button.

Sysmac Stud	tio
A	Even if the controller operation mode is changed to Program Mode, the running V+ programs do not stop. If you cannot secure the following, first display [View]-[Task Status Control] of RobotControlSettings, and then stop all V + tasks from [Task Manager]. -The robot controlled by V+ programs operates according to the running V+ program seven in Program Mode. -The outputs from I/O devices controlled by V+ programs may change even in Program Mode.
	Do you want to continue the operation? (Y/N)
	Yes No

**4** Select **Controller - Synchronization** from the menu bar on the Sysmac Studio.

Project	Controller	Simulation	Tools	Window	Help
< 2	Commun Change [	ications Setup Device	112		
	Online Offline				l+W l+Shift+W
		nulation mod mulation mod			
	Synchron	ize		Ctr	l+M

Comparison of programs and settings in Sysmac Studio and the Controller starts. When the comparison is completed, the Synchronization dialog box is displayed.



Select the check box for NJ501.

Synchronization							$\times$
Computer: Data Name	Computer: Update Date	Controller: Update Date	Controller: Data Name	Com	pare		
$\bigcirc$	2120/12/02 18:3000						
S							
Legend: Synchronized Different A Exists on	y on one side 📕 Not che						
Clear the present values of variables with Retain	attribute (Valid for Transfe	r to Controller).					
Do not transfer the POU program source (Valid		All data will be re-transfer	red when this option is ch	anged.			
Do not transfer the following. (All items are no - CI-series Special Unit parameters and EtherCI							
- Slave Terminal Unit operation settings and NX							
Do not transfer the EtherNet/IP connection setti		gs).					
All data will be transferred because the control	ler has no data.						
	ransfer To Controller Tra	ansfer From Controller	Recompare Clos	se			

#### 6 Click the Transfer to Controller button.

	Computer: Data Name	Computer: Update Date	Controller: Update Date	Controller: Data Name	Compare		
- A	NJ501	2020/12/02 18:24:08	-	Controller. Data Name	Compare		
	Synchronized	sts only on one side 🔛 Not che					
	he present values of variables with f	Retain attribute (Valid for Transfe	r to Controller).				
	t transfer the POU program source		All data will be re-transfer	ed when this option is changed.			
	t transfer the following. (All items a ries Special Unit parameters and E						
	Terminal Unit operation settings and						
5 Do not transfer the EtherNet/IP connection settings (i.e., tag data link settings).							
All da	ata will be transferred because the co	ontroller has no data.					

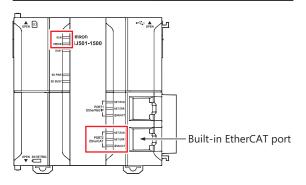
- 7 The following confirmation dialog box appears. Click the **Yes** button.
- 8 Confirm that the message "The Synchronization process successfully finished" is displayed. Then click the **Close** button.

Syne	chronization						×
2	Computer: Data Name NJ501	Computer: Update Date 2020/12/02 18:24:08	Controller: Update Date -	Controller: Data Name	Compare		
	Synchronized	y on one side 🚺 Not che					
	the present values of variables with Retain						
	not transfer the POU program source (Valid not transfer the following. (All items are no		All data will be re-transfer	red when this option is changed.			
	series Special Unit parameters and EtherO/ ve Terminal Unit operation settings and NX						
- and entrinsmic on operations causing a new first own approximate ratio. 5 Do not transfor the first-Monte consection, settings (i.e. tag data link settings).							
The	e Synchronization process successfully finish	$\supset$					
		repefer To Controllo	anofar From Controller				
	Ľ	ransfer To Controller Tr	ansfer From Controller	Recompare Close	<u> </u>		



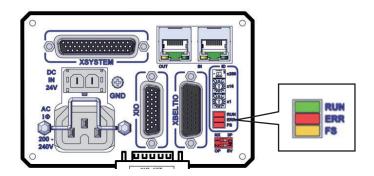
Confirm that the Robot Integrated CPU Unit has started normally. Indicator statuses under a normal operation are given below.

Indicator	Status
RUN indicator	Lit in green
ERROR indicator	Off
NET RUN	Lit in green
NET ERR	Off
LINK/ACT	Blinking



**10** Confirm that the robot has started normally. Indicator statuses under a normal operation are given below.

Indicator	Status
RUN indicator	Lit in green
ERR indicator	Off



**11** Confirm that the IPC Application Controller has started normally. Indicator statuses under a normal operation are given below.

Indicator	Status
PWR indicator	Lit in green
ERR indicator	Off
Crew Crew Co	Anun

## 4-5-4 Setting up the Camera

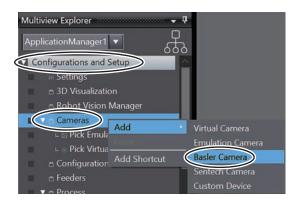
## Adding a Camera to Use

**1** Select ApplicationManager1 in Multiview Explorer.

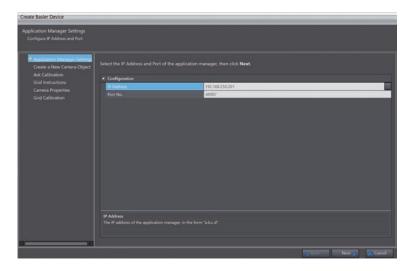
	Multiview Explorer
	new_Controller_0 🔻
	new_Controller_0
	RobotControlSettings
	∟ new_SafetyCPU0
ļ	ApplicationManager()
Q	ApplicationManager1

- **2** Select a camera type.
  - 1) Click Configurations and Setup to expand.
  - 2) Right-click Cameras to display the context menu.

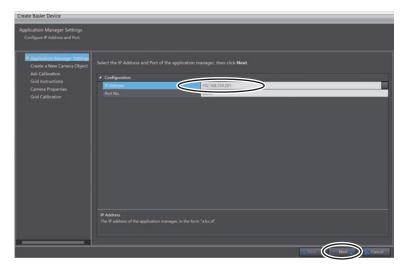
3) Select Add - Basler Camera.



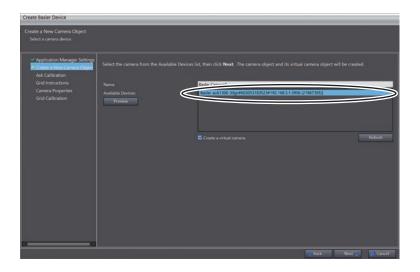
The Create Basler Device wizard appears.



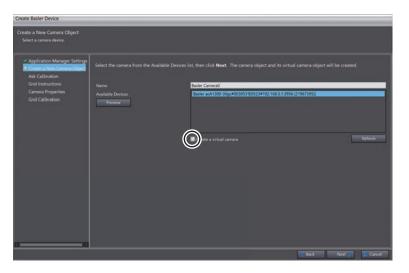
**3** Make sure that **IP Address** is set to the IP address of the IPC Application Controller and click the **Next** button.



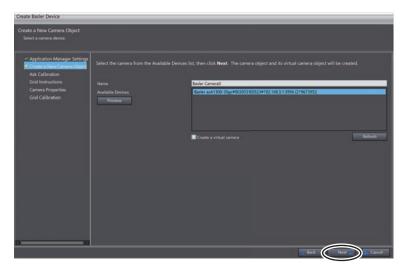
**4** Select the camera you use from the device list.



**5** Clear the **Create a virtual camera** check box.



6 Click the Next button.



The **Create Basler Device** wizard is closed. **BaslerCamera0** has been added under **Configurations and Setup - Cameras** in Multiview Explorer.



## Designating a Default Device for the Virtual Camera

1 Double-click **Pick Virtual Camera** under **Configurations and Setup** - **Cameras** in Multiview Explorer.



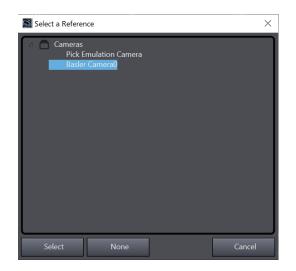
The Pick Virtual Camera window is displayed.



2 Click the ... button on the right side of **Default Device** under **Configuration**.

NewProject - ApplicationManager1 - Sysm	nac Studio (64bit)				- 🗆 ×
File Edit View Insert Controller To	ols Window Help				
D B H Q Q A					
Multiview Explorer 🔹 9	Pick Vinual Camera 🗙				- 8
Application Manager V Carloy Status - Sta	Elem Ormo	jao	mm	Configuration     Descent Configuration     Insage Loging     Ensulation Configuration	
	Calibrations	Emulation Settings	Add Delete Import Edit	<b>Default Device</b> The default camera device u	sed by the virtual carners.
utput Build					
Access Level: Engineer					

The Select a Reference dialog appears.



## **3** Click **Basler Camera0**.



**4** Click the **Select** button.



The Select a Reference dialog is closed, then Basler Camera0 is shown in Default Device under Configuration.

<ul> <li>Configuration</li> </ul>					
Default Device	/ApplicationManager1/Basler ()				
Image Logging	Image Logging: Disabled 🔹				
Emulation Configuration	Generate between 1 and 4 Rand ▼				

## Adding Acquisition Settings

**1** Click the Add button in the Acquisition Settings area.

le Edit View Insert Controller	och Window Help	
a m Haaa	A X O 15 10	
fultiview Explorer 🔹	© Pick Virtual Camera 🗙	-
configuration and Setue     Settings     Settings     Settings     Settings     Setting     Seting     Setting     Setting     Settin		Configuration     Configuration     Configuration     Configuration     Configuration     Configuration     Configuration     Configuration     Configuration
	Associations from the form of	Default Device The default camera device used by the virtual camera.

The Camera Properties dialog box is displayed.

2 Click the Accept button.

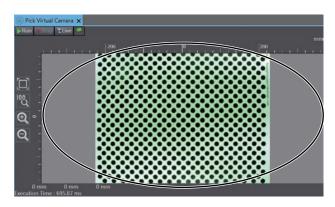
📓 Camera Propert	ies			2 <u>1</u> 2		Х
Information	Stream Fo	ormat Camera Set	tings Tri	gger		
Exposure		<u> </u>	<u> </u>	10000000	100000	¢
Exposure Time						
Gain	300	<u> </u>		850	300	÷
Analog Gain						
Black Level		<u>'</u>		1023	64	¢
Balance Red				1023	96	÷
Balance Green			· · · ·	1023	102	÷
Balance Blue			· · · · ·	1023	150	¢
Grab	Live	Assent	Canco		Apply	
Grab	Live	Accept	Cance		Apply	

Basler Pylon acA1300-30gc Device Settings is added.



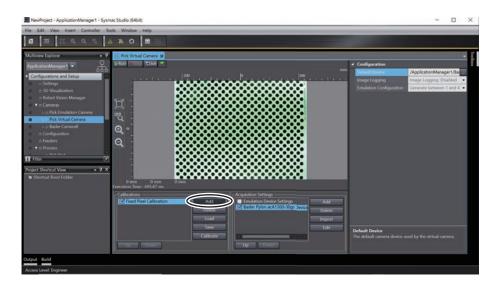
An image taken by the camera can be shown.

For example, the display is seen as illustrated below when the calibration grid is in the shooting range.



## Adding the Grid Calibration

1 Click the Add button in the Calibration area.



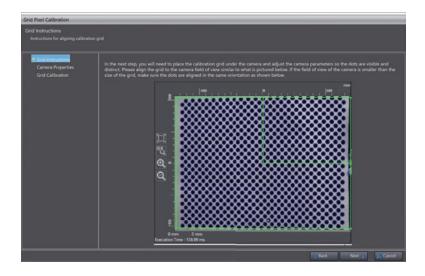
The Select A New Calibration Type dialog appears.



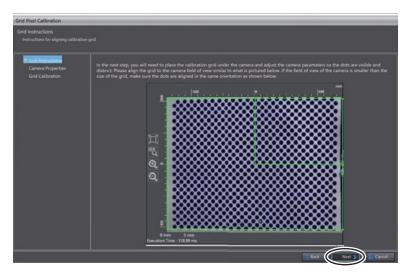
2 Select Grid Calibration and click the OK button.



