OMRON

Machine Automation Controller

NX-series

CPU Unit
Automation Playback

User's Manual

NX502-1□00

SYSMAC
always in control

W639-E1-08

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Introduction

Thank you for purchasing an NX-series CPU Unit.
This manual contains information that is necessary to use automation playback with the NX-series CPU Unit. Please read this manual and make sure you understand the functionality and performance of the NX-series CPU Unit before you attempt to use it in a control system.
When you have finished reading this manual, keep it in a safe location where it will be readily available for future use.

Intended Audience

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

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

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503.

Applicable Products

This manual covers the following product.

- NX-series CPU Unit
  NX502-1□00

Part of the specifications and restrictions for the CPU Unit are given in other manuals. Refer to *Relevant Manuals* on page 2 and *Related Manuals* on page 21.

Relevant Manuals

The following table provides the relevant manuals for the NX-series CPU Units. Read all of the manuals that are relevant to your system configuration and application before you use the NX-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)* for information on the Sysmac Studio.

Purpose of use	Manual												
	Basic information												
	Hardware User's Manual NX-series NX502 CPU Unit	Software User's Manual NJ/NX-series CPU Unit	Instructions Reference Manual NJ/NX-series	Motion Control User's Manual	Motion Control Instructions Reference Manual 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 CPU Unit	EtherNet/IP Unit User's Manual NX-series	OPC UA User's Manual NJ/NX-series CPU Unit	FINS Function User's Manual NX-series CPU Unit	User's Manual NJ/NX-series Database Connection CPU Units	Automation Playback User's Manual NX-series CPU Unit	Troubleshooting Manual NJ/NX-series
Introduction to NX502 CPU Units	●												
Setting devices and hardware	●												
Using motion control				●									
Using EtherCAT						●							
Using EtherNet/IP							●	●					
Software settings		●											
Using motion control				●									
Using EtherCAT						●							
Using EtherNet/IP							●	●					
Using OPC UA									●				
Using FINS										●			
Using the database connection service											●		
Using automation playback												●	

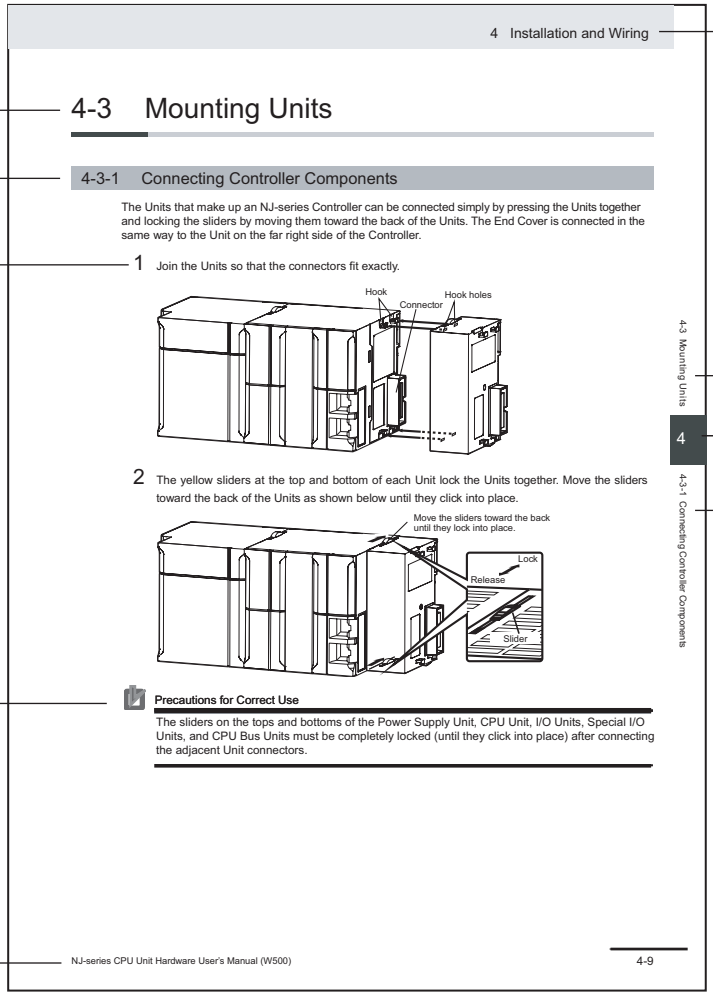
Purpose of use	Manual												
	Basic information												
	Hardware User's Manual	NX-series NX502 CPU Unit	NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series Motion Control User's Manual	NJ/NX-series CPU Unit Motion Control Instructions Reference Manual	NJ/NX-series Built-in EtherCAT Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual	NJ/NX-series CPU Unit EtherNet/IP Unit User's Manual	NX-series OPC UA User's Manual	NJ/NX-series CPU Unit FINS Function User's Manual	NX-series CPU Unit User's Manual	NJ/NX-series Database Connection CPU Units	NX-series CPU Unit Automation Playback User's Manual	NJ/NX-series Troubleshooting Manual
Writing the user program															
Using motion control					●	●									
Using EtherCAT							●								
Using EtherNet/IP								●	●						
Using OPC UA			●	●						●					
Using FINS											●				
Using the database connection service													●		
Using automation playback														●	
Programming error processing															●
Testing operation and debugging															
Using motion control					●										
Using EtherCAT							●								
Using EtherNet/IP								●	●						
Using OPC UA			●							●					
Using FINS											●				
Using the database connection service													●		
Using automation playback														●	
Learning about error management and corrections*1										△	△	△	△	△	●
Maintenance															
Using motion control	●				●										
Using EtherCAT							●								
Using EtherNet/IP								●	●						

*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

The following page structure is used in this manual.



Level 1 heading

Level 2 heading

Level 3 heading

Gives the current headings.

Level 2 heading

Level 3 heading

A step in a procedure

Indicates a procedure.

Page tab

Gives the number of the main section.

Special information

Icons indicate precautions, additional information, or reference information.

Manual name

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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1 Overview of Automation Playback

2 Collecting Playback Data

3 Capturing Video Using the Camera Control Function

4 Executing Playback

5 Checking Program Behavior Using Playback

6 Checking Time Series Variable Values, Videos, and HMI Screens Using Playback

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Warranty, Limitations of Liability

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Safety Precautions

Refer to the following manuals for safety precautions.

- *NX-series NX502 CPU Unit Hardware User's Manual (Cat. No. W629)*

Precautions for Safe Use

Refer to the following manuals for precautions for safe use.

- *NX-series NX502 CPU Unit Hardware User's Manual (Cat. No. W629)*

Precautions for Correct Use

Refer to the following manuals for precautions for correct use.

- *NX-series NX502 CPU Unit Hardware User's Manual (Cat. No. W629)*

Regulations and Standards

Refer to the following manuals for regulations and standards.

- *NX-series NX502 CPU Unit Hardware User's Manual (Cat. No. W629)*

Versions

Hardware revisions and unit versions are used to manage the hardware and software in NX-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.

Refer to the following manuals for versions.
- *NX-series NX502 CPU Unit Hardware User's Manual (Cat. No. W629)*

Unit Versions of CPU Units and Sysmac Studio Versions

The functions that are supported depend on the unit version of the NX-series CPU Unit. The version of Sysmac Studio that supports the functions that were added for an upgrade is also required to use those functions.
Refer to *Version Information for NX-series Controllers* in the *NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)* for the relationship between the unit versions of the CPU Units and the Sysmac Studio versions, and for the functions that are supported by each unit version.

Related Manuals

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

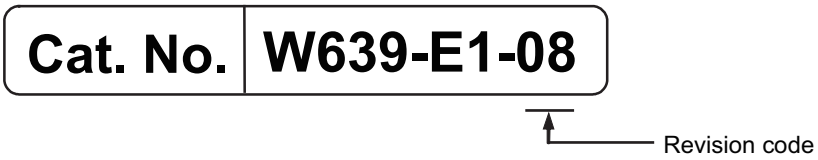
Manual name	Cat. No.	Model numbers	Application	Description
NX-series CPU Unit Automation Playback User's Manual	W639	NX502-□□□□	Using automation playback	Describes automation playback.
NX-series NX502 CPU Unit Hardware User's Manual	W629	NX502-□□□□	Learning the basic specifications of the NX502 CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NX502 system is provided along with the following information on the CPU Unit. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NJ/NX-series CPU Unit Software User's Manual	W501	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software information is provided.	The following information is provided on a Controller built with an NJ/NX-series CPU Unit. • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications
NJ/NX-series Instructions Reference Manual	W502	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning detailed specifications on the basic instructions of an NJ/NX-series CPU Unit.	The instructions in the instruction set (IEC 61131-3 specifications) are described.
NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port User's Manual	W506	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Using the built-in EtherNet/IP port on an NJ/NX-series CPU Unit.	Information on the built-in EtherNet/IP port is provided. Information is provided on the basic setup, tag data links, and other features.
NJ/NX-series Troubleshooting Manual	W503	NX701-□□□□ NX502-□□□□ NX102-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning about the errors that may be detected in an NJ/NX-series Controller.	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.

Terminology

Term	Description
automation playback	A function that captures and records variable data as well as video data while the program in the Controller is running, and reproduces these data on monitor displays in the Sysmac Studio to allow the user to analyze and identify the causes of problems.
sampling	The operation of the CPU Unit to collect variable data.
network storage	Storage devices that can be connected to a network (LAN), such as HDDs and SSDs. In this document, this refers to NAS (Network Attached Storage) and Windows SMB file-sharing servers.
playback	Reproducing recorded data on monitor displays in the Sysmac Studio.
playback chart	A window that displays the time series variable graph and plays videos during playback.
playback data	Variable logs, event logs, and video data collected and recorded for automation playback. In a broad sense, playback data includes backup data of the project. Event logs, video data, and the project backup data are included only if they are configured to be collected and saved.
backup project	Backing up the project as a file when variable data is collected.
restoration	Reading saved data into the Sysmac Studio so that the Sysmac Studio can handle it as data.
time series variable graph	A graph that displays variable data in a time series.
variable data collection	The act or function of collecting variable data that is used in the program in the Controller according to the collection target and time set by the user.
variable log	Variable data that is collected and recorded in the storage.

Revision History

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



Revision code	Date	Revised content
01	July 2023	Original production
02	January 2024	• Made changes accompanying the upgrade of the CPU Units to unit version 1.65. • Corrected mistakes.
03	January 2024	Corrected mistakes.
04	April 2025	• Made changes accompanying the upgrade of the CPU Units to unit version 1.68. • Corrected mistakes.
05	April 2026	Made changes accompanying the upgrade of the CPU Units to unit version 1.70.
06	July 2026	Made changes accompanying the upgrade of the CPU Units to unit version 1.71.
07	July 2026	Corrected mistakes.
08	October 2026	Made changes accompanying the upgrade of the CPU Units to unit version 1.72 and Sysmac Studio version 1.68.

1

Overview of Automation Playback

Automation playback is a solution that integrates three activities that you perform in system maintenance.
It provides functionality that integrates three system maintenance activities, which are recording, reproduction, and analysis.

1-1 Features of Automation Playback 1-2

1-2 System Configuration for Automation Playback..... 1-3

1-2-1 System Configuration for Saving Playback Data to Network Storage..... 1-3

1-2-2 System Configuration for Saving Playback Data to an SD Memory Card..... 1-5

1-3 Flow of Using Automation Playback 1-7

1-1 Features of Automation Playback

Automation playback allows you to reproduce the variables used in the program in the Controller, the captured videos, and other data on monitor displays in the Sysmac Studio and identify the causes of problems.
Automation playback has the following features:

Collecting and recording of data to use for identifying the causes of problems

- Collect and record variable data, video data, and other data used in the Controller's control program in time series.
- You can achieve a system that captures and records videos of on-site manufacturing linked to the operation of the control program in the Controller.
- Back up the project for data collection.

Reproducing the recorded data in the Sysmac Studio

- Reproduce the operation of the control program in the Controller on the Sysmac Studio, based on the recorded data.

Analyzing the causes of problems in the Sysmac Studio

- Facilitate the identification of the causes of problems through analysis of the control program in the Sysmac Studio.

You can use automation playback with the recorded variable data and other data for the Controller to check how the control program in the Controller operated. You can also use the recorded data to reproduce the operation of the control program in the Controller without the presence of the designer of the control program at the location where the Controller is operating, which enables earlier analysis of problems that occur at a remote location in comparison with when you visit the site.
In addition, you can play videos captured together with the variable data and other data to check the correspondence between the operation of the control program and the scenes of on-site manufacturing.
Since the project can be backed up at the start of variable data collection, you can import data on a different computer than the one on which you collected the variable data to reproduce the operation.

1-2 System Configuration for Automation Playback

You can save data used for automation playback (playback data) to network storage or an SD Memory Card mounted on the CPU Unit.

Additional Information

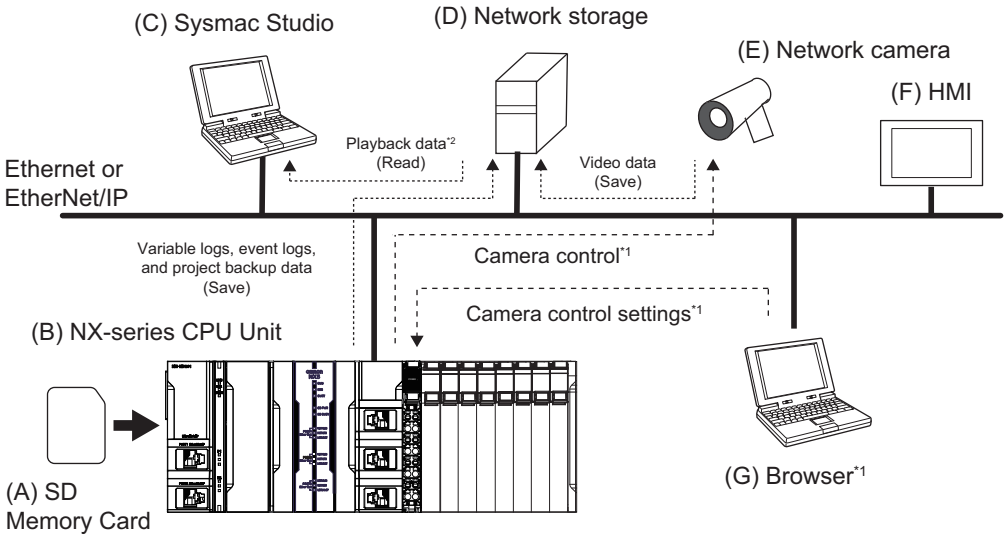
This system assumes that you will take measures to prevent playback data leakage.