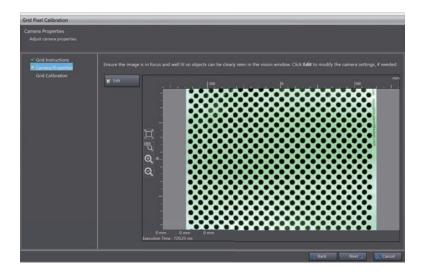
The Grid Pixel Calibration dialog is displayed.



## **3** Click the **Next** button.

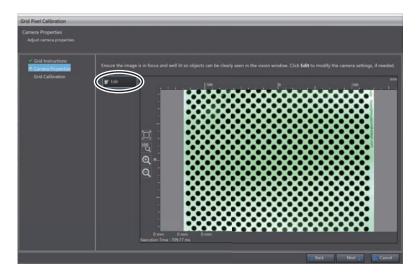


The calibration grid taken by the camera is shown.



**4** Check the calibration position, focus, and light. If necessary, adjust each element.

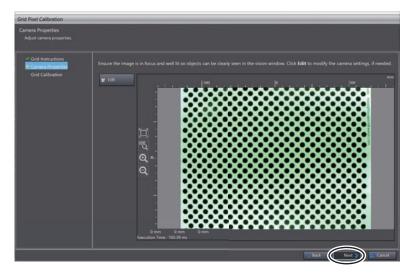
**5** Click the **Edit** button if dots are not clearly displayed.



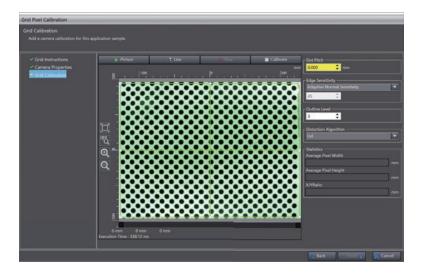
The **Camera Properties** dialog is shown. Configure properties so that dots get clear. Then click the **Accept** button to close the **Camera Properties** dialog.

📓 Camera Propert	ies			21 <u></u> 2		Х
Information	Stream Forr	nat Camera Set	ttings Trie	gger		
Exposure		<u>۵</u> ـــــ		10000000	100000	¢
Exposure Time						
Gain	300	Ò	<u> </u>	850	300	÷
Analog Gain						
Black Level		<u>-</u>		1023	64	¢
Balance Red			· · · ·	1023	96	¢
Balance Green		<u> </u>		1023	102	÷
Balance Blue			<u>к к к I</u>	1023	150	¢
Grab	Live	Accept	Cancel		Apply	

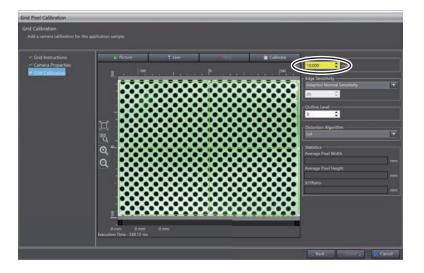




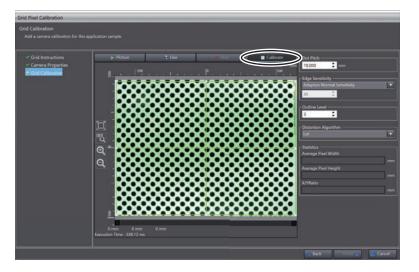
The dialog for grid calibration is displayed.



7 Enter a dot pitch value of the calibration grid in use into the **Dot Pitch** box.

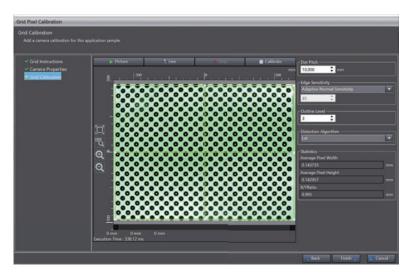


In this manual, *10.00* is entered in the box because the calibration grid whose dot pitch is 10 mm is used to explain the procedure.



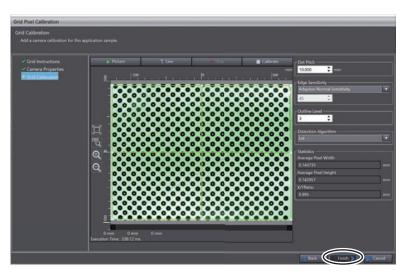
8 Click the Calibration button.

Calibration is performed.



Yellow points in the black dots mean the calibration has been successfully done. If yellow points are not shown, click the **Back** button to return to Step 4, then re-adjust properties so that the dots get clear.





The Grid Pixel Calibration dialog is closed.

## 4-5-5 Running a Sequence Control Program and V+ Program

To operate the conveyor belt for a calibration, run a sequence control program and V+ program.

- **1** Select **Operation Mode RUN Mode** from the **Controller** menu.
- 2 Select View Task Status Control from the menu bar.

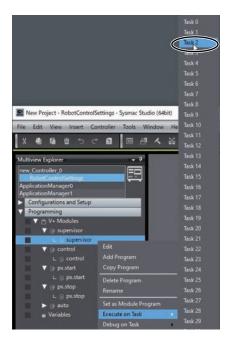
Edit	View	Insert	Controller	Tools	Window	Help		
	Mul	tiview Ex	plorer		Alt+1	í		
-	Proj	ect Short	cut View		Alt+9	ihift+1		
iew E	Tool	Toolbox 3D Visualizer			Alt+2	Alt+2		
obot	3D Y				Alt+5	ihift+2		
0001	Out	put Tab F	Page		Alt+3	Ē.		
figur	Wat	ch Tab P	age		Alt+4	E		
gram	Wat	ch Tab Pa	age(Table)		Alt+S	Alt+Shift+4		
n V	Cros	ss Refere	nce Tab Page		Alt+5	Alt+5		
	Buil	Build Tab Page				Alt+6		
	Event Log							
	Search and Replace Results Tab Page			ge Alt+7				
•	Sim	ulation P	ane		Alt+8	£		
•	Diff	erential M	Monitor		Alt+9	Alt+9		
• Vi	Sma	art Projec	t Search		Ctrl+	Shift+F		
	Rec	Recently Closed Windows			Ctrl+	Ctrl+Shift+H		
er	Clea	ar Recent	ly Closed Wir	ndows Hi	story			
t Sho	V+ .	Jog Cont	foi		Alt+S	ihift+J		
orte	Task	Status C	Control		Alt+S	ihift+T		
	Visid	on Winde	W		Alt+S	ihift+V		

The Task Status Control pane is displayed.

**3** Select **RobotControlSettings** from the device list in the Multiview Explorer.

Robot	ControlSe	ttings 🗖	
ew Cont			
Robot	ControlSe	ttings	>

4 Right-click Programming - V+ Modules - supervisor - supervisor, then click Execute on Task - Task 2.



The supervisor and control of the V+ program is executed in Task2 and Task 3 respectively.

<ul> <li>RobotControlSettings 50 •</li> <li>Task Manager 10 Watcher V + File Browser Virtual Front Panel</li> <li>ApplicationManager1 C # Program • PM_Stop</li> <li>PM_Stop</li> <li>Process Manager</li> <li>Process Manager</li> </ul>	Start Undock Abort Abort All
Task 0: Task 2: supervisor at step 38, stack 0.1 K8 Task 2: supervisor at step 25, stack 0.0 K8 Task 3: control at step 25, stack 0.0 K8 Task 5: Task 6: Task 7: Task 8: Task 9:	

**5** Select Watch Tab Page from the View menu on the main window.

ïew	Insert	Controller	Tools	Window	Help	
Mul	tiview Ex	plorer		Alt+1		
Proj	ect Short	cut View		Alt+S	Shift+1	
Tool	Toolbox			Alt+2		
3D Visualizer				Alt+Shift+2		
Output Tab Page				Δlt+3		
Wat	ch Tab Pa	age		Alt+4		
Wat	ch Tab Pa	ge(lable)	- C	Alt+S	Shift+4	

The Watch (Project)1 tab page appears at the bottom of the main window.



Click the **TRUE** button in the **Modify** column for the variable **gStart** in the **Watch** (**Project**)**1** tab page.

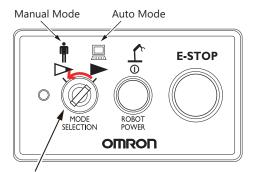
Device name	Name	Online value	Modify	Comment	
new_Controller_0	gStart	False	TRUE	Auto start Button	B
new_Controller_0		٦			

The program runs.

## 4-5-6 Turning Robot High Power ON

The robot high power is turned ON.





Operating mode switch

**2** Press the enable switch on the T20 pendant to Position 2 (half-way).



**3** Press the Robot Power button while the enable switch is kept in Position 2 (half-way).



The Robot Power button on the front panel flashes.

Press the Robot Power button on the front panel.The robot high power is turned ON and the Robot Power button is lit.

If you release the enable switch (Position 1) or press the enable switch further from Position 2 (halfway) to Position 3, the robot high power will be turned OFF.



#### Precautions for Correct Use

If it is necessary to move the robot, follow the procedure above to turn ON the high power.

## 4-5-7 Calibrating the Belt

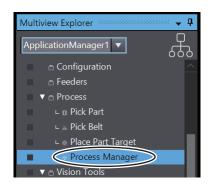
Calibrate the belt.

**1** Select **ApplicationManager1** from the device list in Multiview Explorer.

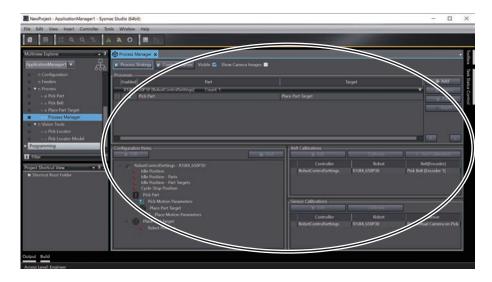




Double-click **Process Manager** under **Configurations and Setup** - **Process** in Multiview Explorer.



The **Process Manager** tab page is displayed.



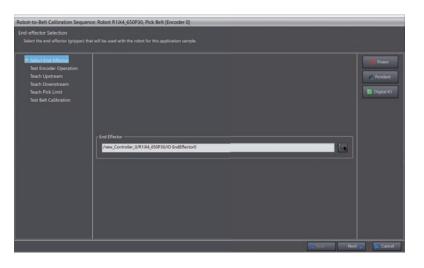
**3** In the **Belt Calibrations** pane, click the row where the belt you calibrate is.

NewProject - ApplicationManager1 - Sysn	mac Studio (64bit)				- 🗆 X
File Edit View Insert Controller To	ools Window Help				
B H C C C .					
Multiview Explorer	Process Manager ×				- Toolt
ApplicationManager1 •	Process Strategy 📽 Control Sources	Visible 💟 Show Camera Images 🖬			1
Configuration	Processes				
n Feeders	Enabled				+ Add
♥ △ Process > □ Pick Part	R10X4_650P30 [RobotControlSettings]	Count 1	- And		
- o Pick Belt	Pick Part		Place Part Target		and the second s
s = Place Part Target					a lotter
Process Manager					
▼					
L = Pick Locator L = Pick Locator Model					10 IN 10 IN
Programming	- Configuration Items		e left Calibrations		
E Filter	and a second processing of the second s		T Edit	Calbrate	<ul> <li>Test Calibration</li> </ul>
	RobotControlSettings - R10X4-65			10000	
Project Shortcut View • V × Shortcut Root Folder	- Idle Position		LiberContinutsettings	R104 550930	This lief: Knowler, 1
	Idle Position - Parts				
	Cycle-Stop Position				
	Pick Part		Sensor Calibrations ————————————————————————————————————		
	Place Part Target			CHERNIN	
	Place Motion Paramet				Sensor
	Place Part Target		RobotControlSettings	R1064_650P30	Pick Virtual Camera on Pick
	E POTOT POINTON				
	J				
Output Build					
Access Level: Engineer					

4 Click the Calibrate button in Belt Calibrations.

Belt Calibrations	Calibrate	V 🛷 Test Calibration
Controller	Robot	Belt[Encoder]
RobotControlSettings	R1iX4_650P30	Pick Belt [Encoder 1]

The Robot-to-Belt Calibration Sequence dialog is displayed.



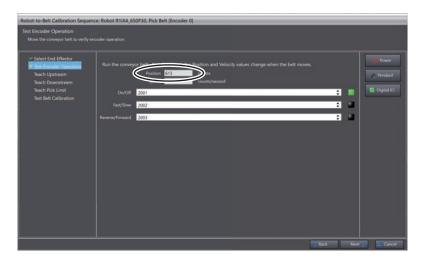
**5** Make sure that the right end effector has been selected , and then click the **Next** button.



# 6 Click the On/Off lamp to lit.

Robot-to-Belt Calibration Sequence	n: Robot R1IX4_650P30, Pick Belt [Encoder 0]	
Test Encoder Operation Move the conveyor belt to verify enc		
<ul> <li>Select End Effector</li> <li>Teach Upstream</li> <li>Teach Upstream</li> <li>Teach Downteem</li> <li>Teach Pick Limit</li> <li>Test Belt Calibration</li> </ul>	Run the conveyor belt. You should see the Position and Welocity values change when the belt moves. Position Speed Could FactStaw Counts	
	😵 Back Next 🦻 💥 Canol	1

Confirm the conveyor belt moves and the number of counts of the **Position** box changes.

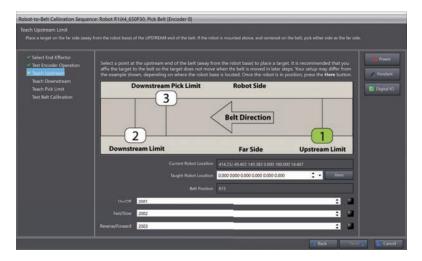


7 Click the **On/Off** lamp to turn off the light.

The conveyor belt stops and also the counter of **Position** stops.

# 8 Click the Next button.

The Teach Upstream Limit dialog appears.



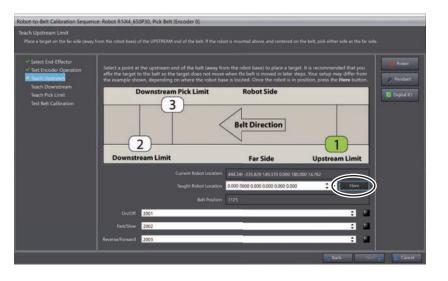


**10** Operate the robot with the T20 Pendant to move it to the upstream limit point.

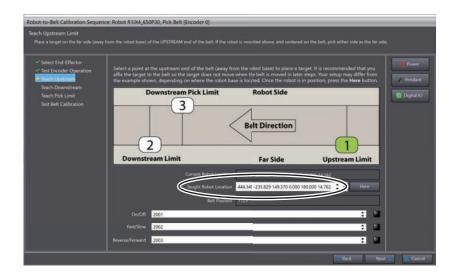
### Additional Information

It is also possible to move the robot in the **V+ Jog Control** window, which is displayed through a click of the **Pendant** button.

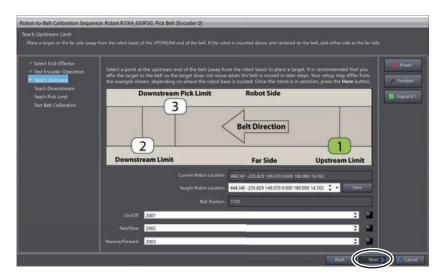
# **11** Click the Here button.



The present robot position is set to the Taught Robot Location box.



# 12 Click the Next button.



**13** Click **On/Off** and **Reverse/Forward** lamps to move the belt so that the target reaches to the downstream limit point.



**14** Teach the robot the downstream limit in the same way as shown in Step 10 to 12.

**15** Click **On/Off** and **Reverse/Forward** lamps to move the belt so that the target reaches to the pick limit point.

**16** Teach the robot the pick limit in the same way as shown in Step 10 to 12.

- 17 Change the operating mode to Auto mode from Manual mode on the front panel, and click the Power button. When the Robot Power button on the front panel flashes, press it to turn on the robot high power.
- **18** Move the robot to the upstream of the belt, then click the **Start Tracking** button in **Belt Transform** in the **Test Belt Calibration** window.



The robot moves as the belt moves.

**19** Click the **Stop Tracking** button if you have confirmed the robot moved as the belt moved.

Belt Transform	
444.340 -235.829 149.370 -22.26	9 179.992 70.576 🗘 👻
Stop Tracking	Level Along
	Level Lateral

The tracking operation stops.

## **20** Click the **Finish** button.

The Robot-to-Belt Calibration Sequence dialog is closed.

### 4-5-8 Calibrating the Sensor

Calibrate the sensor.



### Additional Information

- The procedure in this section includes steps for detecting the target. It is for position detection required for calibration of the sensor. For settings of the locater model to detect an actual target, refer to 4-5-9 Setting the Locator on page 4-146.
- If the target cannot be detected, adjust the camera's shooting environment or the acquisition settings. Refer to the *Automation Control Environment (ACE) Version 4 User's Manual (Cat. No. 1633)* for information on the acquisition settings of the virtual camera.

**1** Select **ApplicationManager1** from the device list in Multiview Explorer.

4



2 Double-click Process Manager under Configurations and Setup - Process in Multiview Explorer.

Multi	view Explorer	. џ
Арр	licationManager1 🔻	£
	Configuration	
	Feeders	
	Process	
	∟ 🛛 Pick Part	
	∟ ≞ Pick Belt	
	∟ ⊚ Place Part Target	
	Process Manager	
	🔻 🗅 Vision Tools	

The Process Manager tab page is displayed.

NewProject - ApplicationManager1 - Sysm	nac Studio (64bit)		- 🗆 🗙
File Edit View Insert Controller To	ols Window Help		
Multiview Diplorer 👥 🗸 🛛	Process Manager X		- 1
ApplicationManager1   Configuration  Configuration  Feeders	Process States	nera Images	
	Ten 1 17 June (Local Constitution) Court 1 Plat Net	Place Part Target	
Process Manager      Otsion Tools      O Vision Tools      O Pick Locator      Pick Locator Model      Programming	a		
Fiber      Fiber      Project Shortcut View      Project Shortcut Root Folder	Configuration Items Rebot ControlSettings - R1204,650P30 & Mel Polition & Mel Polition - Parts & Mel Polition - Parts	Bell Californian Controller Controller Robort Robort Controllertings #1304_650930	Betijfnooderj Pick Beti (Encoder 1)
	Cycle Stop Position Pick Pat Pick Motion Parameters Place Part Target Place Motion Parameters	Sensor Calibrations	



In the **Sensor Calibrations** pane, click the row where the sensor you calibrate is.

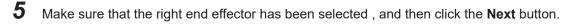
NewProject - ApplicationManager1 - Sysm	sac Studio (64bit)		- 🗆 X
File Edit View Insert Controller, To	iols Window Help		
	A XA O 👧 10		
Multiview Explorer	Process Manager 🗙		- Colt
Configuration     Configu	Process Strategy Control Source Value Source Process Indeed Process REDE Cool 39 Polacit ControlScirings Content Rede Polacity Red Polacity Rede Polacity Rede Polacity Rede Polacity Rede Polaci	Canners Indiget	6-2006 Tex Your Crowd
	Flace Part Target Robot Position		PSK V95ad Common 041592
Output Build			
Access Level: Engineer			

4 Click the Calibrate button in Sensor Calibrations.

- Sensor Calibrations	Calibrate	
Controller	Robot	Sensor
RobotControlSettings	R1iX4_650P30	Pick Virtual Camera on Pick

The Robot-to-Belt Camera Calibration Sequence dialog is displayed.

oot-to-Belt Camera Calibration	Sequence: Robot R1iX4_650P30, Camera Pick Virtual Camera	 
d-effector Selection Select the end-effector (gripper) th		
Teach Model Teach Model Locate Object Object Orden Advance Belt Advance Belt Advance Belt Advance Belt More Robot Calibration Summary	ford filtetor /new_Costipilier_0/R134_550P30/H0 End(filetor0	Pendent Pendent Digital IO ar Settings
		2 2 Gave

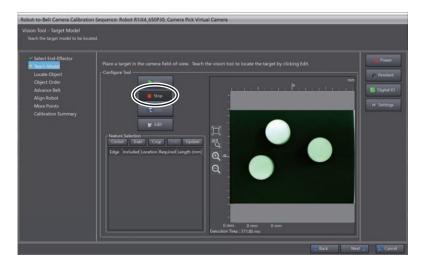


obot-to-Belt Camera Calibratio	in Sequence: Robot R1iX4_650P30, Camera Pick Virtual Camera	 
ind-effector Selection		
Select the end-effector (gripper)		
Parkin Con Hindon Inach Model Loade Object Object Order Advance Belt Adya Robot More Points Calibration Summary	- Erd Effector	Protect
		) x care

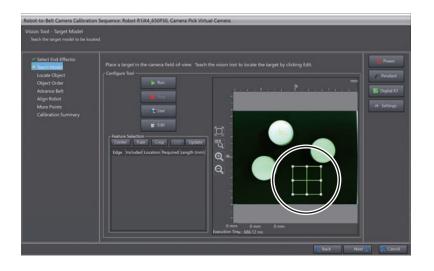
**6** Click the **Live** button and place the target in the camera view while watching the displayed image.



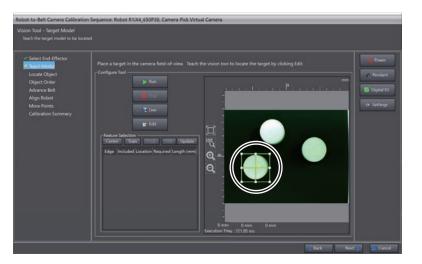
7 Click the Stop button.



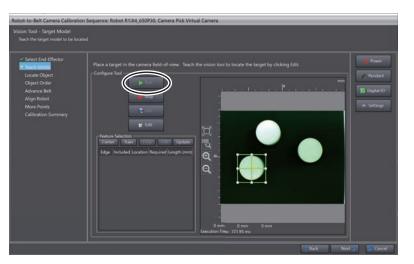
The green frame which specify a target is shown.



**8** Drag and drop the green frame, and scale it to box a target.

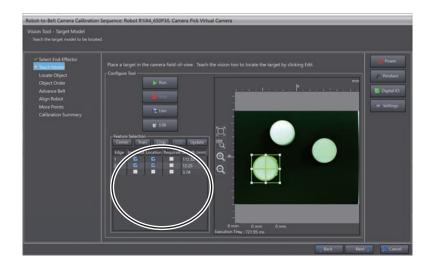


**9** Click the **Run** button.

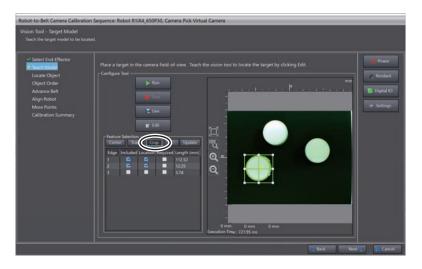


Features of the boxed target are detected.

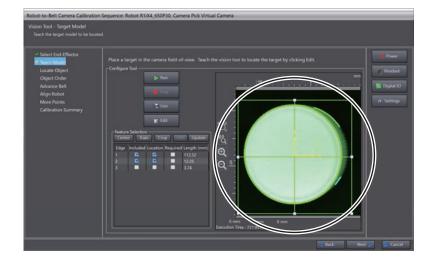
4



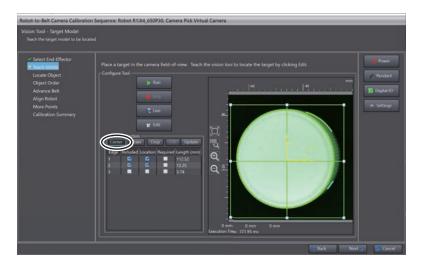
# **10** Click the **Crop** button.