Version Information

- With unit version 1.71 or later, you can make settings for saving playback data to network storage.
- With unit version 1.71 or later, you can save video data from network cameras to an SD Memory Card.

1-2-1 System Configuration for Saving Playback Data to Network Storage

The system configuration consists of a Controller, the Sysmac Studio, network cameras, network storage, and other equipment.
With unit version 1.71 or later, you can make settings for saving playback data to network storage.



*1. Supported for CPU Unit with unit version 1.71 or later
*2. “Playback data” is a general term for video data, variable logs, event logs, and project backup data.

Symbol	Configuration element	Description
A	SD Memory Card	This is mounted on the CPU Unit. Variable logs, event logs, and project backup data are temporarily saved before being saved to network storage.

Symbol	Configuration element	Description
B	NX-series CPU Unit	• Collects playback data and saves it to network storage. • Controls cameras by providing instructions to save video data, etc. *1
C	Sysmac Studio	• Reads saved playback data. • Executes playback using the read data to analyze the causes of problems.
D	Network storage	Saves playback data.
E	Network camera	• Captures video according to video capture instructions from the NX-series CPU Unit. • Saves captured video data to the network storage.
F	HMI	This is used for operating the system or equipment and displaying their status. Automation playback enables reproducing the operations and displays seen on NA-series. *2
G	Browser*1	Connects to the Web UI of the NX-series CPU Unit to configure network camera connection settings and display a live view. You cannot connect the browser via an NX-series EtherNet/IP Unit. Connect the browser to the built-in EtherNet/IP port on the CPU Unit.

*1. A CPU Unit with unit version 1.71 or later is required.
*2. Unit version 1.71 or later is required to reproduce HMI screens.

Precautions for Correct Use

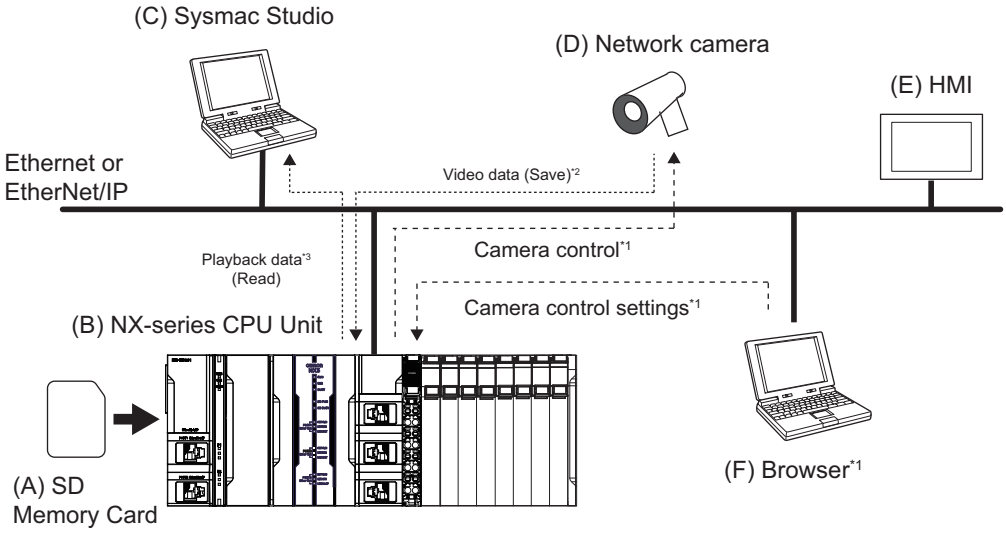
- The Controller uses the SMB protocol to transfer playback data. We recommend that you set the network storage to use SMB3, encrypted. Use SMB2 or earlier protocols at your own responsibility.
- Configure the security settings for your network storage appropriately at your own responsibility.
- Take appropriate measures to prevent leakage of the user name and password for the network storage.
- When using network storage, limit the data to be saved to the network storage to the data saved by the automation playback function. Do not save any other data to the network storage.
- Keep the firmware of your network storage up to date to avoid security risks arising from vulnerabilities.
- We recommend that you use network cameras that support SMB3, encrypted. Use the setting of SMB3, not encrypted or SMB2 at your own responsibility.
- Manage your network cameras appropriately at your own responsibility. Manage user names and passwords for network cameras appropriately to prevent unauthorized user access.
- When server validation is not set, manage the network configuration appropriately to prevent unauthorized user access.
- To avoid security risks arising from vulnerabilities, update the firmware of your network cameras by referring to *A-6 Cameras That Have Been Tested for Operation* on page A-19.
- Processing performance for recording may vary depending on the network environment, image quality and number of cameras, and performance of your network storage. Perform operational verification in your own environment.

Additional Information

If you want to use the playback chart and play videos on it, we recommend using Sysmac Studio of 64-bit application.
If you want to show more than 16 variables in the playback chart or play more than 2 video files, Sysmac Studio of 64-bit application is required.

1-2-2 System Configuration for Saving Playback Data to an SD Memory Card

The system configuration consists of a Controller, the Sysmac Studio, network cameras, and other equipment.



*1. Supported for CPU Unit with unit version 1.71 or later
*2. Unit version 1.71 or later is required to save video data from network cameras to an SD Memory Card.
*3. “Playback data” is a general term for video data, variable logs, event logs, and project backup data.

Symbol	Configuration element	Description
A	SD Memory Card	This is mounted on the CPU Unit. Saves playback data.
B	NX-series CPU Unit	• Collects playback data and saves it to an SD Memory Card. • Controls cameras by providing instructions to save video data, etc. *1
C	Sysmac Studio	• Reads saved playback data. • Executes playback using the read data to analyze the causes of problems.
D	Network camera	• Captures video according to video capture instructions from the NX-series CPU Unit. • Saves captured video data to the internal memory of the camera.*2
E	HMI	This is used for operating the system or equipment and displaying their status. Automation playback enables reproducing the operations and displays seen on NA-series. *3
F	Browser	Connects to the Web UI of the NX-series CPU Unit to configure network camera connection settings and display a live view. You cannot connect the browser via an NX-series EtherNet/IP Unit. Connect the browser to the built-in EtherNet/IP port on the CPU Unit.

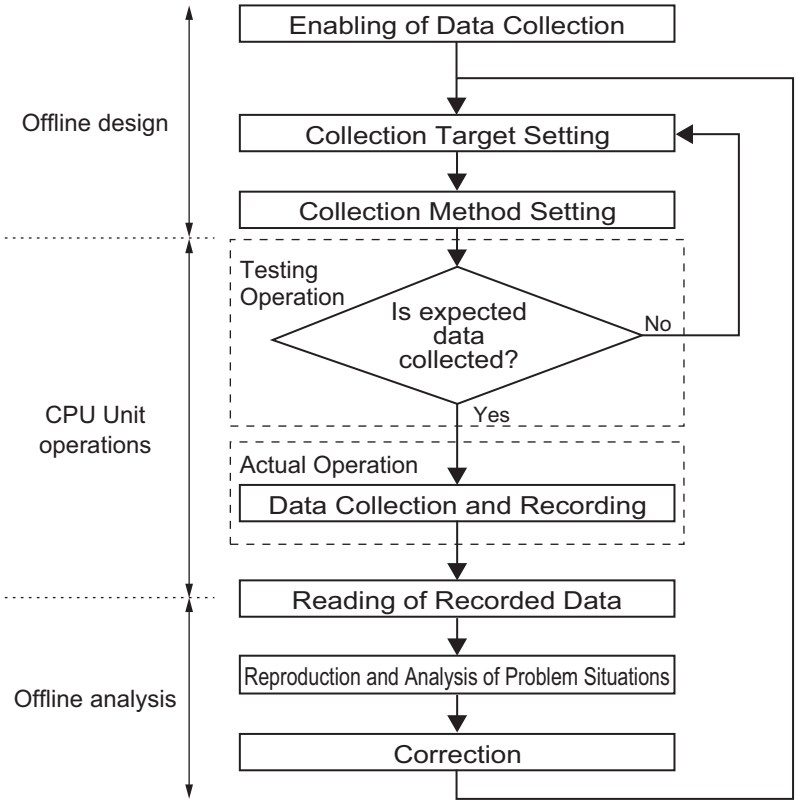
*1. A CPU Unit with unit version 1.71 or later is required.
*2. Unit version 1.71 or later is required to save video data from network cameras to an SD Memory Card.
*3. Unit version 1.71 or later is required to reproduce HMI screens.

Precautions for Correct Use

- We recommend that you use network cameras that support SMB3, encrypted. Use the setting of SMB3, not encrypted or SMB2 at your own responsibility.
- Manage your network cameras appropriately at your own responsibility. Manage user names and passwords for network cameras appropriately to prevent unauthorized user access.
- To avoid security risks arising from vulnerabilities, update the firmware of your network cameras by referring to *A-6 Cameras That Have Been Tested for Operation* on page A-19.
- Processing performance for recording may vary depending on the network environment, image quality and number of cameras, etc. Perform operational verification in your own environment.

1-3 Flow of Using Automation Playback

The flow of automation playback consists of offline design, CPU Unit operations, and offline analysis.



Process	Overview	Reference
Enabling of Data Collection	Enable automatic playback.	*2-2 Enabling Variable Data Collection* on page 2-12
Collection Target Setting	Set what data should be collected.	*2-3 Setting the Variable Data Sampling Target and Output Method* on page 2-15 *Section 3 Capturing Video Using the Camera Control Function* on page 3-1
Collection Method Setting	Set under what conditions the data should be collected.	
Testing Operation	Check if data that ensures the set sampling time length and data concurrency can be collected and if the collected data meets the expected applications, and adjust the settings.	*2-7 Checking Collected Variable Data* on page 2-47
Actual Operation	Collect data for reproduction and analysis.	---

Process	Overview	Reference
Reading of Recorded Data	Copy the collected data to the computer and read the copied playback data in the Sysmac Studio. **Note** When playback data is saved to an SD Memory Card, you can also read the playback data directly by mounting the SD Memory Card on the computer on which the Sysmac Studio is running. However, for performance reasons, we recommend that you read the playback data copied to the computer.	*4-1 Copying Playback Data to a Computer* on page 4-2 *4-2 Starting Playback* on page 4-5
Reproduction and Analysis of Problem Situations	Reproduce the operation of the user program in the Sysmac Studio. Then, analyze the causes of the problem.	*Section 5 Checking Program Behavior Using Playback* on page 5-1 *Section 6 Checking Time Series Variable Values, Videos, and HMI Screens Using Playback* on page 6-1
Correction	Correct the program.	*Section 7 Troubleshooting* on page 7-1

2

Collecting Playback Data

Set up automation playback and enable the function to collect playback data.
Note that *playback data* is a general term for variable logs, video data, event logs, and project backup data.

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2-1-1 Variables to Collect 2-3
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2-8-2 Conditions That Must Be Met to Back Up the Project 2-49
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2-8-4 Items for Project Backup 2-50
2-8-5 Specifications of Project Backup Data 2-50

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2-10 Changing Variable Data Sampling Setting While the Controller is in RUN Mode 2-55

2-10-1 Procedure for Modifying Variable Data Sampling Setting While the Controller is in RUN Mode 2-55

2-11 Additional Information about Automation Playback Settings 2-57

2-1 Specifications of Variable Data Collection

This section provides the specifications of variable data collection in automation playback.
The automation playback combines the following operations to collect variable data and output variable logs.

Symbol	Processing	Constraints
(1)	Monitors variables to be collected and samples variable data while ensuring concurrency within the task period.	The size and number of variables to be collected and unused time in task period affect the availability of concurrency.
(2)	Accumulates a certain amount of sampled variable data.	The amount of data that can be accumulated cannot be changed. When accumulated data reaches the upper limit, the oldest data is overwritten and data continues to be accumulated.
(3)	When the condition for the file save trigger is met, stops recording and accumulating variable data and outputs the variable log file.	Variable data for a set sampling time is output to a variable log file from the accumulated data. The time length of the accumulated data may be shorter than the set sampling time.

In this document, (1) is described in terms of sampling and (1) and (2) collectively as the collection processing.

Note that sampling, collection processing, and variable log output processing have performance limitations.
Use this document as a guide and make sure that you can get the variable log as expected before using the automation playback in your system.

2-1-1 Variables to Collect

You can collect data of local and external variables defined in the program POU and function block POU used in the program POU.

Precautions for Correct Use

To collect data of global or system-defined variables, register the global or system-defined variables as external variables of the POU.

The following table shows whether or not it is possible to collect variables with automation playback function.

Variable			Collection
User-defined variables			Possible
Semi-user-defined variables	Device variables	Device variables for EtherCAT slaves	Possible
		Device variables for NX Units	Possible
		Device variables for X Bus Units	Possible
	Cam data variables		Possible

Variable			Collection
System-defined variables	System-defined variables for PLC Function Module		Possible*1
	System-defined variables for motion control	MC Common Variables	Not possible
		Axis Variables*2	Possible only for specific members
		Axes Group Variables	Not possible
	System-defined variables for EtherNet/IP		Possible
	System-defined variables for EtherCAT master		Possible
	System-defined variables for NX bus		Possible
	System-defined variables for X Bus		Possible

*1. P_CY, P_First_RunMode, and P_First_Run cannot be collected.

*2. Axis Variables will be collected when **Include** is selected for **Axis variable sampling** in the sampling setting. Refer to *Items for Variable Data Collection* on page 2-17.
Note also that the axis variables to be collected are limited to the following.
- Position and velocity of axis command values and axis current values (member names: Cmd.Pos, Cmd.Vel, Act.Pos, Act.Vel)
- Members that are used in program POUs

The following table shows whether or not it is possible to collect local variables and external variables from POUs.