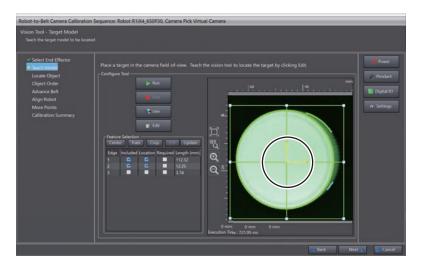
The boxed target is displayed in an enlarged image.







A yellow marker is displayed at the center of the detected target.

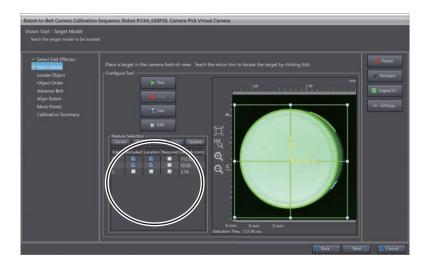


If the detected center point is wrong, drag and drop the arrows of the marker for adjustment.

12 Click the Train button.



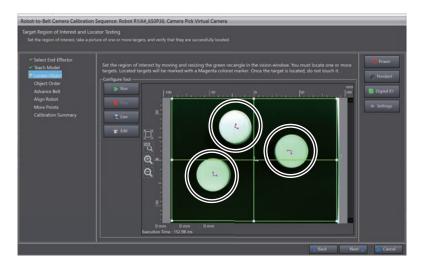
Features are detected.



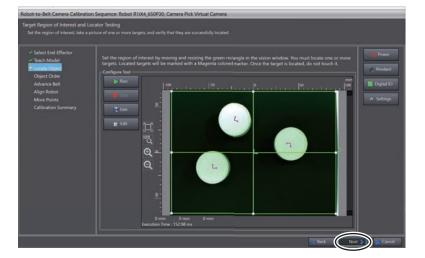
Clear the **Included** check boxes of unnecessary features of the target. The color of edges whose **Included** check boxes have been cleared turn to red from green. After clearing the check boxes, click the **Update** button.

<text>

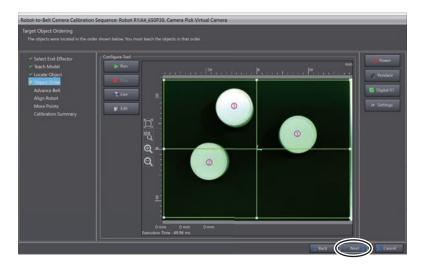
Locations of all targets are detected, and a magenta markers appear around the center of targets.



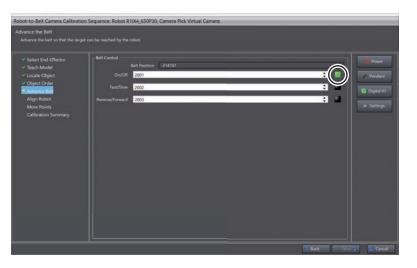
**14** Make sure that the targets have been detected properly, and then click the **Next** button.



**15** Click the **Next** button in the Target Object Ordering window, which is subsequently displayed.

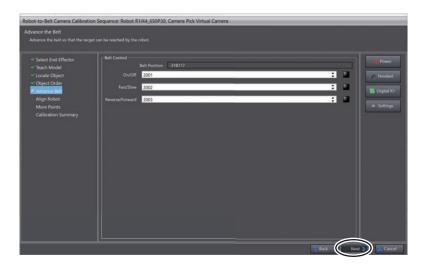


**16** Forward the belt with **On/Off** lamp in the Belt Control pane to move the targets to the point where the robot can reach.



4

# 17 Click the Next button.



18 Operate the robot with the T20 Pendant so that its end effector touch the marked target.

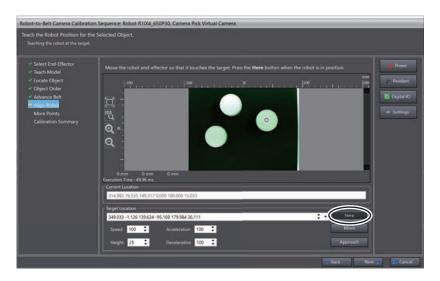




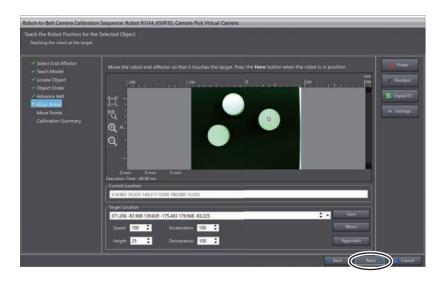
#### **Additional Information**

It is also possible to move the robot in the **V+ Jog Control** window, which is displayed through a click of the **Pendant** button.

# **19** Click the Here button.







The marker moves to the next target. Repeat the step 19 and 20 for all the target. You need to teach for at least 4 targets. In the example above, three targets were set and taught. So, place the target again in the camera view and perform the step 14 and later.

**21** Click the **Next** button.





### Additional Information

To increase the accuracy of teaching, select **Continue adding more points** to continue teaching using additional targets.

The Calibration Summary window is displayed.

4

tobot-to-Belt Camera Calibration	n Sequence: Robot R1iX4_650P30, Camera Pick Virtual Camera	
Calibration Summary Review the calibration summary.		
✓ Select Frd Efflector     ✓ Trach Model     ✓ Loade Gliject     ✓ Order Gliject     ✓ Order Gliject     ✓ Advance Beit     ✓ Advance Beit	The scale factor value should be close to 1 if the calibration is successful/Valid scale factor range is between 0.92 and 1.08 Error values are the differences in distance between the taught position and the calculated position.Scale Factor: 0.941 mm 1 XY Error: 13.443 mm Z Error: 0.293 mm 2 XY Error: 20.808 mm Z Error: 0.2471 mm 3 XY Error: 20.109 mm Z Error: 0.0471 mm 5 XY Error: 3.1453 mm Z Error: 0.0471 mm 6 XY Error: 13.4253 mm Z Error: 0.0473 mm 7 XY Error: 13.4253 mm Z Error: 0.0473 mm	Power Podert Cogital IO A Settings
	C Back Fin	sh 🦻 😹 Cancel

# 22 Click the Finish button.

alibration Summary Review the calibration summary		
<ul> <li>✓ Select End Efflector</li> <li>✓ Tack Model</li> <li>✓ Tack Model</li> <li>✓ Coster Object</li> <li>✓ Object Object</li> <li>✓ Alger Robot</li> <li>✓ Alger Robot</li> <li>✓ Alger Robot</li> <li>✓ More Points</li> <li>✓ Calibration Science of Calib</li></ul>	The scale factor value should be close to 1 if the calibration is successful Valid scale factor range is between 0.92 and 100 Enror values are the differences in distance between the taught position and the calculated position.Scale factor: 0.941 mm 1 X Y Error: 0.243 mm Z Error: 0.293 mm 2 X-Y Error: 0.243 mm Z Error: 0.243 mm 3 X Y Error: 0.2606 mm Z Error: 0.243 mm 5 X Y Error: 0.343 mm Z Error: 0.471 mm 5 X Y Error: 0.343 mm Z Error: 0.471 mm 6 X Y Error: 0.343 mm Z Error: 0.473 mm	Product Product Digital IO Ar Settings

The Robot-to-Belt Camera Calibration Sequence dialog is closed.

## 4-5-9 Setting the Locator

Set up the Locator.



### **Additional Information**

Refer to the Automation Control Environment (ACE) Version 4 User's Manual (Cat. No.1633) for details of the following items.

Item	References in Cat. No. I633
About the configuration items of the locater model (Pick Locater Model in this section) for defining the shape and features of the tar- get	Locator Model Configuration Items in Vision Tools
About the properties of the detected target, which are defined by the locator's configuration items	Locator Configuration Items in Vision Tools

**1** Select **ApplicationManager1** from the device list in Multiview Explorer.



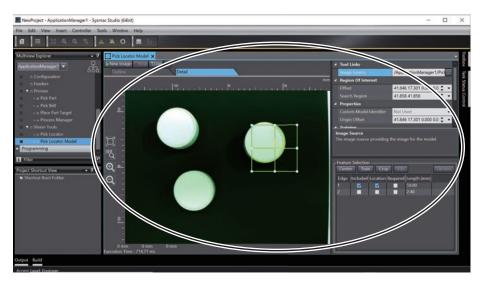
2 Double-click **Pick Locator Model** under **Configurations and Setup - Vision Tools** in Multiview Explorer.



**3 Pick Locator Model** tab page is displayed. Click the **Live** button and place the target in the camera view while watching the displayed image. Click the **Stop** button, and then the **New Image** button.

Pick Locator Model ×
New Image Stop CLive
Outline

The image is fixed and the green frame appears on the image.



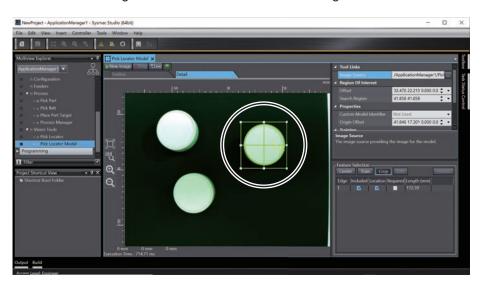
4

**4** Drag and drop the green frame, and scale it to box a target.



**5** Click the **Train** button.



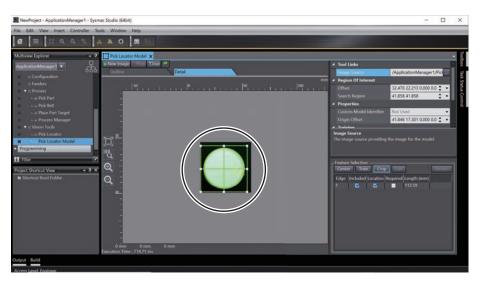


Features of the target are detected and indicated with green lines.

6 Click the Crop button.



The boxed target is displayed in an enlarged image.



If the detected position and features are not appropriate, adjust them in the way described in *4-5-8 Calibrating the Sensor* on page 4-135.

7 Double-click **Pick Locator** under **Configurations and Setup** - **Vision Tools** in Multiview Explorer.

4

Multi	view Explorer	···· <b>↓</b> ₽
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	Feeders	
	Process	
	∟ 🛛 Pick Part	
	∟ Pick Belt	
	∟ ⊚ Place Part Target	
	∟	_
	Vision Tools	
<	💷 Pick Locator	
-	□ Pick Locator Model	
> Pro	gramming	

The model you have created is registered to the **Models** pane.



A target in the green frame is detected in the **Pick Locator** tab page, and a magenta marker appears around the center of the detected target.



- 8
- Drag and drop the green frame, and expand it to an entire shooting range.

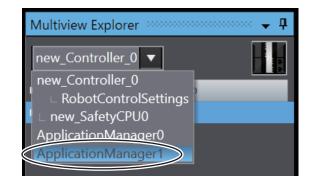


Locations of all the target in the green frame are recognized.

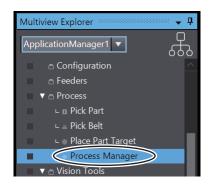
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# 4-5-10 Teaching Idle, Pick, and Place Positions

**1** Select **ApplicationManager1** from the device list in Multiview Explorer.



2 Double-click Process Manager under Configurations and Setup - Process.



The Process Manager tab page is displayed.

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s o Pick Locator Model		
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**3** Select a process from the **Processes** list.

Edit View Insert Controller	Tools Window Help		
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▼ ⊜ Vision Tools			
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1) Click the **Teach** button at the right of the list.

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Multiview Explorer -	OProcess Manager X		- 3
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<ul> <li>Pick Locator Model</li> <li>Programming</li> </ul>	Configuration Items	Belt Calibrations	
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	Pick Part Pick Motion Parameters Place Part Target V Place Motion Parameters	Serior Calibratoria Controller Robot Serior	
	Place Part larget Robot Position	Robot Sensor RobotControlSettings R1004.650P30 Pick Virtual Camera on Pick	
Output Build		升	
Access Level: Engineer			

The Teaching a Process dialog box is displayed.

Teaching Process	
Teaching a Process. Instructions	
P.Satings/Stand	You are teaching the selected process. This procedure will first take you through the steps of picking all the parts associated with the process. Once the robot has all the parts, you will be taken through the steps of teaching the part(s) at the target(s) configured in the process.
	Titlet 2 Scanol

**4** Click the **Finish** button.

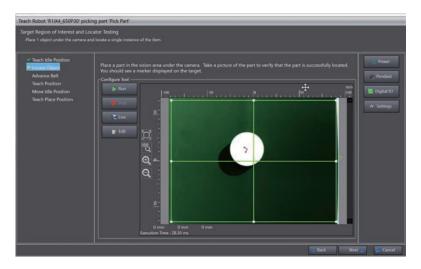


The teaching window appears.

**5** Adjust each teaching following instructions shown in the window. Adjustment can be performed in the same way as simulation.

Use the T20 Pendant to move the robot. Clicking the **Pendant** button enables to move the robot on the **V+ Jog Control** window.

In the **Locate Object** window, you can confirm it is possible to detect a location of a target placed alone.



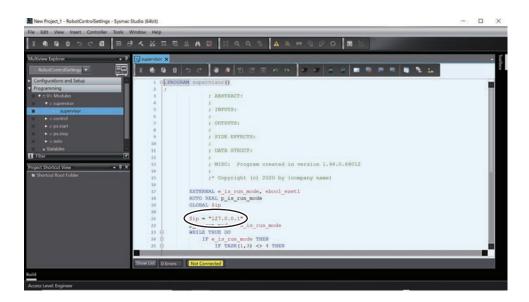
## 4-5-11 Running the Program to Check the Operation

Check that turning on the Robot Integrated CPU Unit and IPC Application Controller runs the program automatically.

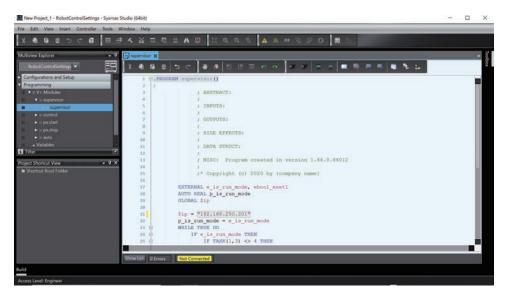
**1** Select **RobotControllerSettings** from the device list in the Multiview Explorer.



- 2 Click **Controller Offline** from the menu bar.
- **3** On the V+ program supervisor, rewrite the IP address assigned to *\$ip* to that of the IPC Application Controller.



In case the IPC Application Controller IP address is 192.168.250.201, rewrite it as illustrated in the screen shot below.



- 4 Click **Controller Online** from the menu bar. Sysmac Studio goes online.
- **5** Click the synchronization icon in the toolbar.



The Synchronization window is displayed.

Synchronisatio	_ 0.						
	Computer: Data Name	Target : Data Name	Compare				
	Programs	▼ Programs					
- 0							
	L control	L control					
	L. px.stop	L px.stop					
	Variables	▼ Variables					
Legend: Synchronized Exists only on one side Not checked							
		Toron the Texture	Transfer From Target Recompare Close				
		number 10 miller	Cose				

**6** Check the **supervisor** box under **Programs**.

Synchronisa	- 0		
			Terrer 1
	Computer: Data Name	Target : Data Name	Compare
	▼ Programs	✓ Programs	
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		-	
		Transfer To Target	Transfer From Target Recompare Close
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7 Click the Transfer To Target button.

Synchronisation		
Computer: Data Nam	e Target : Data Name ▼Programs ■ control = postart = postart = auto ▼Variables = \$ip	Compare
Legend: Synchronized Bifferen	Exists only on one side	Not checked Transfer From Target Recompare Close

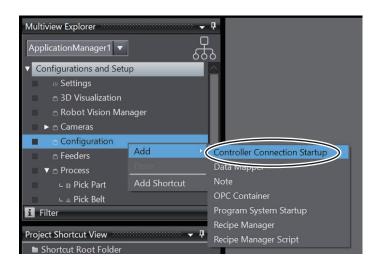
The supervisor program is transferred to the Robot Integrated CPU Unit.

Synchronis	ation		
	Computer: Data Name	Target : Data Name	Compare
	▼ Programs	▼ Programs	
	supervisor	supervisor	
	- control	L control	
	▼ Variables	▼ Variables	
		∟ \$ip	
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	Synchronization process succ	cessfully finished	
		Transfer To Target	Transfer From Target Recompare Close

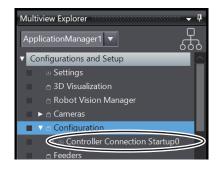
8 Click the Close button. The Synchronization window is closed.



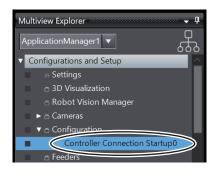
**10** Click Configurations and Setup - Configuration - Add - Controller Connection Startup.



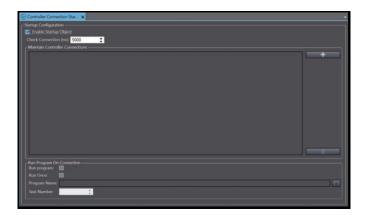
Controller Connection Startup0 is added under Configuration.



**11** Double-click Controller Connection Startup0.



Controller Connection Startup0 tab page is displayed.



**12** Click the + button.



The Select a Reference dialog appears.



**13** Select **Controller Settings**, then click the **Select** button.



/new\_Controller\_0/Controller Settings is added to the Controller Connection Startup0 tab page.

Enable Startup Object		
Check Connection (mi) 5000		
Maha		 +
		 _
		- 0
- Run Program On Connection		
Run program:		
Run program:  Run Once: Program Name:		

**14** Click the synchronization icon in the toolbar.

File	Edit	View	Insert	Con	troller	Tools	Window	Help	_	
12	30	]] [	] @	Q	<sup>100</sup>	4	×(0)	00	'n	

The Synchronization window is displayed.

	Computer: Data Name	Target : Data Name	Compare	
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**15** Click the **Transfer To Target** button.



The settings and program is transferred to the destination IPC Application Controller.

Synchronis	ation	$\bigcirc$	
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	Synchronized	Exists of the Not checked ssfully finished. Transfer To Target Transfer from Target Recompare Close	

16 Click the Close button.

	Computer: Data Name	Target : Data Name	ompare	
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	L 3D Visualization	3D Visualization		
	Robot Vision Manager	Robot Vision Manager		
	▼ Cameras	▼ Cameras		
	Pick Virtual Camera	Pick Virtual Camera		
	Configurations and Set	▼ Configurations and Set		
~	Controller Connection	Controller Connection		
	▼ Process	▼ Process		
5	L Pick Belt	Pick Belt		
	Place Part Target	Place Part Target		
5	Process Manager	Process Manager		
	L Programs	Programs		
	L Variables	Variables		
	Vision Tools	▼Vision Tools		
	n:-i-i	Rf-1. 1		
	Synchronized Different			
The	Synchronization process succe	webilly finished		
	synchronization process succe	initially initialized.		

The Synchronization window is closed.

17 Disconnect Sysmac Studio (offline) to the Robot Integrated CPU Unit and IPC Application Controller.

To go offline, select **Offline** instead of **Online** in the processes described in *Connecting Sysmac Studio to the Robot Integrated CPU Unit Online* on page 4-110 and *Going Online with the IPC Application Controller* on page 4-111.

- **18** Power off the Robot Integrated CPU Unit and IPC Application Controller.
- **19** Power on the Robot Integrated CPU Unit and IPC Application Controller.
- **20** Boot up ACE as a server in the IPC Application Controller. Refer to Automation Control Environment (ACE) Version 4 User's Manual (Cat. No.I633) for the ACE server instance.
- **21** Establish an online connection between Sysmac Studio and the Robot Integrated CPU Unit. Refer to *Connecting Sysmac Studio to the Robot Integrated CPU Unit Online* on page 4-110 for the procedure to connect online.
- **22** Set TRUE to *gStart* in the **Watch (Project)1** tab page.

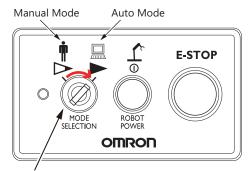


Refer to *4-5-5 Running a Sequence Control Program and V+ Program* on page 4-126 for how to open the Watch tab page.

**23** Turn on the robot high power on the robot front panel.

1) Switch the front panel to Auto mode.

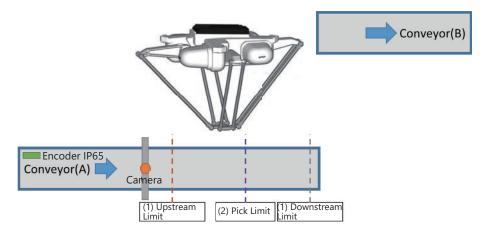
4



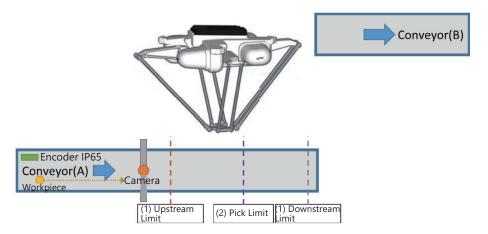
Operating mode switch

- 2) Press the Robot Power button. The Robot Power button blinks.
- 3) Press the Robot Power button again.

The robot high power turns ON, then the dynamic pick-and place program runs automatically. The carrying conveyor A operates.

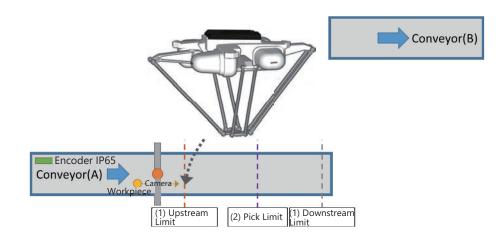


**24** Put a part at the upstream of the conveyor A.

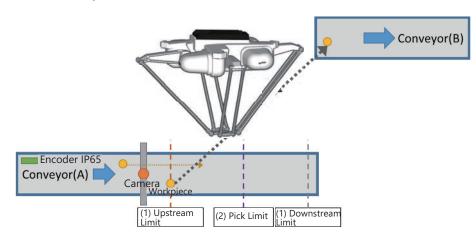


 ${\bf 25}$  Check that the robot works as described in the following.

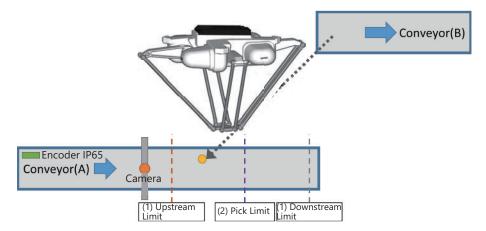
1) The robot moves to the upstream limit point when the camera detects the part, then pause.



2) The part is carried to the upstream limit point, then the robot picks up the part and place it on the conveyor B.



**26** Repeat Step 24 to 25 to check the robot works as described in the following. The robot repeats picking and placing the parts detected subsequently.



# A

# Appendices

#### A-1 Designing Example of the Safety Functions for the Pick-andplace Equipment...... A-2 A-1-1 A-1-2 A-1-3 A-1-4 A-1-5 Safety System Configuration and Devices ......A-5 A-1-6 Installation and Wiring ......A-7 A-1-7 A-2 How to Use 3D Visualizer ...... A-21 A-2-1 A-2-2 A-2-3 A-2-4 Zoom-in and Zoom-out......A-26 Setting Items on the Sysmac Studio and the Setting Targets ...... A-28 A-3 A-4 Using Troubleshooting Functions ...... A-29

# A-1 Designing Example of the Safety Functions for the Pick-and-place Equipment

This section describes the designing example of the safety functions for the pick-and-place equipment.