Type of variable		POU type		
		Program	FB	FUN
Local variables	Internal variables	Possible	Possible	Not possible
	Input variables	---	Possible	Not possible
	Output variables	---	Possible	Not possible
	In-out variables	---	Not possible	Not possible
External variables		Possible	Possible	Not possible

2-1-2 Upper Limit of Variable Data to Collect

The following table shows the upper limits of variables that can be sampled.
Transferring a sampling setting that exceeds the upper limit value to the Controller changes the automation playback state to Error, causing the automation playback function to stop operating. At this time, the event *Upper Limit of Variable Sampling* (95770000 hex or 95790000 hex) occurs.
To see how automation playback works, use the Automation Playback Operation Monitor in the Sysmac Studio. Refer to *7-3-1 Checking the Operation Status of Automation Playback* on page 7-13 for information on the Automation Playback Operation Monitor.

CPU Unit with Unit Version 1.68 or Later

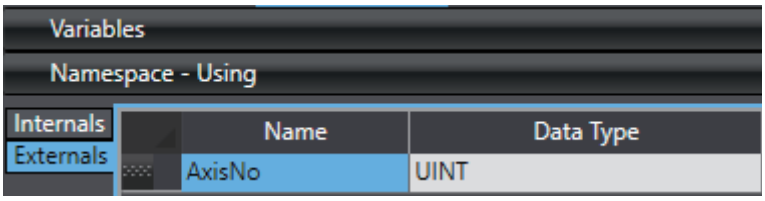
For the total size of variable data, the upper limit is fixed regardless of the task period.

Task to be sampled	Number of variables	Total size of variable data
Primary periodic task	60,000 variables	10,000,000 bytes
Periodic task (priority 16, 17, or 18)*1	60,000 variables	10,000,000 bytes

*1. For periodic tasks, the number of variables and the total size of variable data are the totals of each task.

Additional Information

For Sysmac Studio projects with project unit version 1.68 or later, when an external variable that points to the same global variable in more than one POU is used, the number of variables is counted as one. Similarly, the total size of variable data is the total data size of the global variables, not the total of the external variables in each POU.
For example, when an external variable that points to the global variable *AxisNo* is defined in 10 POUs, the results are as follows.



Project unit version	Number of variables	Total size of variable data
Version 1.68 or later	1 variable	2 bytes
Version earlier than 1.68	10 variables	20 bytes

CPU Unit with Unit Version Earlier Than 1.68

For the total size of variable data, the upper limit is determined by the task period of each task.

Task to be sampled	Number of variables	Task period*1	Total size of variable data	
			CPU Unit with unit version earlier than 1.65	CPU Unit with unit version 1.65 or later but earlier than 1.68
Primary periodic task	60,000 variables	Less than 1 ms	500,000 bytes	
		1 ms or more but less than 8 ms	1,000,000 bytes	
		8 ms	2,000,000 bytes	5,000,000 bytes
Periodic task (priority 16, 17, or 18)*2	60,000 variables	Less than 1 ms	500,000 bytes	
		1 ms or more but less than 8 ms	1,000,000 bytes	
		8 ms or more but less than 16 ms	2,000,000 bytes	5,000,000 bytes
		16 ms or more	3,000,000 bytes	5,000,000 bytes

*1. For the periodic task, this is the period of the highest priority task used among priority-16, priority-17, and priority-18 periodic tasks.
*2. For periodic tasks, the number of variables and the total size of variable data are the totals of each task.

Precautions for Correct Use

Even if the number of sampling target variables is less than the upper limit, the process of collecting variable data may not be completed within the specified processing time. In this case, one of the following occurs.

a. When the processing capacity to collect variable data is exceeded
   The following event occurs. The event that occurs depends on the unit version of the CPU Unit.
   Version 1.65 or earlier: *Upper Limit of Variable Sampling* (95770000 hex)
   Version 1.65 or later: *Upper Limit of Variable Sampling* (95790000 hex)
   Version 1.68 or later: *Upper Limit of Sampling Processing Capacity* (64040000 hex)
b. When data concurrency cannot be ensured in variable logs
   The following events occur. For version 1.68 or later, this information is also displayed in the Playback dialog box during playback.
   No Variable Log Concurrency (64060000 hex)
   Cycle with No Variable Sampling (64070000 hex)

If these events occur, take corrective action with reference to *7-2 Troubleshooting for Variable Data Collection* on page 7-3. In addition, consider reviewing the design of the POUs and variables to be sampled based on the information in "Additional Information" below.

Additional Information

By considering the following when you design the user program, you can expect more effective variable log collection. Refer to the following when you use the automation playback function.

Designing Program POU

Is it possible to design the program POU that use variables with fixed values such as recipe data separately from the program POU that you want to collect variable logs?

Designing Array Variables

To define the number of array elements, is it possible to decide from the value estimated in the expected range, instead of deciding from the value overestimated in the areas for future expansion?

Designing Structure Variables

Is it possible to classify structures according to how often their values change and add variables in the structure member according to the frequency, instead of including a variable that have high frequency of value change and a variable that have low frequency of value change in the same structure member?

Example:

HighCycle_1, 2, 3: Variables that have high frequency of value change
MidCycle_1, 2, 3: Variables that have middle frequency of value change
LowCycle_1, 2, 3: Variables that have low frequency of value change

Structure of variables for which members that have different frequency of value change are included in the same structure.

Structure Struct_A	Structure Struct_B	Structure Struct_C
HighCycle_1	HighCycle_2	HighCycle_3
MidCycle_1	MidCycle_2	MidCycle_3
LowCycle_1	LowCycle_2	LowCycle_3

Structure of variables for which structures are separated depending on the frequency of value change.

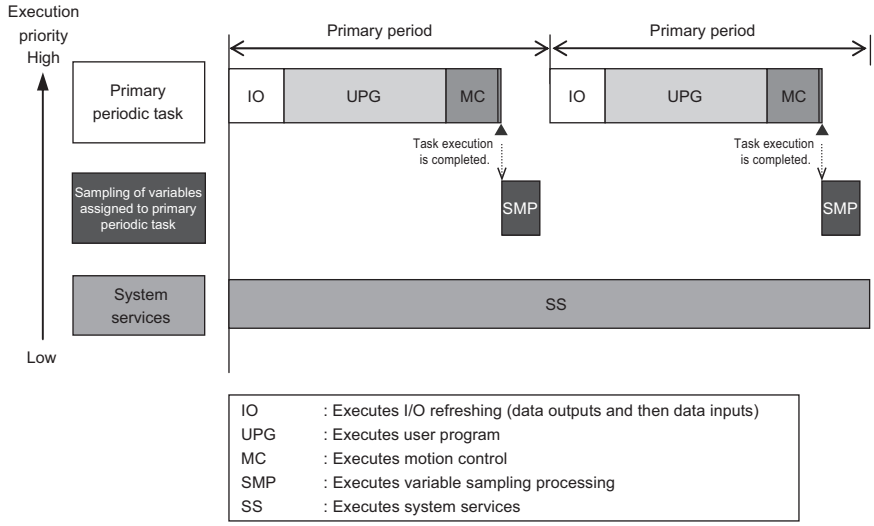
Structure Struct_HighCycle	Structure Struct_MidCycle	Structure Struct_LowCycle
HighCycle_1	MidCycle_1	LowCycle_1
HighCycle_2	MidCycle_2	LowCycle_2
HighCycle_3	MidCycle_3	LowCycle_3

2-1-3 Sampling Operation of Variable Data

Sampling of variable data occurs in unused time of tasks, in processing separate from the tasks.

When Only the Primary Periodic Task Is Executed

The primary periodic task is executed every primary period, and sampling of variable data is performed after execution of motion control.



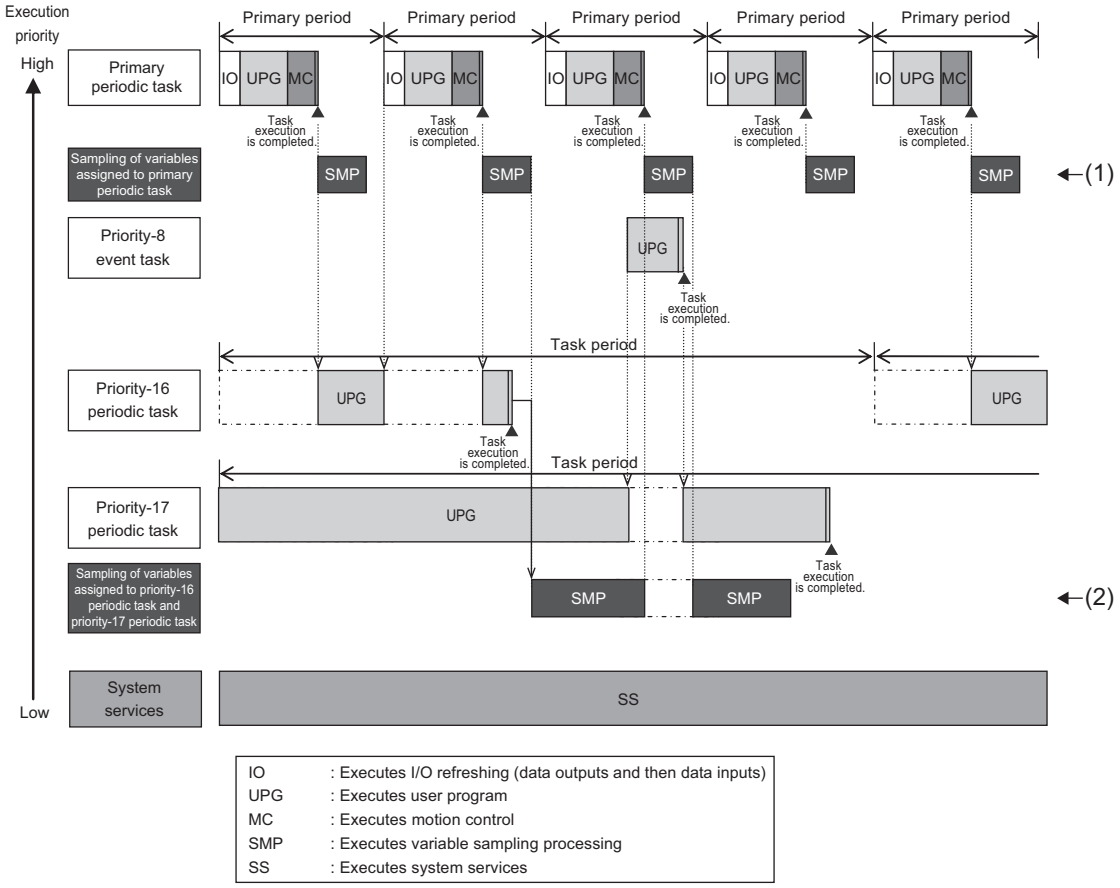
When the Primary Periodic Task, Priority-16 Periodic Task, and Priority-17 Periodic Task Are Executed

Sampling of variable data is performed in two parts: a primary periodic task and periodic tasks. Variables assigned to the primary periodic task are sampled on a priority basis, while variables assigned to the periodic task are sampled when variables assigned to the primary periodic task are not sampled.

1. Sampling of variables to be used in the program POU assigned to the primary periodic task occurs after the primary periodic task is executed every primary period.
2. Sampling of variables to be used in the program POU assigned to the priority-16 periodic task and priority-17 periodic task occurs after the priority-16 periodic task is executed and when (1) is not executed every task period.

Precautions for Correct Use

When several periodic tasks with different execution priorities are used, after execution of the periodic task with the highest execution priority, sampling of variables used in the program POUs assigned to all periodic tasks occurs. For this reason, concurrency is not ensured for variable log data for variables used in the program POUs assigned to other than the periodic task with the highest execution priority.



Precautions for Correct Use

Variable data that is sampled by the automation playback function is based on the values of the variables after execution of the task. This means that the values of variables that you can check when the playback operation is performed with the Sysmac Studio are also the values after execution of the task. Even for internal variables that are used as logical conditions and the values of which are changed in the same program POU, or external variables that are input variables of the program POU, the values after execution of the task are displayed during playback operation, which may not match the values at the start of execution of the program POU. Keep this in mind when you check the values of variables during playback operation.

2-1-4 Outputting Variable Log Files

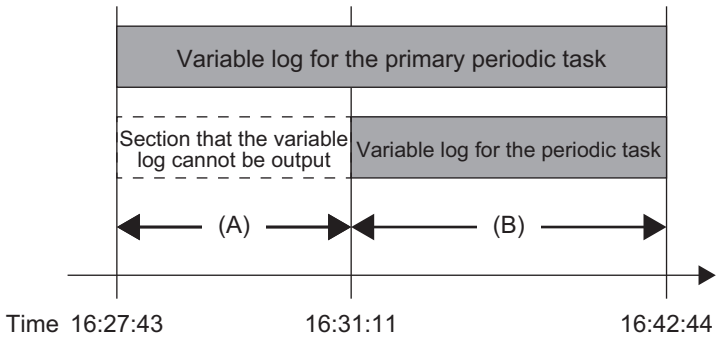
The variable data to be sampled in the primary periodic task and periodic tasks is compiled and output as a variable log file.

The output of the variable log file is executed when the file save trigger changes to TRUE. The time range of the saved variable data varies depending on the output method of the variable log. Refer to *2-3-2 Setting How to Output Variable Logs* on page 2-27 for details.

When the variable log file is output, the variable log information file that records the information of the variable log file is also output. Refer to *Specifications of Variable Log Files (Unit Version Earlier Than 1.71)* on page 2-10 or *Specifications of Variable Log Information Files (Unit Version Earlier Than 1.71)* on page 2-11 for information on specifications such as the save destination for the variable log file or variable log information file.

Precautions for Correct Use

The output settings for the variable log are applied to all tasks. There is an upper limit on the total amount of data that can be retained in the memory of the CPU Unit for each task. Therefore, depending on the sampling time specified in the variable log output settings and the timing when the trigger condition is met, all of the data for the specified sampling time cannot be retained in the memory of the CPU Unit, and the sampling time of the data output to the variable log may differ between the primary periodic task and the periodic task.
For example, if the amount of data per hour collected in the periodic task is larger than the data collected in the primary periodic task, there may be a difference in the sampling time of the data output to the variable log between the primary periodic task and the periodic task, as shown below.



In a variable log file with such data, if the variable data of the program POU for a periodic task is displayed in the Program Editor when playback data for the section (A) is played, “!” is displayed for the variable data for the periodic task. In the section (B), the contents of the variable log are displayed.
In addition, when the variable log with such data is read in the Sysmac Studio, the following message is displayed on the **Start Playback** dialog box.

The start time of the periodic task is different. The value of the variable is not displayed until the start time. Periodic task start time: YYYY/MM/DD hh:mm:ss

Specifications of Variable Log Files (Unit Version Earlier Than 1.71)

The save destination, folder structure, file name, and file format of variable log files are as shown in the table below.
Here, the specifications for unit version earlier than 1.71 are described. Refer to *2-6-3 Folder Structure and Files for Saving Playback Data* on page 2-45 for specifications for unit version 1.71 or later.

Item	Description	Remarks
Save destination	SD Memory Card mounted on the CPU Unit	
Folder structure	\APB\(hash code)\(output setting name)\	• If the APB folder does not exist in the file output destination, an APB folder and lower folders will be created automatically when sampling of variables starts. • A hash code consists of a 16-byte string. You can get it with the GetPrgHashCode (Get Program Hash Code) instruction.

Item	Description	Remarks
File name	• Project unit version 1.68 or later: VL_YYYYMMDDhhmmss.bin2 • Project unit version earlier than 1.68: VL_YYYYMMDDhhmmss.bin YYYY: Year MM: Month DD: Day hh: Hours (24-hour notation) mm: Minutes ss: Seconds	• The time of the oldest data in the variable log file is used. For example, if the variable log file has data recorded from 13:45:56 on January 2, 2023, the file name is as follows. VL_20230102134556.bin • The time information is based on the Controller's clock. • If you change the file name, the Sysmac Studio cannot read the file. Do not change the file name.
File format	Original format	

Specifications of Variable Log Information Files (Unit Version Earlier Than 1.71)

The save destination, folder structure, file name, and file format of variable log information files, which are output simultaneously with variable log files, are shown in the table below.
In a variable log information file, a summary of the variable log file is recorded.
Here, the specifications for unit version earlier than 1.71 are described. Refer to *2-6-3 Folder Structure and Files for Saving Playback Data* on page 2-45 for specifications for unit version 1.71 or later.

Item	Description	Remarks
Save destination	SD Memory Card mounted on the CPU Unit	
Folder structure	\APB\(hash code)\(output setting name)\	• If the APB folder does not exist in the file output destination, an APB folder and lower folders will be created automatically when sampling of variables starts. • A hash code consists of a 32-byte string. You can get it with the GetPrgHashCode (Get Program Hash Code) instruction.
File name	VL_YYYYMMDDhhmmss.ini YYYY: Year MM: Month DD: Day hh: Hours (24-hour notation) mm: Minutes ss: Seconds	• The time of the oldest data in the variable log file is used. For example, if the variable log file has data recorded from 13:45:56 on January 2, 2023, the file name is as follows. VL_20230102134556.ini • The time information is based on the Controller's clock.
File format	Original format	

2-2 Enabling Variable Data Collection

To collect variable data for automation playback, configure the settings to use automation playback.

Precautions for Correct Use

- If you use the automation playback function, design the tasks in the Controller to meet one of the following so that their operations are not affected.
  a) If the task period of the primary periodic task is 250 μs, the task execution time ratio is 60% or less.
  b) The task period of the primary periodic task is 500 μs or more.
- For the CPU Unit (including the factory defaults) set to **Do not use** for **Automation playback**, if the automatic transfer from SD Memory Card is executed with the backup data set to **Use** for **Automation playback**, restart the CPU Unit to use the automation playback function.

Additional Information

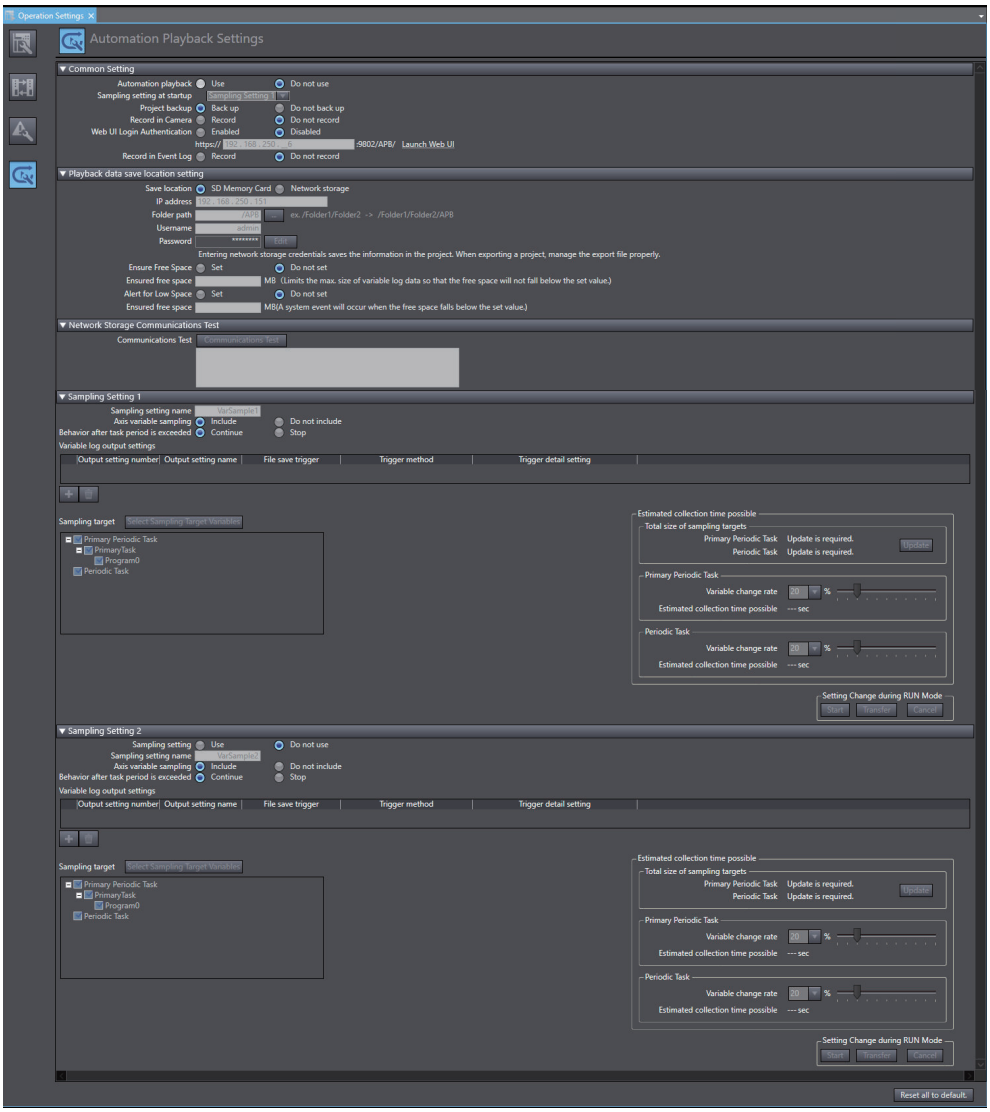
To use automation playback, you must set the trigger to save variable logs and the trigger method.
Before you set them, consider which variable to set as the trigger.
Refer to *2-3-2 Setting How to Output Variable Logs* on page 2-27 for how to set variable logs.

2-2-1 Procedure for Enabling Variable Data Collection

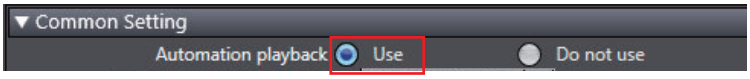
When automation playback is enabled, the CPU Unit starts the variable data collection function when it changes to RUN Mode.
Make sure that the Sysmac Studio and the Controller are offline before you enable variable data collection.

1 Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

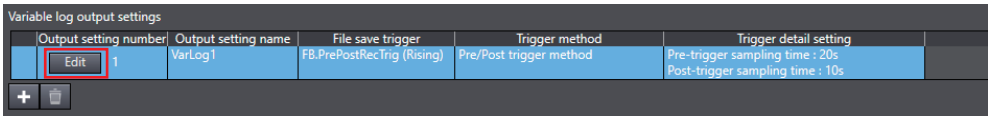
2 In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
The **Automation Playback Settings** display opens.



3 Select **Use** for **Automation playback** in **Common Setting**.



4 Set the trigger and trigger method to save variable logs in the **Variable log output settings**. Refer to *2-3-2 Setting How to Output Variable Logs* on page 2-27 for details.



5 From the Synchronization window, transfer the Controller Setup to the CPU Unit.

6 Restart the CPU Unit.

Additional Information

To disable automation playback, select **Do not use** for **Automation playback** in **Common Setting**, and transfer the Controller Setup data to the CPU Unit.
Then, restart the CPU Unit.

2-2-2 Items for Enabling Variable Data Collection

There is a setting for whether or not to use automation playback.

Item	Description	Setting range	Default
Automation playback	Set whether or not to use automation playback. When **Use** is selected, the sampling of variable data will be performed according to the sampling setting.	Use or Do not use	Do not use

2-3 Setting the Variable Data Sampling Target and Output Method

Set the variable data to collect and the method to output variable data to a variable log.
You can create up to two variable log output settings per sampling setting.
You can create up to two sampling settings. However, you can enable only one sampling setting.

Additional Information

- To specify the sampling setting to enable at the startup of the Controller, select **Sampling Setting 1** or **Sampling Setting 2** for **Sampling setting at startup** in **Common Setting**.
- You can use the APB_ChangeSamplingSettings instruction in RUN Mode to switch between the sampling settings. However, switching the setting using the APB_ChangeSamplingSettings instruction is not reflected in **Sampling setting at startup** in **Common Setting**. If you perform any of the following operations, the sampling setting returns to the setting selected in **Sampling setting at startup**.
  a) Restarting the Controller
  b) Restoring the Controller
  c) Downloading the project synchronously from the Sysmac Studio
  d) Transferring the settings after editing the settings in **Sampling setting** using **Setting Change during RUN Mode** while the Controller is running

2-3-1 Setting the Variable Data Sampling Target

Set the variable data to collect and the collection behavior.

Procedure for Setting the Variable Data Sampling Target

Set the variable data to collect and the behavior when the execution of sampling exceeds the task period.
To change the setting of the variable data sampling, the Sysmac Studio and the Controller must be offline.
For unit version 1.65 or later, you can also execute setting change during RUN Mode.

1 Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

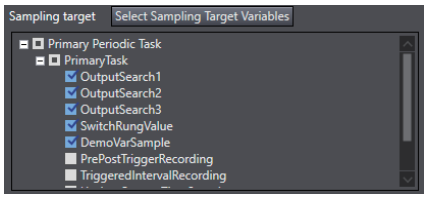
2 In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
The **Automation Playback Settings** display opens.

3 Click **Sampling Setting 1** or **Sampling Setting 2**.
You can have two sampling settings. **Sampling Setting 1** and **Sampling Setting 2** have the same setting items.
The sampling setting is opened.
To use **Sampling Setting 2**, select **Use** for **Sampling setting** in **Sampling Setting 2**.

Additional Information

To specify the sampling setting to enable at the startup of the Controller, select **Sampling Setting 1** or **Sampling Setting 2** for **Sampling setting at startup** in **Common Setting**.

4 Select the sampling target.



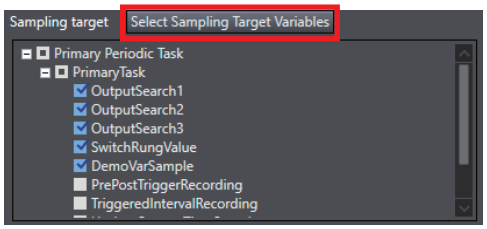
All selectable POUs and their variables are selected by default. Deselect POUs from which you do not need to collect data, such as variables that do not change values during operation.

Selecting a check box in the upper level of the tree also selects all check boxes in the lower levels. Similarly, clearing a check box in the upper level of the tree also clears all items in the lower levels.

Precautions for Correct Use

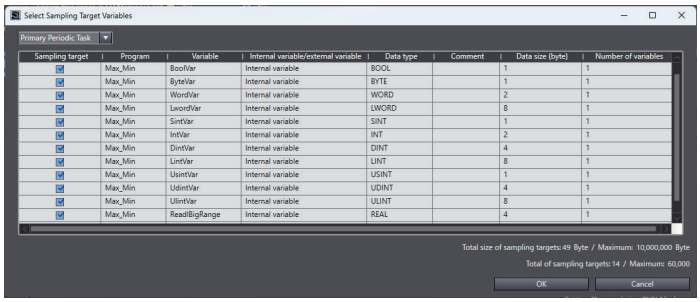
By default, all selectable sampling targets are selected. Refer to *2-1-2 Upper Limit of Variable Data to Collect* on page 2-4 and select sampling targets so that the upper limit is not exceeded.

5 Select the sampling target variables in the POU.
Click the **Select Sampling Target Variables** button.

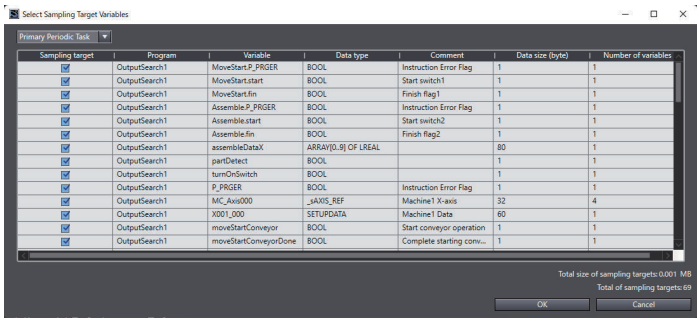


The **Select Sampling Target Variables** dialog box is displayed. Select the variable to include in the sampling target.
By default, all selectable variables are selected. Deselect structure and array variables from which you do not need to collect data, such as variables that do not change values during operation.
In the lower right corner of the **Select Sampling Target Variables** dialog box, you can see the **Total size of sampling targets** and **Total of sampling targets**. Please select sampling targets so that the upper limit in *2-1-2 Upper Limit of Variable Data to Collect* on page 2-4 is not exceeded.