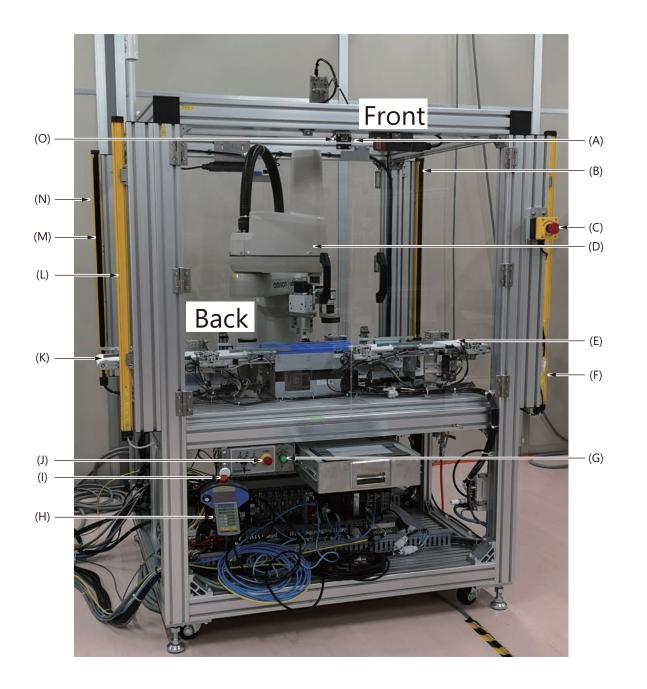
## Precautions for Correct Use

You must implement the actual safety measures based on the *Robot Safety Guide (Cat. No. 1590)* and risk assessment. In addition, it is necessary to consider the performance level and safety distances of the equipment while it conforms to the safety standards.

## A-1-1 Pick-and-place Equipment Configuration

The configuration of the pick-and-place equipment inclusive of the safety devices is shown in the table below.





Letter	Name
А	Safety door switch 2
В	Safety light curtain 2 (Emitter)
С	Emergency stop pushbutton switch 1
D	Robot
E	Belt conveyor (Unload side)
F	Safety light curtain 2 (Receiver)
G	Reset switch
Н	Enable switch on T20 pendant
I	E-STOP button on T20 pendant
J	E-STOP button on front panel
К	Belt conveyor (Load side)
L	Safety light curtain 1 (Receiver)
М	Safety light curtain 1 (Emitter)
Ν	Emergency stop pushbutton switch 2
0	Safety door switch 1

## A-1-2 Hazards

The movable parts of the robot are the mechanical hazards in the system configuration described in this section.

## A-1-3 Protective Measure

You must assume the cases in which the hazards are approached from each side of the pick-andplace equipment.

The safeguarding to each case is implemented as shown in the table below.

Equipment side Approached case		Safeguarding	Safety device
Back		Fixed guard	
Front	Adjustment/ maintenance	Movable guard	Safety door switch
Loading side	Loading	Opto-electronic protective device	Safety light curtain
Unload side	Unloading	Opto-electronic protective device	Safety light curtain

In addition to the safeguarding, the emergency stop switches as the complementary protective measures are placed at positions accessible from each side of the equipment.

Equipment side	Complementary protective measure	Safety device
Back	Emergency stop switch	Emergency stop pushbutton switch
Front		Emergency stop pushbutton switch
		E-STOP button on T20 pendant
		E-STOP button on front panel

## A-1-4 Safety Functions

You must decide the safety function of each safety device for the case it operated. The functions need to be decided for each operating mode of the OMRON robot.

# Auto Mode

Set the safety functions when the operating mode of the OMRON robot is in Auto mode as shown in the table below.

Safety device	Safety function	Recovery
Emergency stop pushbutton switch 1	Stop the robot when pressed	High power ON after resetting
Emergency stop pushbutton switch 2	Stop the robot when pressed	High power ON after resetting
Safety light curtain 1	Stop the robot when the beam is inter-	High power ON
	rupted	
Safety light curtain 2	Stop the robot when beam is interrupted	High power ON
Safety door switch 1	Stop the robot when the door is open	High power ON after resetting
Safety door switch 2	Stop the robot when the door is open	High power ON after resetting
E-STOP button on front panel	Stop the robot when pressed	High power ON after resetting
E-STOP button on T20 pendant	Stop the robot when pressed	High power ON after resetting
Enable switch on T20 pendant		

## Manual Mode

Set the safety functions when the operating mode of the OMRON robot is in Manual mode as shown in the table below.

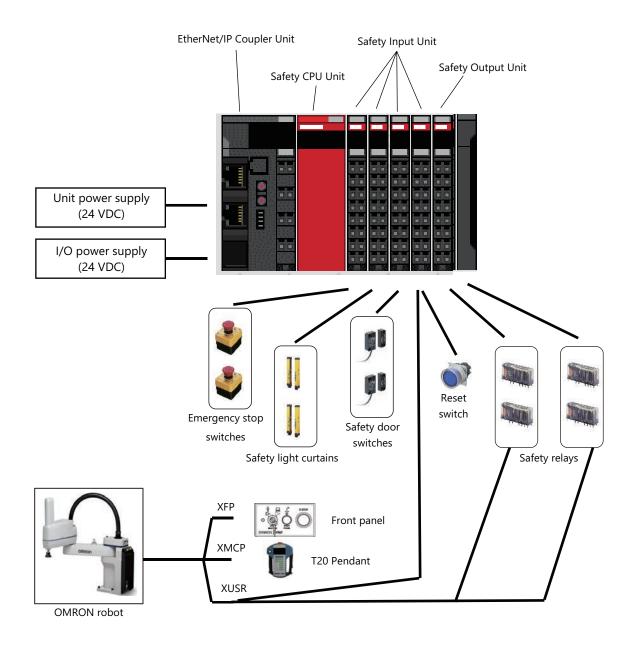
Safety device	Safety function	Recovery
Emergency stop pushbutton switch 1	Stop the robot when pressed	Reset
Emergency stop pushbutton switch 2	Stop the robot when pressed	Reset
Safety light curtain 1		
Safety light curtain 2		
Safety door switch 1		
Safety door switch 2		
E-STOP button on front panel	Stop the robot when pressed	Reset
E-STOP button on T20 pendant	Stop the robot when pressed	Reset
Enable switch on T20 pendant	Stop the robot when not pressed or fully pressed pass- ing the middle position	High power ON

## A-1-5 Safety System Configuration and Devices

You must select the safety system configuration and devices for it to achieve the safety functions.

## Safety System Configuration

The safety system configuration in this guide uses an NX-series EtherNet/IP Coupler Unit and NX-series Safety Control Units.



## **Configuration Devices**

The safety system configuration in this guide uses the devices shown in the table below.

Name	Model	Manufac- turer	Description
EtherNet/IP Coupler	NX-EIC202	OMRON	A Coupler Unit that supports EtherNet/IP.
Unit			This Unit can compose a Slave Terminal by connecting with an NX Unit.
Safety CPU Unit	NX-SL3300	OMRON	A Unit that runs safety programs.
Safety Input Unit	NX-SIH400	OMRON	A Unit to be connected with safety input devices.
Safety Output Unit	NX-SOD400	OMRON	A Unit to be connected with safety output devices.
Safety Light Curtain	F3SG	OMRON	A photoelectric safety sensor. This sensor detects human
			entry to hazardous area.
Safety Door Switch	D40A	OMRON	A non-contact safety door switch. This switch detects open and close of the entrance door to hazardous area.
Reset Switch	A22-H	OMRON	A reset switch. This switch is used to manually recover the
	□-10M		equipment from the stop state after the safety function oper- ated.
Emergency Stop	A22E	OMRON	An emergency stop switch.
Pushbutton Switch			
Safety Relay	G7SA	OMRON	A safety relay.
Unit Power Supply	S8VK	OMRON	A 24 VDC power supply. This control power supply is for the
			EtherNet/IP Coupler Units and the NX Units.
I/O Power Supply	S8VK	OMRON	A 24 VDC power supply. This power supply is for the I/O cir-
			cuits of the NX Units and the connected external devices.

## A-1-6 Installation and Wiring

This section describes the installation and wiring related to the safety functions for the pick-and-place equipment.

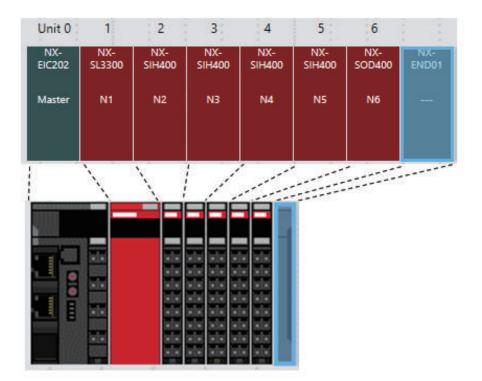
The NX Unit configuration of the EtherNet/IP Slave Terminal and the wiring diagram of the safety devices are described in this guide.

Refer to the following manual for details on installing and wiring the actual devices.

- NX-series Safety Control Unit User's Manual (Cat. No. Z930)
- NX-series EtherNet/IP Coupler Unit User's Manual (Cat. No. W536)
- eCobra 600 and 800 Robot with EtherCAT User's Guide (Cat. No. 1653)
- T20 Pendant User's Guide (Cat. No. I601)

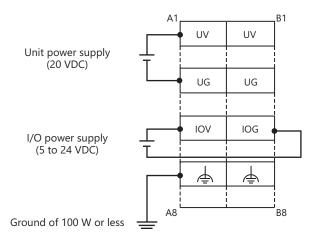
## NX Unit Configuration

Compose the EtherNet/IP Slave Terminal by the connection order shown in the figure below.



## Wiring the Power Supplies

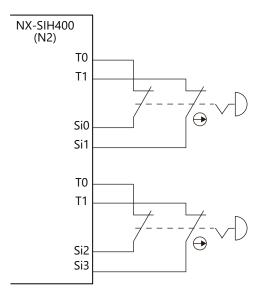
The power supply wirings and grounding for the EtherNet/IP Coupler Unit are shown in the figure below.



- Connect the + terminal (24 VDC) of the Unit power supply to A1 or B1.
- Connect the terminal (0 VDC) of the Unit power supply to A3 or B3.
- Connect the + terminal (5 to 24 VDC) of the I/O power supply to A5.
- Connect the terminal (0 VDC) of the I/O power supply to B5.
- Connect the ground line to A7 or B7.

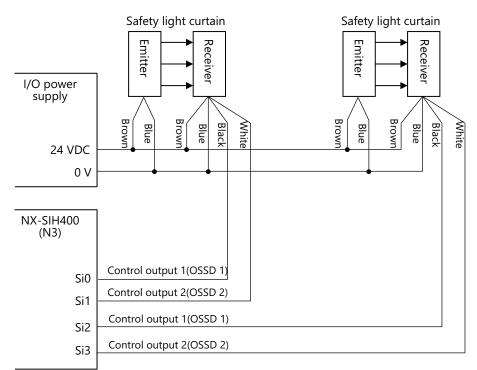
## Wiring the Emergency Stop Pushbutton Switch

Connect the emergency stop pushbutton switch to the Safety Input Unit (N2).



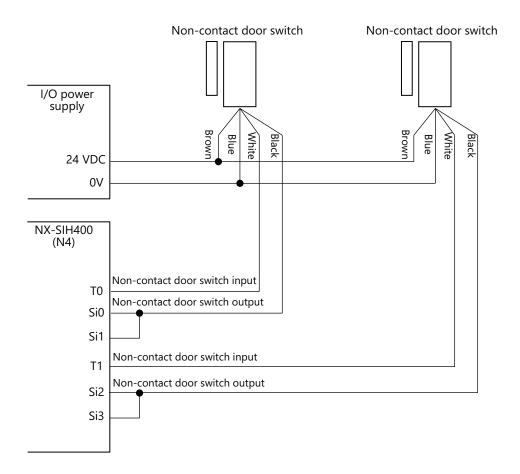
# Wiring the Safety Light Curtain

Connect the safety light curtain to the I/O power supply and Safety Input Unit (N3).



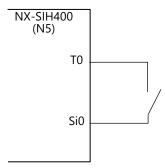
## Wiring the Safety Door Switch

Connect the non-contact door switch to the I/O power supply and Safety Input Unit (N4).