- Project unit version 1.68 or later



- Project unit version earlier than 1.68



For the items on the dialog box for selecting variables of a program POU to include in the sampling target, refer to *Items on the Select Sampling Target Variables Dialog Box* on page 2-19.

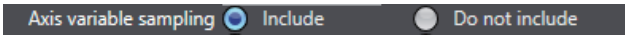
Additional Information

If you deselect a POU, the variables of the POU are no longer displayed in the **Select Sampling Target Variables** dialog box. However, if you select the POU again, the previously selected variables appear again in the **Select Sampling Target Variables** dialog box, unless you click the **OK** button in the dialog box.

Version Information

The function of selecting variables to be include in the sampling target can be used on the CPU Unit with unit version 1.65 or later.

6 Select whether to include axis variables in the sampling target.



7 Select the behavior when the execution of sampling exceeds the task period.

8 From the Synchronization window, transfer the settings to the CPU Unit.

Items for Variable Data Collection

There are settings that specify the sampling setting name, behavior after the task period is exceeded, and sampling target.

Item	Description	Setting range	Default
Sampling setting name	Set the name of the sampling setting.	1-byte to 31-byte string (not including the terminating NULL character). No duplicates are allowed between Sampling Setting 1 and Sampling Setting 2. Refer to *Restrictions on Characters in the Sampling Setting Name* on page 2-18 for usable characters.	
Axis variable sampling	Set whether to include axis variables in the sampling target.	Include or Do not include	Include
Behavior after task period is exceeded	Select the behavior of variable data collection when the execution of sampling exceeds the task period. If you select Continue, it may happen that concurrency cannot be ensured for variable data that will be collected.*1	Continue or Stop	Continue
Sampling target	Select the program POUs from which to collect variable data. For the items on the dialog box for selecting variables of a program POU to include in the sampling target, refer to *Items on the Select Sampling Target Variables Dialog Box* on page 2-19.	All program POUs excluding event tasks	All program POUs excluding event tasks

*1. Refer to *7-2-2 What to Do If Data Concurrency Cannot be Ensured in Variable Logs* on page 7-5 for what to do when concurrency of variable data cannot be ensured.

● Restrictions on Characters in the Sampling Setting Name

There are restrictions on characters that can be used in the sampling setting name.

Item	Description
Usable characters	0 to 9, A to Z, a to z $ % ' - _ @ ! ` ( ) ~ = # & + ^ [ ] { } , . ; Single-byte space (Not allowed at beginning and end of string)
Unusable characters	• Reserved words CON, PRN, AUX, CLOCK$, NUL, COM0, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9, LPT0, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9 • Multi-byte characters
Case sensitivity	Not case sensitive
Maximum string size (without NULL)	31 bytes

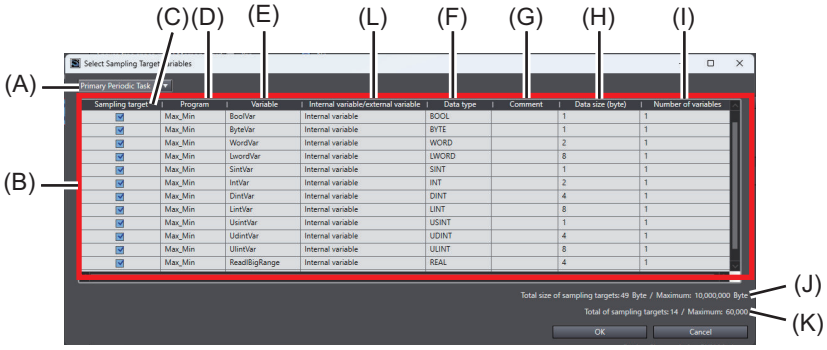
Items on the Select Sampling Target Variables Dialog Box

In the **Select Sampling Target Variables** dialog box, specify variables in a POU to include in the sampling target.

Version Information

The function to select the sampling target for each variable can be used in project unit version 1.65 or later.

The setting items in the **Select Sampling Target Variables** dialog box are as follows.



Symbol	Meaning		Description
A	Task type		You can select the task type from primary periodic task or periodic task to specify the variable to show in the variable list.
B	Variable list		A list of variables included in the program POUs selected as **Sampling target** in the sampling setting is displayed. Refer to the following for operations on the variable list. • *Sorting Variables in the Variable List* on page 2-20 • *Filtering Variables in the Variable List* on page 2-20 • *Showing or Hiding Columns in the Variable List* on page 2-24 • *Selecting All Rows in the Variable List* on page 2-25 • *Copying Data from the Variable List* on page 2-25
C		Sampling target	A checkbox is displayed to select whether or not to include the variable in the sampling target. You can specify multiple items and select or deselect their check boxes all at once. For information on how to select or deselect check boxes at one, refer to *Specifying Multiple Sampling Targets in the Variable List* on page 2-26. By default, they are all selected. When a variable is added to a POU that is included in the sampling target, the check box for that variable is selected (i.e., it is included in the sampling target).
D		Program	The program name that contains the variable is displayed.
E		Variable	The variable name is given. The units of variable to be displayed are as follows. • Basic data type: each variable • Structure/union/enumeration/array: each variable • User-defined function block: Individual internal variable, external variable, input variable and output variable for each instance variable • System-defined function block: each instance variable

Symbol	Meaning		Description
L		Internal variable/ external variable (Project unit version 1.68 or later)	The variable type is shown. • Internal variable: Variables used only within a POU • External variable: Variables that reference global variables outside of a POU. • Other: Other than the above, such as internal variables, input variables, and output variables for FBs
F		Data type	The data type of the variable is shown.
G		Comment	The comment for the variable is displayed.
H		Data size (byte)	The size of the sampled variable is displayed in bytes. For an axis variable, the total size of the sampled members is displayed.
I		Number of variables	The number of sampled variables is displayed. For a system-defined function block instance variable, the total number of sampled input and output variables is displayed. For an axis variable, the total number of sampled members is displayed. For other variables, 1 is displayed.
J	Total size of sampling targets		The total **data size** of variables whose check boxes in the **Sampling target** column are selected is displayed. Change of the check box selection is reflected immediately.
K	Total of sampling targets		The total **number of variables** whose check boxes in the **Sampling target** column are selected is displayed. Change of the check box selection is reflected immediately.

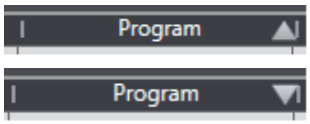
Additional Information

In project unit version 1.68 and later, the number of variables and the total data size may not be reduced even if you deselect the *Sampling target* check boxes for external variables.
To reduce the number of variables and total data size by excluding external variables, deselect the Sampling target check boxes for all of the external variables to exclude.

Sorting Variables in the Variable List

You can sort the variable in the variable list on the Select Sampling Target Variables dialog box.

1 In the variable list in the **Select Sampling Target Variables** dialog box, click the header of the column to sort.
Variables are listed in ascending order on first click and the ▲ icon is displayed. Variables are listed in descending order on second click and the ▼ icon is displayed. Subsequent clicks toggle between ascending and descending order.



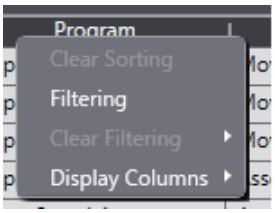
To cancel sorting, right-click on the variable list header and select **Clear Sorting** from the pop-up menu that appears.

Filtering Variables in the Variable List

You can filter the variable in the variable list on the Select Sampling Target Variables dialog box.

1 In the variable list in the **Select Sampling Target Variables** dialog box, right-click the header of the column to filter.

The pop-up menu is displayed.

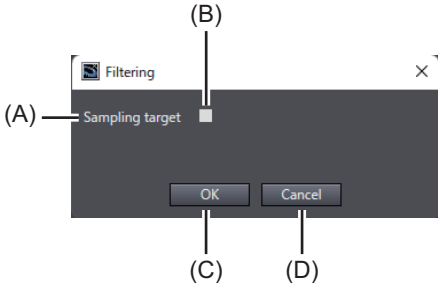


2 Select **Filtering** from the menu.
The Filtering window for the column is displayed.

3 Specify conditions for filtering.
Refer to the description below for the Filtering window and settings for each column.

4 Click the **OK** button.
The Filtering window closes and the variables on the variable list are filtered according to the set conditions.
To cancel filtering, right-click on the variable list header and select **Clear Filtering** from the pop-up menu. You can choose to clear filtering for only selected columns or all columns.

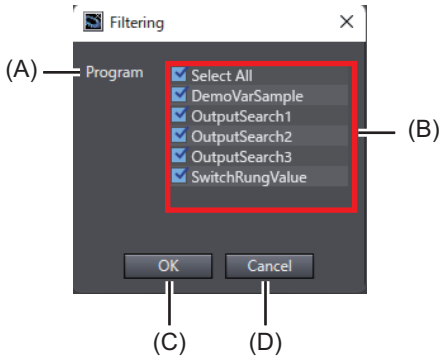
Filtering window for Sampling target column



Symbol	Meaning	Description
A	Setting	The name of the column for which filtering is set.
B	Condition check box	You select this check box to display only the variables specified as sampling targets. By default, this check box is not selected.
C	**OK** button	Clicking this button filters rows that meet the set conditions.
D	**Cancel** button	Clicking this button cancels the changes made and closes the window.

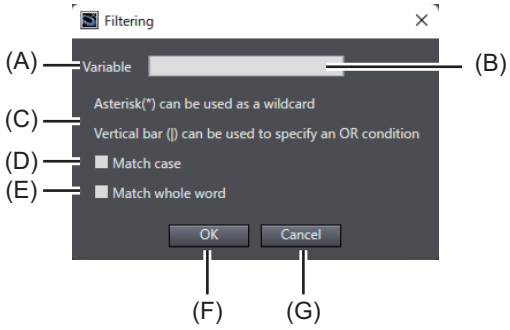
Filtering window for Program and Internal variable/external variable columns

An example of the Filtering window for the **Program** column is shown below. The Filtering window for the **Internal variable/external variable** column has a similar screen configuration.



Sym-bol	Meaning	Description
A	Setting	The name of the column for which filtering is set.
B	List of conditions	Program names or internal variables/external variables are displayed in ascending order. Those with identical strings that differ only in case are not shown. Select the check boxes for the program names or variables/external variables you want to display. It is not possible to change the selection for multiple rows at once. These check boxes are all selected by default.
C	**OK** button	Clicking this button filters rows that meet the set conditions.
D	**Cancel** button	Clicking this button cancels the changes made and closes the window.

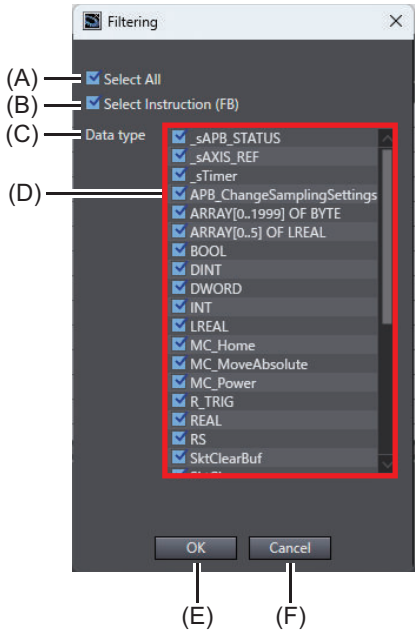
Filtering window for Variable and Comment columns



Sym-bol	Meaning	Description
A	Setting	The name of the column for which filtering is set.
B	Condition input field	You specify the filtering conditions. You can use * (asterisk) as a wildcard. You can also use | (bar) as an OR condition.
C	Description	This is an description of the symbols that can be used in conditions.
D	**Match case** check box	Select this check box to make the entered condition text case sensitive. By default, this check box is not selected.

Symbol	Meaning	Description
E	**Match whole word** check box	Select this check box to filter only those that exactly match the entered text. By default, this check box is not selected.
F	**OK** button	Clicking this button filters rows that meet the set conditions.
G	**Cancel** button	Clicking this button cancels the changes made and closes the window.

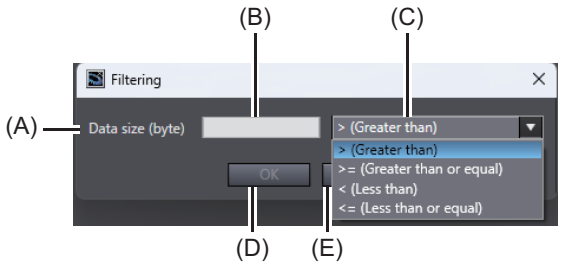
Filtering window for Data type column



Symbol	Meaning	Description
A	**Select All** check box	Use this check box to select or clear all rows at once. Selecting the check box selects all rows. Clearing the check box clears the selection of all rows. By default, this check box is selected.
B	**Select Instructions (FBs)** check box	Use this check box to select or clear all instruction (function block) rows at once. Selecting the check box selects all instruction (function block) rows. Clearing the check box clears the selection of all instruction (function block) rows. By default, this check box is selected.
C	Setting	The name of the column for which filtering is set.
D	List of conditions	Data types are displayed in ascending order. Those with identical strings that differ only in case are not shown. Select the check boxes for the data types you want to display. It is not possible to change the selection for multiple rows at once. By default, these check boxes are all selected.
E	**OK** button	Clicking this button filters rows that meet the set conditions.

Sym-bol	Meaning	Description
F	**Cancel** button	Clicking this button cancels the changes made and closes the window.

Filtering window for Data size and Number of variables columns

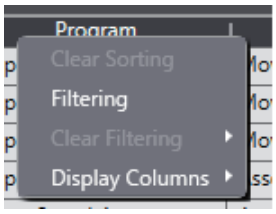


Sym-bol	Meaning	Description
A	Setting	The name of the column for which filtering is set.
B	Threshold input field	Set the threshold. You can set an integer between 1 and 2,147,483,647. Entering a value outside this range or text grays out the **OK** button, making it impossible to click. By default, this field is blank.
C	Condition selection drop-down list	Specify the inequality relationship between the data to filter and the threshold. > (Greater than): Greater than the threshold >= (Greater than or equal): Greater than or equal to the threshold < (Less than): Less than the threshold <= (Less than or equal): Less than or equal to the threshold By default, the condition is **> (Greater than)**.
D	**OK** button	Clicking this button filters rows that meet the set conditions.
E	**Cancel** button	Clicking this button cancels the changes made and closes the window.

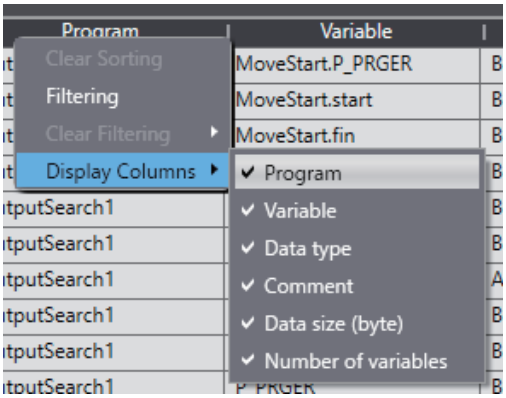
● Showing or Hiding Columns in the Variable List

You can toggle between showing and hiding columns of the variable list in the Select Sampling Target Variables dialog box.
It is convenient for efficiently checking necessary items.

1 Right-click on the column header of the variable list in the **Select Sampling Target Variables** dialog box.
The pop-up menu is displayed.



2 Select **Display Columns**.
The column name is displayed.



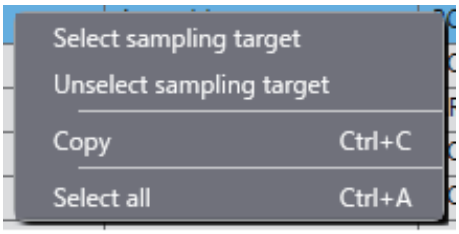
A check mark (✓) is displayed for the name of the column being displayed.

3 Click the name of the column you want to toggle between showing and hiding.
The specified columns are shown or hidden accordingly.

● Selecting All Rows in the Variable List

You can select all rows in the variable list.
This function is useful to select all rows when there are many rows in the variable list.

1 Right-click on the variable list in the **Select Sampling Target Variables** dialog box.
The pop-up menu is displayed.



2 Click the **Select all** menu command.

Additional Information

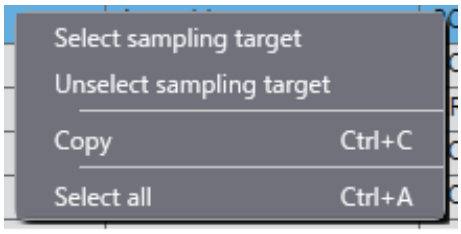
You can also select all rows by pressing Ctrl + A keys on the variable list.

● Copying Data from the Variable List

You can copy the data from the variable list and paste it to an Excel file, etc.

1 On the variable list in the **Select Sampling Target Variables** dialog box, select the row to copy.

2 Right-click on the variable list in the **Select Sampling Target Variables** dialog box.
The pop-up menu is displayed.



3 Select **Copy**.
The data in the selected row is copied to the clipbоard.

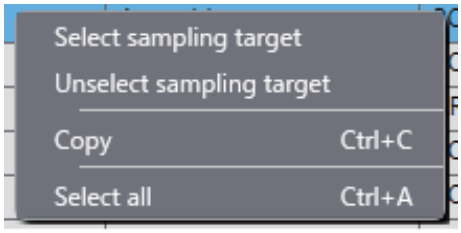
4 Paste it into an Excel file or something.

● Specifying Multiple Sampling Targets in the Variable List

You can specify multiple variables to be included in the sampling target at once on the variable list.

1 From the variable list in the **Select Sampling Target Variables** dialog box, select multiple rows of variables to include in the sampling target or rows that you do not want to include in the sampling target.

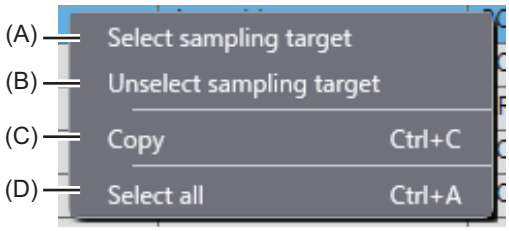
2 Right-click on the variable list in the **Select Sampling Target Variables** dialog box.
The pop-up menu is displayed.



3 If you want to include the variables in the selected rows in the sampling target, click **Select sampling target**. If you want to exclude the variables in the selected rows from the sampling target, select **Unselect sampling target**.
The check boxes for **Sampling target** of these rows are selected or deselected depending on the menu command you selected.

● Pop-up Menu of the Variable List

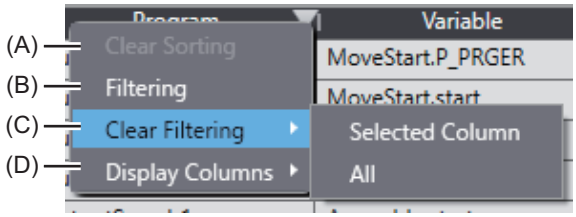
Right-click on the variable list to display the operation menu.



Symbol	Meaning	Description
A	Select sampling target	This menu selects the check boxes of the selected rows in the **Sampling target** column.
B	Unselect sampling target	This menu deselects the check boxes of the selected rows in the **Sampling target** column.
C	Copy	This menu copies the data in the selected rows. You can paste the copied data into an Excel file.
D	Select all	This menu selects all rows.

● Pop-up Menu of the Variable List Header

Right-click on the header of the variable list to display the operation menu.



Symbol	Meaning		Description
A	Clear Sorting		Select this menu to cancel sorting. This menu is available when data in the column is sorted.
B	Filtering		Select this menu to filter the data. Refer to *Filtering Variables in the Variable List* on page 2-20 for details on filtering.
C	Clear Filtering		Select this menu to cancel filtering. This menu is available when filtering is applied.
		Selected Column	This menu removes filtering for the selected column.
		All	This menu removes filtering on all columns.
D	Display Columns		Select this menu to display or hide each column. A check mark (✓) is displayed to the left of the column name while the column is displayed. By default, the column is displayed.

2-3-2 Setting How to Output Variable Logs

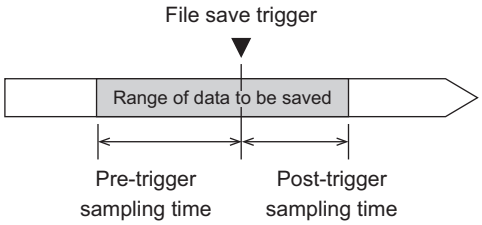
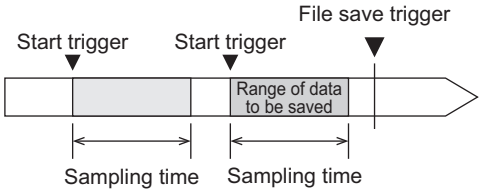
Set the trigger to save a variable log, and the trigger method.
You can create more than one variable log output setting. You can use them for different purposes as follows.

- Save variable logs for a certain period of time using the pre/post trigger method to analyze unexpected problems during system operation.
- Save variable logs only when necessary using the start/save trigger method during system design and debugging.

Once variable log output processing is started by one of the output settings, until the variable log output is completed, variable logs cannot be output by the other output setting. You can check the status of variable log output with the _APB_LogStatus system-defined variable. The status of variable log output is as follows.

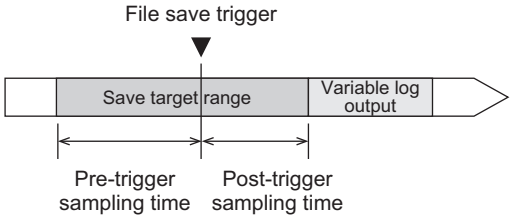
- After start of variable log output: Storing
- After completion of variable log output: Sampling

The following trigger methods are available for specifying the range of data to be saved in a variable log.

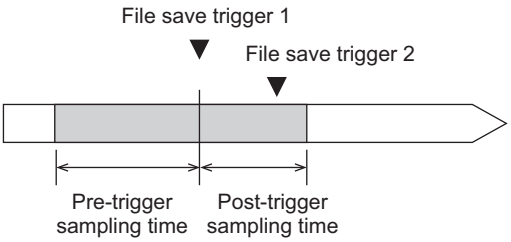
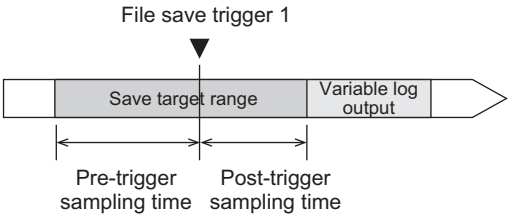
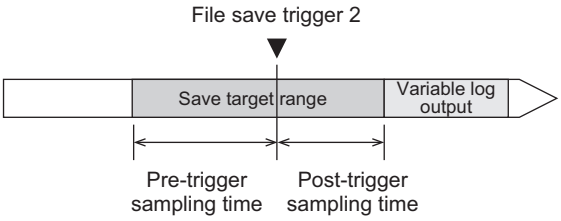
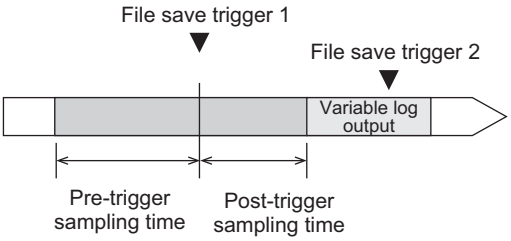
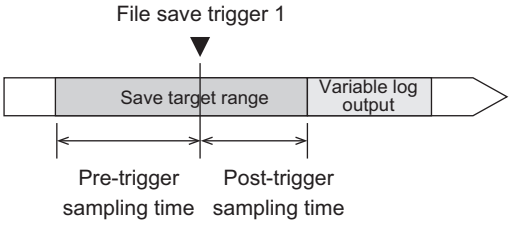
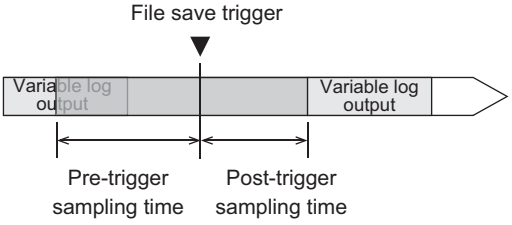
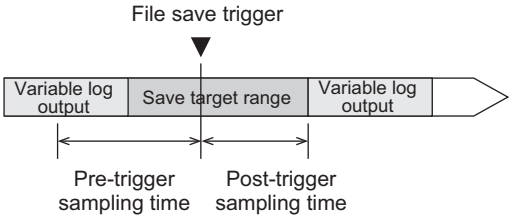
Trigger method	Description
Pre/Post trigger method	Outputs the data before and after the trigger changes to TRUE to a variable log. This method is used, for example, to save and check data before and after occurrence of a problem in a variable log. 
Start/Save trigger method	Samples the data after the start trigger changes to TRUE. The data sampled by the previous start trigger is output to the variable log when the file save trigger changes to TRUE. This method is used, for example, in debugging to save and check the data when a specific condition is satisfied in the variable log. 

Operation of the Pre/Post Trigger Method

In the Pre/Post trigger method, data before and after the trigger changed to TRUE is output to the variable log.
The variable log is output when the post-trigger sampling time has elapsed after the file save trigger was input.

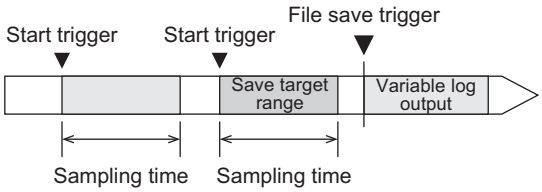


If the next trigger is input during the trigger processing, the operation is as shown below.

Condition	Operation
The next file save trigger is input before the post-trigger sampling time has elapsed.  	• Unit version 1.70 or later The variable log for the file save trigger that was input earlier is output, ignoring any file save triggers input later.  • Unit version earlier than 1.70 The variable log for the file save trigger that was input later is output. 
The next file save trigger is input when the variable log is being output.  	The file save trigger that was input later is ignored. 
The next file save trigger is input before the pre-trigger sampling time has elapsed after the completion of variable log output.  	The variable log saved for the pre-trigger sampling time of the file save trigger that was input is the portion after the completion of the previous variable log output, so the sampling time is shorter than the set sampling time. 

Operation of the Start/Save Trigger Method

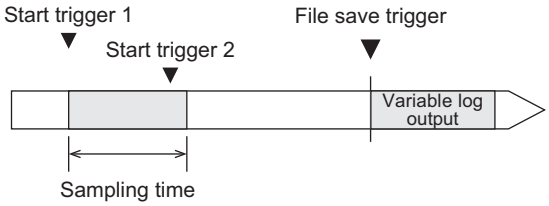
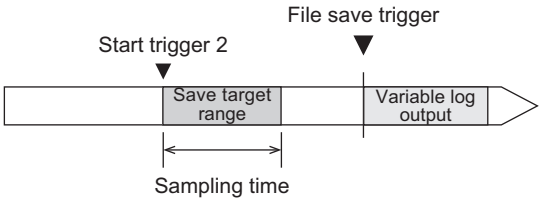
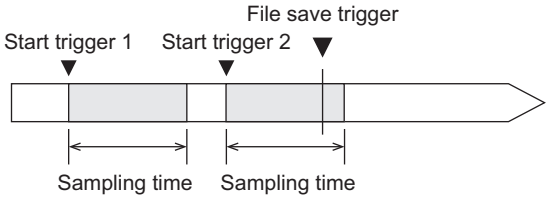
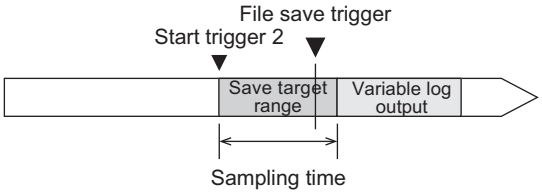
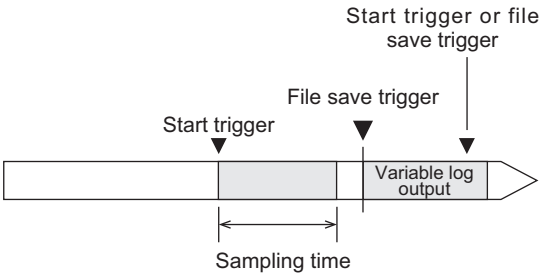
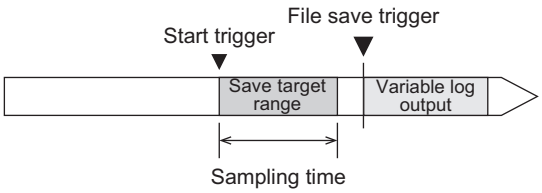
The start/save trigger method samples the data after the start trigger changes to TRUE.
The data sampled by the previous start trigger is output to the variable log when the file save trigger changes to TRUE.