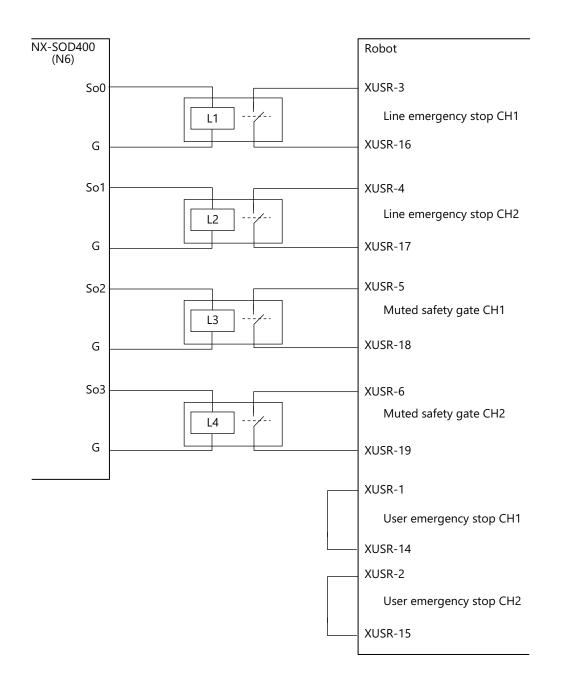
# Wiring the Reset Switch

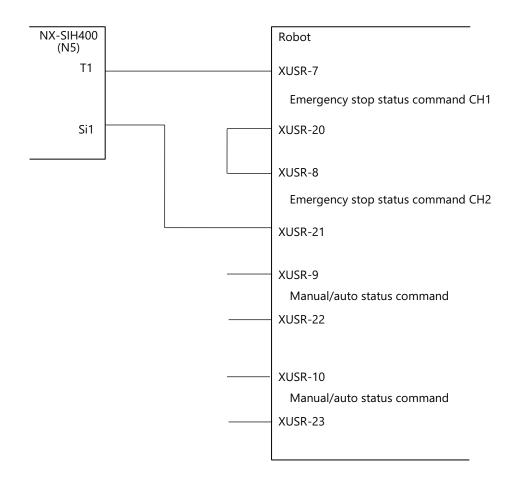
Connect the reset switch to the Safety Input Unit (N5).



## Wiring the Robot

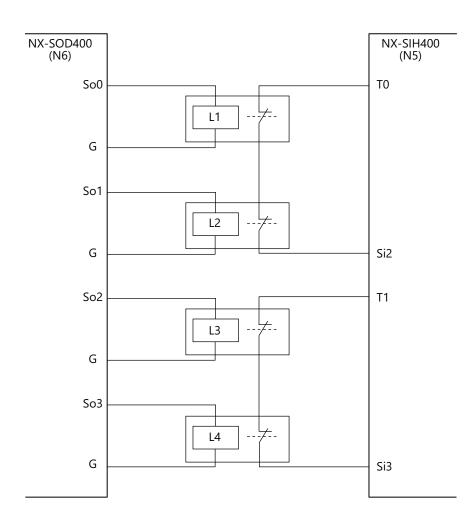
Connect the robot to the Safety Output Unit (N6), Safety Input Unit (N5) and safety relays. The outputs of the Safety Output Unit (N6) and the inputs of the robot cannot be directly connected, therefore they are connected through the safety relays. Use the contact a of each safety relay L1 to L4.





## Wiring the Safety Relays for Operation Check

Connect the contact b of each safety relay L1 to L4 to the Safety Input Unit (N5) for checking the operation of each contact a.



## A-1-7 Settings and Programming

This section describes the settings and programming related to the safety functions.

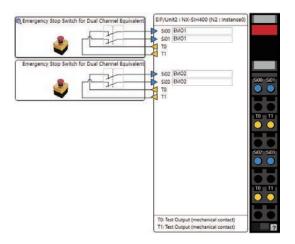
Refer to the *NX-series Safety Control Unit Instructions Reference Manual (Cat. No. Z931)* for information on the instructions for the Safety CPU Unit.

Refer to the *NX-series Safety Control Unit User's Manual (Cat. No. Z930)* for information on the specifications and how to configure the Safety Control Units.

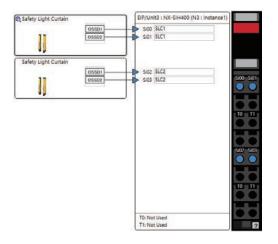
# Setting Safety I/O Unit

Use the Sysmac Studio and set the safety functions of each safety I/O terminal.

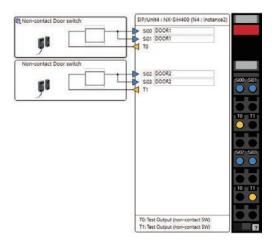
Set the Safety Input Unit (N2) as shown below.



Set the Safety Input Unit (N3) as shown below.



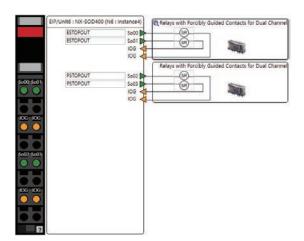
Set the Safety Input Unit (N4) as shown below.



Set the Safety Input Unit (N5) as shown below.

Reset Switch with Test Pulse	EIP/Unit5 : NX-SIH400 (N5 : Instance3)
	\$100 RST T0
Mechanical Contact for Single Channel	SIOT EDM_PSTOP
EDM Feedback	
EDM Feedback	5.03 EDM_PSTOP
	542° S
	T0: Test Output (mechanical contact) T1: Test Output (mechanical contact)

Set the Safety Output Unit (N6) as shown below.



# **Registering Device Variables**

Use the Sysmac Studio and set the device variables of each Safety I/O Unit.

Position	Port	R/W	Data Type	Variable	Variable Comment	Variable Type
	🔻 👮 NX Bus					
NX Bus Master	Master					
EIP/Unit2	▼ NX-SIH400					
	Safety Inputs and Status					
	Si00 Logical Value	R	SAFEBOOL	EMO1	EMO1	Global Variables
	Si01 Logical Value	R	SAFEBOOL		EMO1	
	Si02 Logical Value	R	SAFEBOOL	EMO2	EMO2	Global Variables
	Si03 Logical Value	R	SAFEBOOL		EMO2	
	Safety Connection Status	R	SAFEBOOL	N2_Safety_Connection_Status		Global Variables
	Safety Input Terminal Status	R	SAFEBOOL			
EIP/Unit3	VI NX-SIH400					
	Safety Inputs and Status					
	Si00 Logical Value	R	SAFEBOOL	SLC1	SLC1	Global Variables
	Si01 Logical Value	R	SAFEBOOL		SLC1	
	Si02 Logical Value	R	SAFEBOOL	SLC2	SLC2	Global Variables
	Si03 Logical Value	R	SAFEBOOL	-	SLC2	
	Safety Connection Status	R	SAFEBOOL	N3_Safety_Connection_Status		<b>Global Variables</b>
	Safety Input Terminal Status	R	SAFEBOOL			
EIP/Unit4	▼ NX-SIH400					
	Safety Inputs and Status					
	Si00 Logical Value	R	SAFEBOOL	DOOR1	DOOR1	Global Variables
	Si01 Logical Value	R	SAFEBOOL		DOOR1	
	Si02 Logical Value	R	SAFEBOOL	DOOR2	DOOR2	Global Variables
	Si03 Logical Value	R	SAFEBOOL		DOOR2	
	Safety Connection Status	R	SAFEBOOL	N4_Safety_Connection_Status		Global Variables
	Safety Input Terminal Status	R	SAFEBOOL			
EIP/Unit5	VINX-SIH400					
	Safety Inputs and Status					
	Si00 Logical Value	R	SAFEBOOL	RST	RST	<b>Global Variables</b>
_	Si01 Logical Value	R	SAFEBOOL	LOCALSTOP	LOCALSTOP	<b>Global Variables</b>
	Si02 Logical Value	R	SAFEBOOL	EDM_ESTOP	EDM_ESTOP	Global Variables
	Si03 Logical Value	R	SAFEBOOL	EDM_PSTOP	EDM_PSTOP	<b>Global Variables</b>
	Safety Connection Status	R	SAFEBOOL	N5_Safety_Connection_Status		<b>Global Variables</b>
	Safety Input Terminal Status	R	SAFEBOOL			
EIP/Unit6	VX-SOD400					
	▼ Status					
	Safety Connection Status	R	SAFEBOOL	N6_Safety_Connection_Status		<b>Global Variables</b>
	Safety Output Terminal Status	R	SAFEBOOL			
	▼ Safety Outputs					
	So00 Output Value	w	SAFEBOOL	ESTOPOUT	ESTOPOUT	Global Variables
	So01 Output Value	w	SAFEBOOL		ESTOPOUT	
	So02 Output Value	W	SAFEBOOL	PSTOPOUT	PSTOPOUT	Global Variables
	So03 Output Value	W	SAFEBOOL		PSTOPOUT	

## Safety Programs

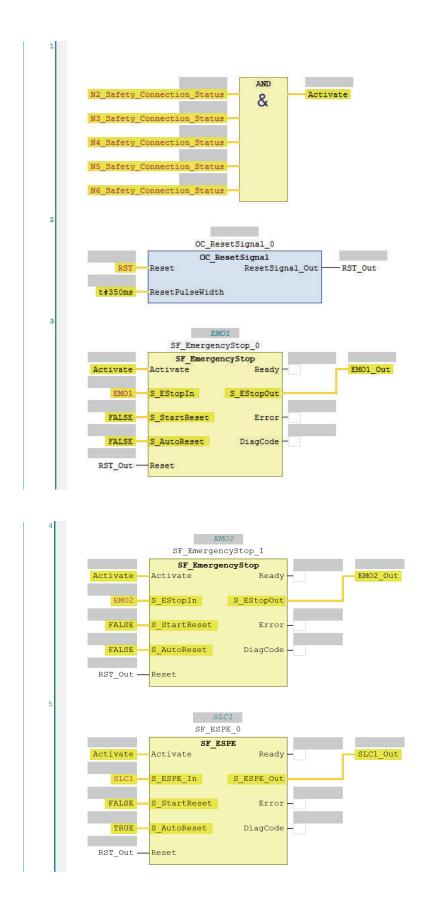
Use the Sysmac Studio to create variables and programs as shown below.

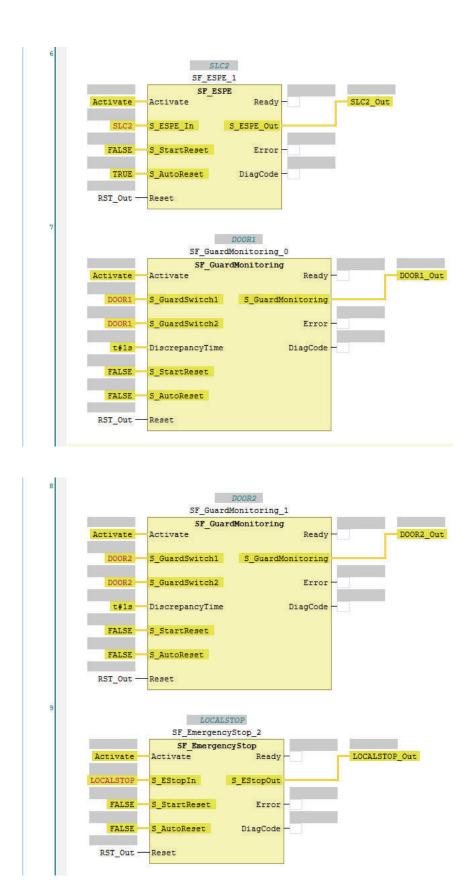
Create variables as shown below.