Precautions for Correct Use

For unit version 1.71 or later, you must set the pre/post trigger method as a trigger for controlling network cameras using the camera control function. If you set the start/save trigger method, video will not be captured.

If the next trigger is input during the trigger processing, the operation is as shown below.

Condition	Operation
The next start trigger is input before the sampling time has elapsed.  	The variable log for the start trigger that was input later is output. 
The file save trigger is input before the sampling time has elapsed.  	The sampling is performed until the sampling time has elapse and the variable log is output. 
The start trigger or file save trigger is input when the variable log is being output.  	The start trigger or file save trigger that was input later is ignored. 

Procedure for Setting How to Output Variable Logs

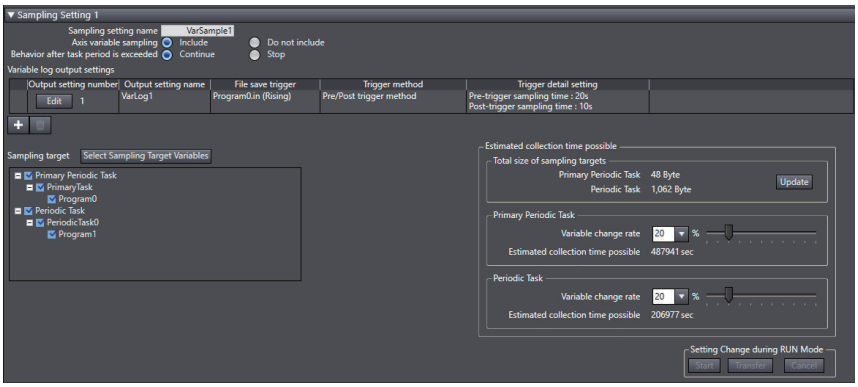
Configure the detailed settings of the save trigger and trigger method for variable logs.
To change the setting of how to collect variable data, the Sysmac Studio and the Controller must be offline.

For unit version 1.65 or later, you can also execute setting change during RUN Mode.

1 Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

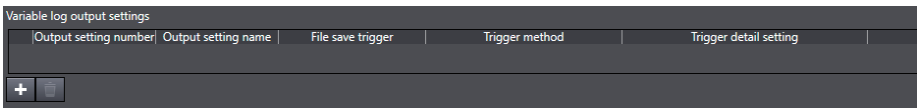
2 In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
The **Automation Playback Settings** display opens.

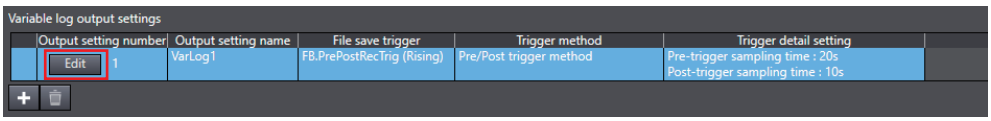
3 Click **Sampling Setting 1** or **Sampling Setting 2**.
The sampling setting is opened.



You can have two sampling settings. **Sampling Setting 1** and **Sampling Setting 2** have the same setting items.

4 In **Variable log output settings**, click the **+** button. If you edit output settings that already exist, click the **Edit** button for the output setting to edit.

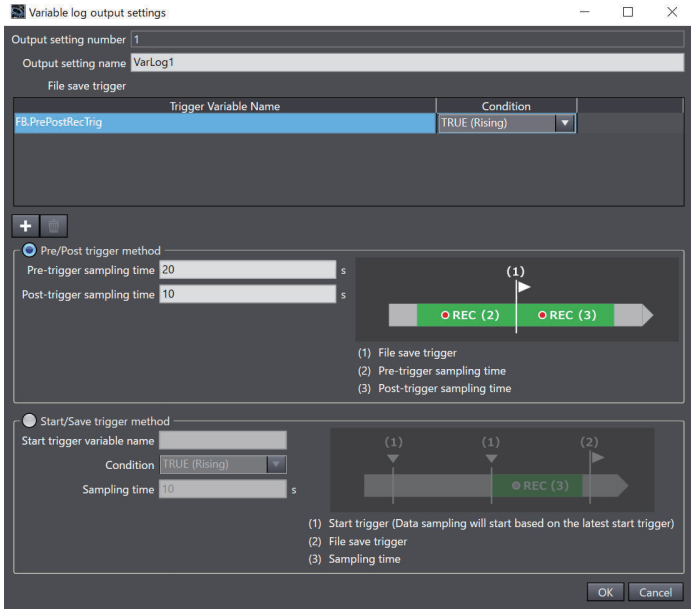




Additional Information

If you delete variable log output settings, select the output setting to delete and click the button.

The **Variable log output settings** dialog box is displayed.



5 Set each item.

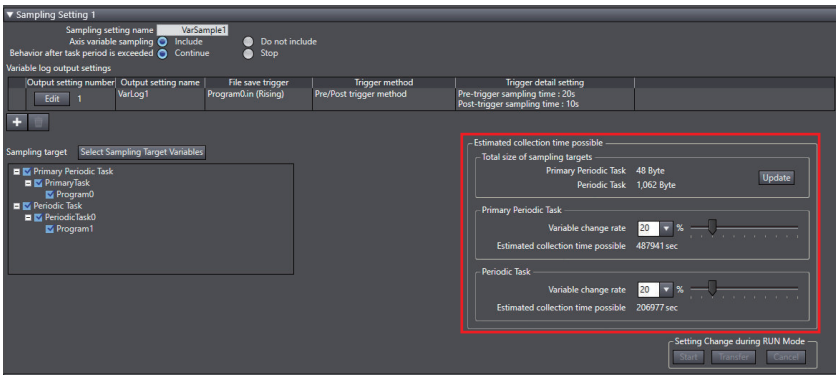
- In **File save trigger**, click the **+** button to add a file save trigger.
- To delete file save triggers, select the file save trigger to delete and click the button.

6 Click the **OK** button.

7 From the Synchronization window, transfer the settings to the CPU Unit.

Additional Information

In project unit version 1.68 or later, you can check the estimated length of time available for sampling using the current settings in the **Estimated collection time possible** in the Automation Playback Settings display. Use the **Estimated collection time possible** as a reference when you set the sampling time in the **Variable log output settings** dialog box.
The length of time available for variable log sampling varies depending on the percentage of variables that change. The larger the percentage of variables that change, the more data needs to be recorded, reducing the length of time available for sampling. By adjusting the **Variable change rate** setting, you can estimate the length of time available for sampling in a variable log with higher accuracy.
Note that the Estimated collection time possible is only a guideline for the maximum length of time that can be recorded in a variable log, and is not guaranteed.



Items for Variable Log Output

There are settings that specify the setting name, file save trigger, and trigger method.

Precautions for Correct Use

If the same variables and the same condition are set as the file save trigger for more than one output setting, the trigger condition for the smallest output setting number is assumed to be met when the file save trigger condition is met.

Item		Description	Setting range	Default
Output setting number		This is automatically set to 1 for the first output setting, and 2 for the second output setting. This number is used in the subscript to specify which output setting is used in the array of the _APB_LogStatus system-defined variable.	1 or 2 The number is automatically set, and you cannot change the number.	---
Output setting name		Set the name of the variable log output setting.	1-byte to 31-byte string (not including the terminating NULL character). No duplicates are allowed between Sampling Setting 1 and Sampling Setting 2. Refer to *Restrictions on Characters in the Setting Name of Variable Log Output* on page 2-34 for supported characters.	VarLogN N is the output setting number.
File save trigger	Trigger Variable Name	Set the variables to use as the file save trigger. Up to 4 variables can be specified for each output setting.	BOOL variable	None
	Condition	Set the condition that must be met for the file save trigger to be established	TRUE (Rising) or FALSE (Falling)	None
Trigger method		Select the method to output the sampling results of variable data to the variable log.	Pre/Post trigger method or Start/Save trigger method	Pre/Post trigger method

Item		Description	Setting range	Default
When **Pre/Post trigger method** is selected in Trigger method	Pre-trigger sampling time [s]	Set how much time data should be output to the variable log before the file save trigger changes to TRUE.	1 to 899 The maximum value is a value in the range where the total value of Pre-trigger sampling time and Post-trigger sampling time is 900 or less.	20
	Post-trigger sampling time [s]	Set how much time data should be output to the variable log after the file save trigger changes to TRUE.	1 to 899 The maximum value is a value in the range where the total value of Pre-trigger sampling time and Post-trigger sampling time is 900 or less.	10
When **Start/Save trigger method** is selected in Trigger method	Start trigger variable name	Set the variable name to use as the start trigger.	BOOL variable	None
	Condition	Set the condition that must be met for the start trigger to be established.	TRUE (Rising) or FALSE (Falling)	None
	Sampling time [s]	Set how much time data should be output to the variable log after the start trigger changes to TRUE.	1 to 900	10

Additional Information

Depending on settings for the following items, the time length of the data output to the variable log is shorter than the set sampling time.
- Variable data set as sampling target
- Unused time in a task

For relationship between the length of the output variable log data and the sampling time, refer to *7-2-3 What to Do If Variable Logs Are Shorter Than the Set Time* on page 7-8.

Restrictions on Characters in the Setting Name of Variable Log Output

There are restrictions on characters that can be used in the setting name of variable log output.

Item	Description
Usable characters	0 to 9, A to Z, a to z $ % ' - _ @ ! ` ( ) ~ = # & + ^ [ ] { } , . ; Single-byte space (Not allowed at beginning and end of string)
Unusable characters	• Reserved words CON, PRN, AUX, CLOCK$, NUL, COM0, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9, LPT0, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9 • Multi-byte characters

Item	Description
Case sensitivity	Not case sensitive
Maximum string size (without NULL)	31 bytes

2-4 Collecting Event Logs (Unit Version 1.71 or Later)

For unit version 1.71 or later, you can also collect event logs for playback.

2-4-1 Sampling Target Event Logs

The CPU Unit collects both Controller event logs and user-defined event logs.
Some types of Controller event logs are not sampled. The sampling target event logs are shown in the table below.

Type	Target or Non-target
System log and access log of the CPU Unit	Target
System log and access log of NX Units on the CPU rack	Non-target
System log and access log of X Bus Units on the CPU rack	Non-target
System log of EtherCAT slaves	Non-target
System log and access log of NX Units on EtherCAT Slave Terminals	Non-target

Precautions for Correct Use

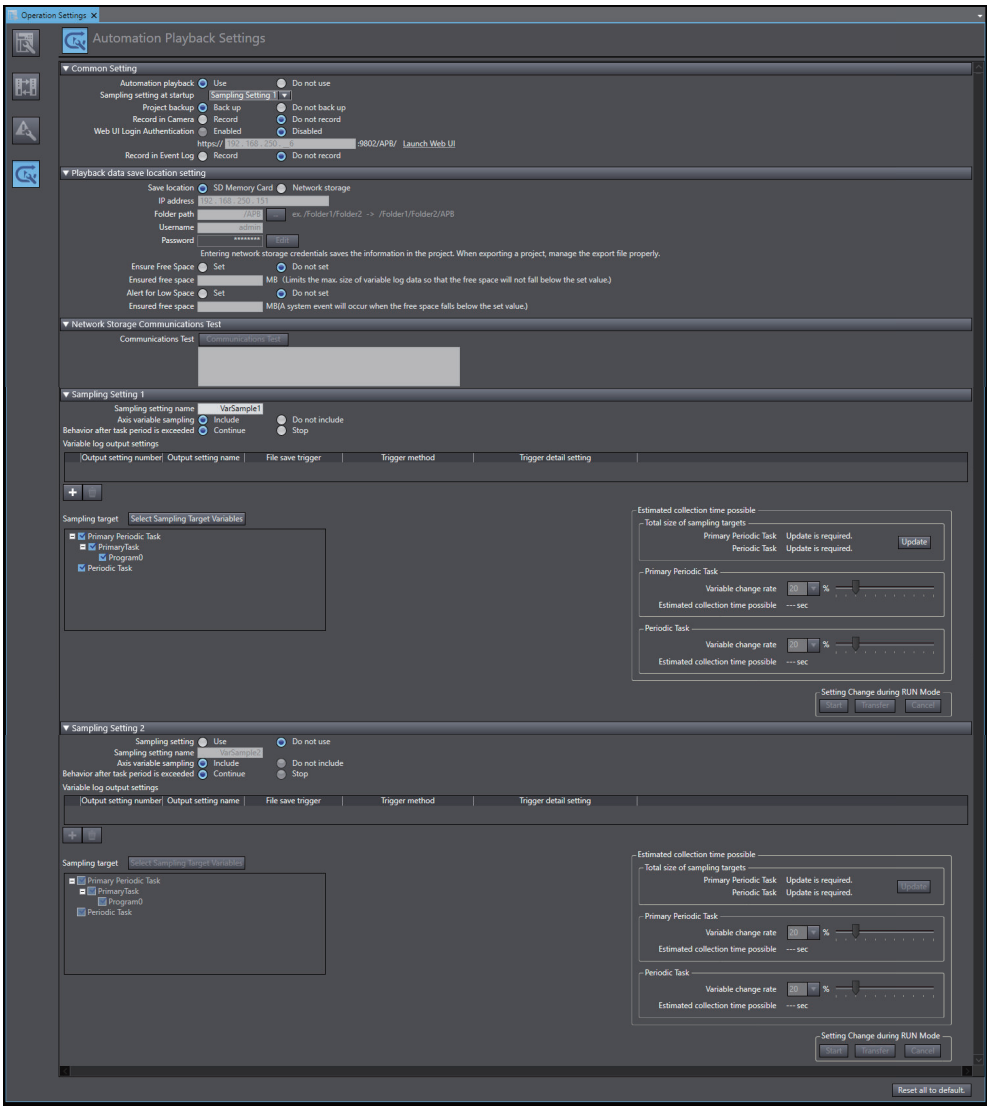
Because some types of event logs are not sampled, the collected event logs will differ from those displayed in the Troubleshooting dialog box of the Sysmac Studio. Check the event logs from the Sysmac Studio as needed.