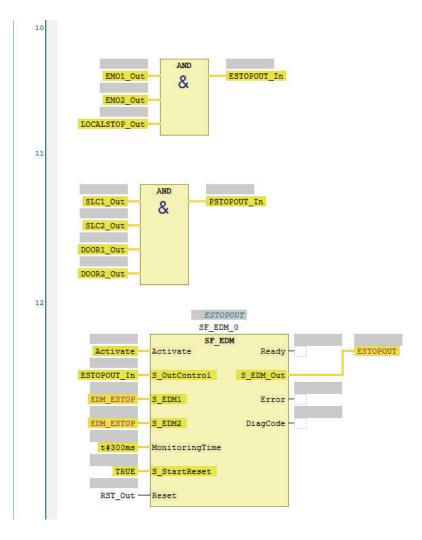
Internals	Name	Data Type	Initial Value	Constant	Comment
Externals	OC_ResetSignal_0	OC_ResetSignal			
	RST_Out	BOOL	FALSE		
	SF_EmergencyStop_0	SF_EmergencyStop			EMO1
	EMO1_Out	SAFEBOOL	FALSE		
	SF_EmergencyStop_1	SF_EmergencyStop			EMO2
	EMO2_Out	SAFEBOOL	FALSE		
	SF_ESPE_0	SF_ESPE			SLC1
	SLC1_Out	SAFEBOOL	FALSE		
	SF_ESPE_1	SF_ESPE			SLC2
	SLC2_Out	SAFEBOOL	FALSE		
	SF_GuardMonitoring_0	SF_GuardMonitori			DOOR1
	DOOR1_Out	SAFEBOOL	FALSE		
	SF_GuardMonitoring_1	SF_GuardMonitori			DOOR2
	DOOR2_Out	SAFEBOOL	FALSE		
	SF_EmergencyStop_2	SF_EmergencyStop			LOCALSTOP
	LOCALSTOP_Out	SAFEBOOL	FALSE		
	ESTOPOUT_In	SAFEBOOL	FALSE		
	PSTOPOUT_In	SAFEBOOL	FALSE		
	SF_EDM_0	SF_EDM			ESTOPOUT
	SF_EDM_1	SF_EDM			PSTOPOUT
	Activate	SAFEBOOL	FALSE		

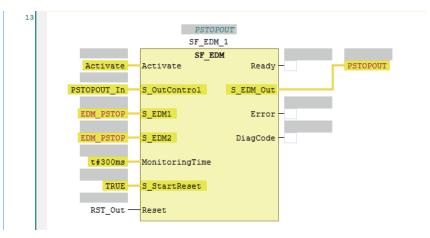
nternals	Name	Data Type	Constant	Comment
xternals	RST	SAFEBOOL		
	EMO1	SAFEBOOL		
	EMO2	SAFEBOOL		
	SLC1	SAFEBOOL		
	SLC2	SAFEBOOL		
	DOOR1	SAFEBOOL		
	DOOR2	SAFEBOOL		
	LOCALSTOP	SAFEBOOL		
	ESTOPOUT	SAFEBOOL		
	PSTOPOUT	SAFEBOOL		
	N2_Safety_Connection_Status	SAFEBOOL		
	N3_Safety_Connection_Status	SAFEBOOL		
	N4_Safety_Connection_Status	SAFEBOOL		
	N5_Safety_Connection_Status	SAFEBOOL		
	N6_Safety_Connection_Status	SAFEBOOL		
	EDM_ESTOP	SAFEBOOL		
	EDM_PSTOP	SAFEBOOL		

Create programs as shown below.







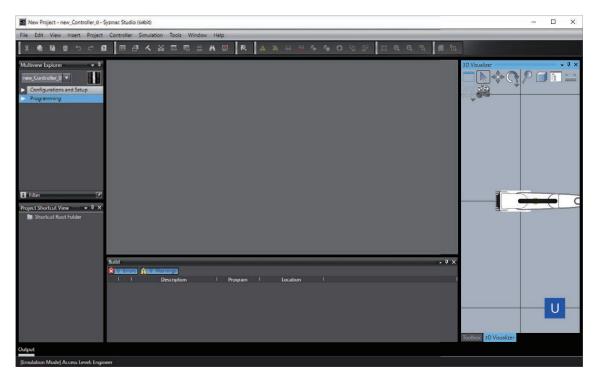


# A-2 How to Use 3D Visualizer

This section describes methods to manipulate the viewpoint on a robot simulation. Operations are performed on the 3D Visualizer in Sysmac Studio.

## A-2-1 Set the 3D Visualizer to the Float Mode

The 3D Visualizer is displayed in the Dock mode by default in Sysmac Studio.



To enlarge the 3D Visualizer, display it in the Float mode, then resize it.

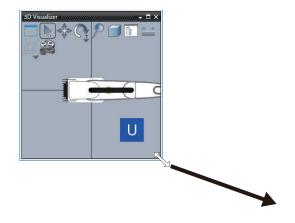
**1** Right-click the 3D Visualize tab, then select **Float** from the menu.

3D Visualizer	- # ×
- NAO OFF	Float
	Auto Hide
	Close

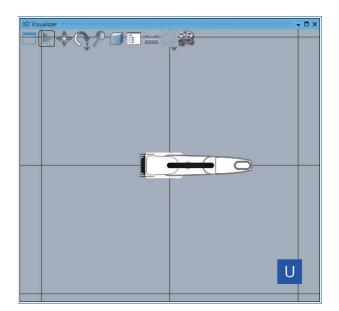
The 3D Visualizer gets into the Float mode.

New Project - new Controller 0 - Sysmac Studio (64bit)	- 🗆 X
File Edit View Insert Project Controller Simulation Tools Window Help	
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Multivee Explore  Configurations and Setup Programming	Toobox - 7 <search> V D V</search>
The Filte Project Shortcut View To Shortcut Root Folder  Rold Root Description I I Description I I I I I I I I I I I I I I I I I I I	×
Output	
[Emulation Mode] Access Level: Engineer	

**2** Click on the 3D visualizer frame and drag it until the 3D Visualizer gets large enough.



The 3D Visualizer is enlarged.



## A-2-2 Rotate the Viewpoint

The following two methods are available to rotate the viewpoint:

- Using the 3D View Switching Tool
- Using the Rotate icon

This section provides the information about these two methods to rotate the viewpoint in the 3D Visualizer.

# 3D View Switching Tool

The 3D View Switching Tool displayed at the right bottom of the window allows to switch the viewpoint. The 3D View Switching Tool consists of three elements: Face, Corner, and Edge. The operation procedure is illustrated with an example.

**1** Put the mouse pointer over the right edge of **U**. Then the pointed place turns black.

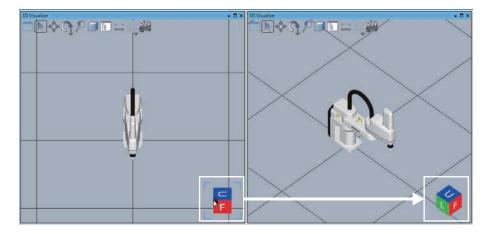




Click it, then the view is switched so that the clicked side faces you.



Clicking the left corner changes the view as shown below.



## Rotate icon

This section describes how to rotate the viewpoint by using the Rotate icon of the 3D Visualizer.

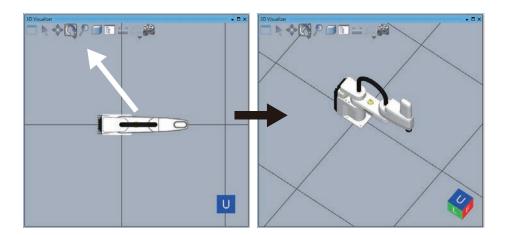
1 Click the **Rotate** icon on the 3D Visualizer.



An icon that shows the mouse pointer can rotate the viewpoint appears.



**2** Press and hold down the left button of the mouse, then drag to the direction you want to rotate the viewpoint.



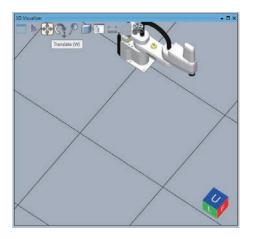
Drag upward: Move the viewpoint downward Drag downward: Move the viewpoint upward Drag to the right: Move the viewpoint to the left Drag to the left: Move the viewpoint to the right

There are two modes in rotation.

Mode	Description
Tumbler rotation	A 3D shape data can be viewed from any angle.
Turntable rotation	The viewpoint can be rotated clockwise or counterclockwise around the Z-axis of the world coordinate system. Or the 3D shape data can be viewed in the range of $\pm 90^{\circ}$ vertically.

## A-2-3 Translate the Viewpoint

This section describes how to move the viewpoint on the 3D Visualizer. Move the viewpoint downward so that you can see the entire robot.



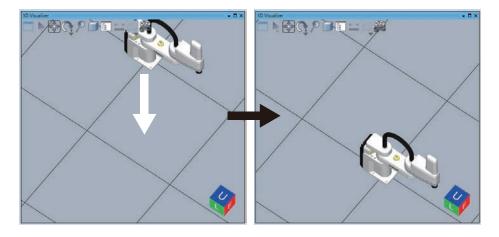
**1** Click the **Translate** icon on the 3D Visualizer.



An icon that shows the mouse pointer can translate the viewpoint on the 3D Visualizer appears.



**2** Press and hold down the left button of the mouse, then drag to the direction you want to translate the viewpoint.





## Additional Information

In addition to the operation mentioned above, pressing the mouse wheel and dragging to an intended direction can translate the viewpoint.

## A-2-4 Zoom-in and Zoom-out

This section describes how to zoom in or out on the 3D Visualizer.

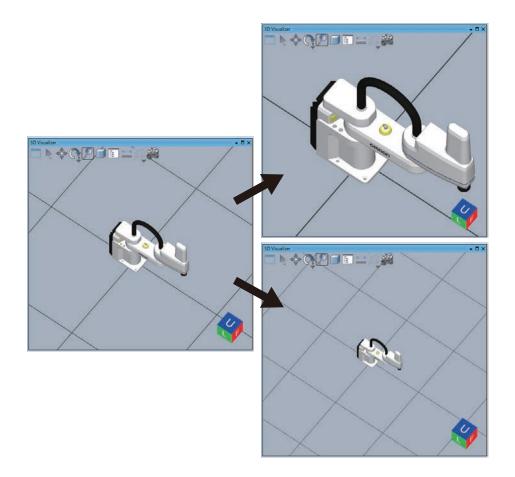
**1** Click the **Zoom** icon on the 3D Visualizer.



An icon that shows the mouse pointer can zoom appears.



Press and hold down the left button of the mouse, then drag it. Drag to the right: Enlarge the size (Zoom-in) Drag to the left: Reduce the size (Zoom-out)



## Additional Information

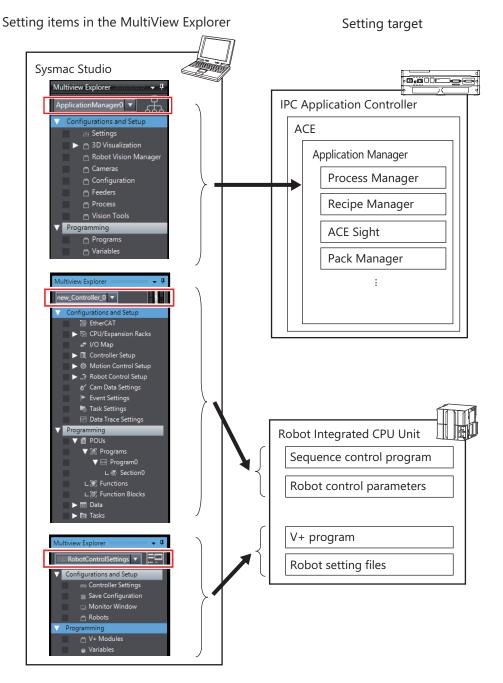
R

Rotating the mouse wheel also enables zoom-in or -out. The position of the mouse pointer represents the center of zooming in or out.

# A-3 Setting Items on the Sysmac Studio and the Setting Targets

The correspondences between the items in the Multiview Explorer of the Sysmac Studio and each hardware are provided below.

If you select **ApplicationManager0** for the device in the Multiview Explorer, the settings for the Application Manager of the IPC Application Controller are available. If you select **new\_Controller\_0**, the settings for a sequence control program of the Robot Integrated CPU Unit, and if you select **RobotControlSettings**, the settings for a V+ program of the Robot Integrated CPU Unit are available. Refer to the product manuals for details.



# A-4 Using Troubleshooting Functions

Refer to the Sysmac Studio Robot Integrated System Building Function with Robot Integrated CPU Unit Operation Manual (Cat. No. W595) for the operation procedure of the troubleshooting functions on the Sysmac Studio.

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