2-4-2 Procedure for Enabling Event Log Collection

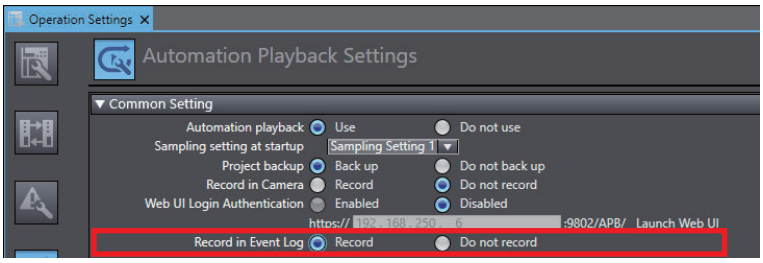
Enabling event log collection allows the CPU Unit to collect event logs in sync with variable log collection.
Make sure that the Sysmac Studio and the Controller are offline before you enable event log collection.
The following procedure assumes that Automation playback is already set to **Use**. Set Automation playback to **Use** if it is not set to **Use**.

1. Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

2. In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
   The **Automation Playback Settings** display opens.



3 Select **Record** for **Record in Event Log** in **Common Setting**.



4 From the Synchronization window, transfer the Controller Setup to the CPU Unit. You do not need to restart the CPU Unit.

2-5 Collecting Playback Data in Sync with HMI Devices (Unit Version 1.71 or Later)

For unit version 1.71 or later, you can use the NA Simulator to play back screens on NA-series Programmable Terminals.

2-5-1 Procedure for Collecting Playback Data in Sync with HMI Devices

To perform playback in sync with an HMI device, the Controller's global variables mapped to the HMI device must be used as the external variables of the POU and set as the sampling target.
If you must use the Controller's global variables that are not used as the external variables of the POU for playback, add them to the sampling target by following the steps below.

1. Check the Controller's global variables mapped to the HMI device.
2. Set the Controller's global variables as external variables for a POU.
3. Assign the POU for which you set the Controller's global variables as external variables to a task.
4. Set the external variables of the POU for which you set the Controller's global variables as the sampling target.

2-6 Setting the Playback Data Save Destination (Unit Version 1.71 or Later)

For unit version 1.71 or later, set the playback data save destination.
All types of playback data are saved to the specified save destination, organized by sampling trigger.
Centralizing playback data in a single location enables efficient reading of playback data. This is referred to as centralized data management.

Version Information

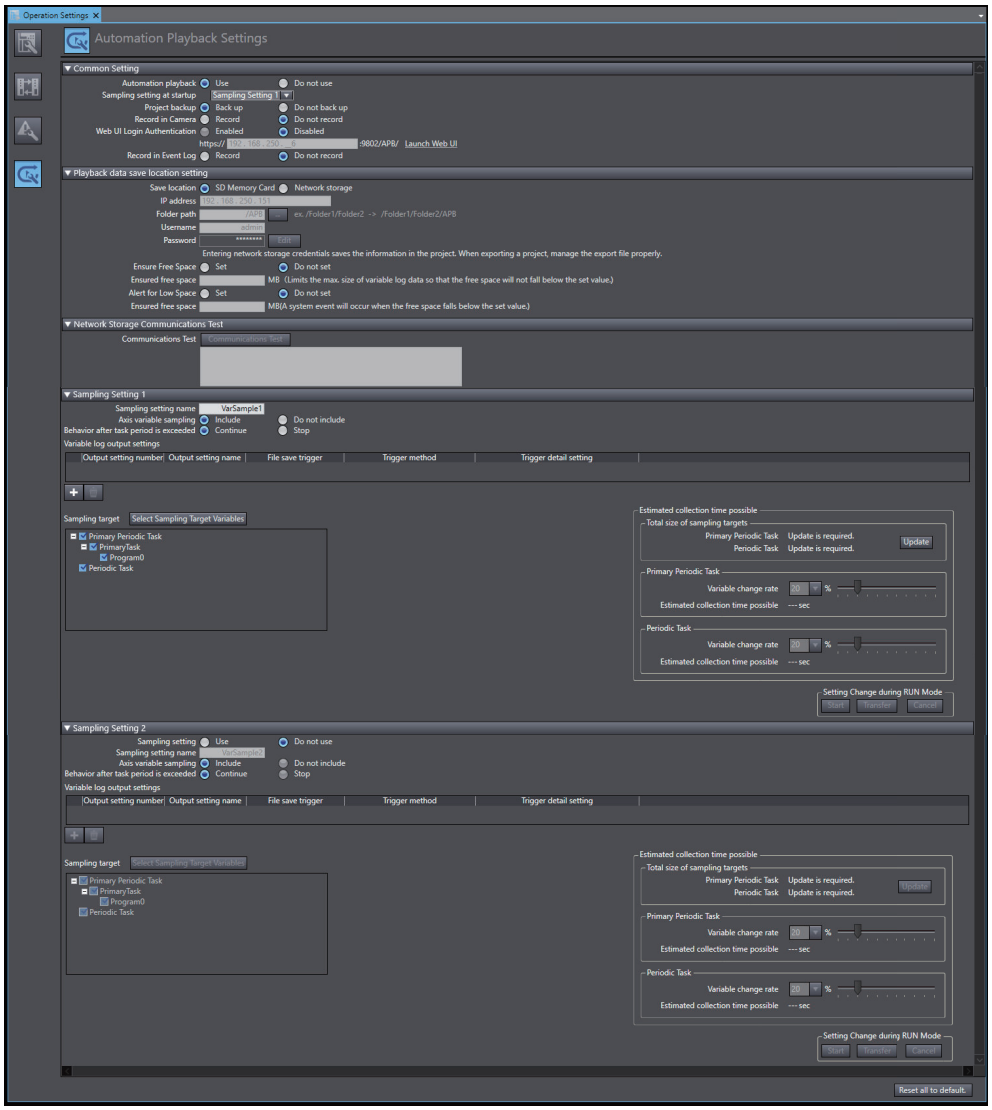
For unit version earlier than 1.71, the save destination for variable logs and project backup data is SD Memory Card. This cannot be changed.

2-6-1 Procedure for Setting the Playback Data Save Destination

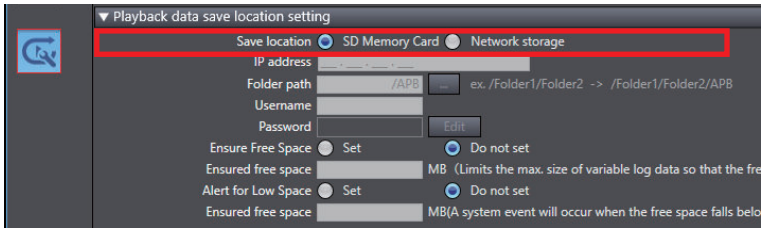
Set the playback data save destination and the Controller's operation when the available storage space in the save destination gets low.
Make sure that Sysmac Studio and the Controller are offline before setting the playback data save destination.
The following procedure assumes that Automation playback is already set to **Use**. Set Automation playback to **Use** if it is not set to **Use**.

1. Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

2. In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
   The **Automation Playback Settings** display opens.

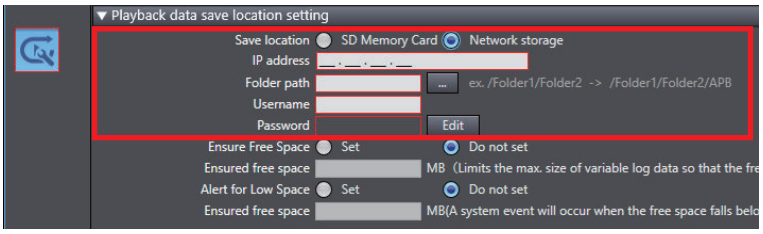


3 In the **Playback data save location setting**, set **Save location** to **SD Memory Card** or **Network storage**.

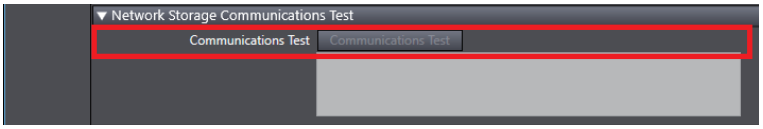


4 If the Save location is set to **Network storage**, configure detailed information on the save destination.

- IP address
- Folder path
- User name
- Password



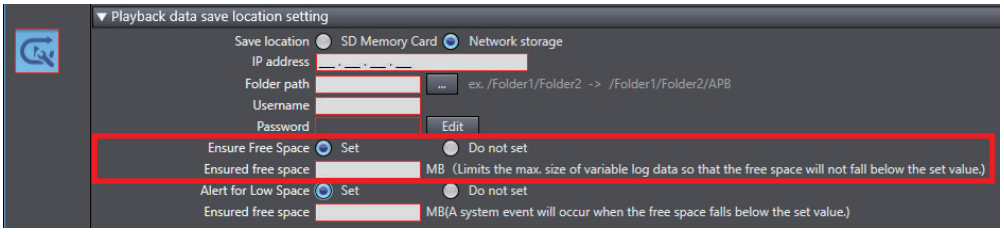
After configuring the settings, perform a communications test for the save destination.



If you cannot communicate with the save destination, review the settings.

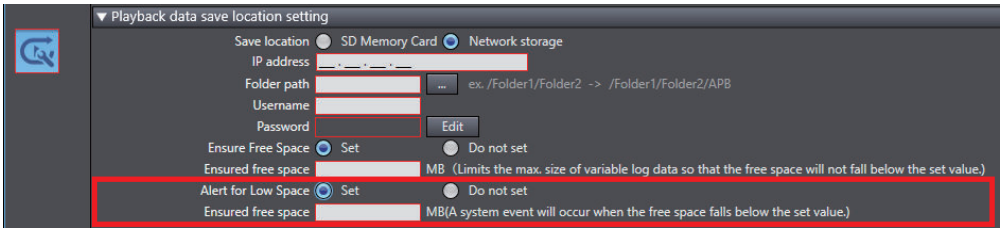
5 Set **Ensure Free Space** to **Set** or **Do not set**.

- If you select **Set**, enter the value in **Ensured free space**.
  When available storage space cannot be secured, new data will be saved after deleting older data.
- If you select **Do not set**, when storage space cannot be secured using the entire storage capacity of the save destination, new data will be saved after deleting older data.



6 Set **Alert for Low Space** to **Set** or **Do not set**.

- If you select **Set**, enter the value in **Ensured free space**.
  When available storage space falls below the set value, an event will occur.
- If you select **Do not set**, no event will occur.



7 From the Synchronization window, transfer the Controller Setup to the CPU Unit.
You do not need to restart the CPU Unit.

Precautions for Correct Use

- It is not possible to set the value of **Alert for low space** to less than or equal to the value of **Ensure free space**.
- If a value that exceeds the total storage capacity is set for both **Ensure free space** and **Alert for low space**, the Controller will operate as if they were not set.
- If you change the user name and password for your network storage, also change the setting of the playback data save destination accordingly.
- The network storage user set in the Playback data save location setting must have permissions for both reading and writing.
- If the save destination for video data set on a network camera differs from the save destination set in the Sysmac Studio, the network camera's setting will be overwritten by the save destination set in the Sysmac Studio.

2-6-2 Items for the Playback Data Save Destination

Set the save destination and the Controller's operation when the available storage space in the save destination gets low.

Item	Description	Setting range	Default
Save location	Select the playback data save destination.	SD Memory Card or Network storage	SD Memory Card
IP address	If the save destination is set to Network storage, set the IP address of the network storage. It must be entered in the format of *192.168.250.1*.	0 to 255 (for each octet)	None
Output folder path	Specify the path to the folder in the save destination storage. It must be entered in the format such as */XXX/YYY*, where the path is separated by slashes (or backslashes). If the save destination is network storage, the path to the shared folder must also be included. If the save destination is set to SD Memory Card, the path cannot be specified as it is fixed to the root of the volume. **Note** The folder path must be specified in UNC (Universal Naming Convention) format with "/" (slash) as a delimiter, excluding the server name or IP address. Additionally, the Controller may not operate as intended due to network storage settings, Windows specifications, permissions, security settings, etc. Perform operational verification in your own environment.	176 characters max. Applicable characters: 0 to 9, A to Z, a to z, $ % ' - _ @ ! ` ( ) ~ = # & + ^ [ ] { } , . ; **Note** Do not set *APB* to the output folder path.	None
User name	If the save destination is set to Network storage, set the user name required to access the network storage.	1 to 256 characters Applicable characters: a to z, A to Z, 0 to 9, - _ .	None

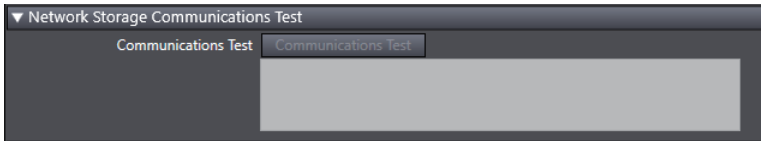
Item		Description	Setting range	Default
	Password	If the save destination is set to Network storage, set the user password required to access the network storage. Click the **Edit** button to edit this.	1 to 256 characters Available characters are the following ASCII characters with byte codes 0x20 to 0x7E. Single-byte space, 0 to 9, A to Z, a to z, and ! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` { | } ~	None
Ensure Free Space		Select whether to set the available storage space to secure.	Yes or No	No
	Ensured free space	Set the available storage space to secure. The Controller controls the available storage space in the playback data save destination so that it does not fall below the amount set for this item. If the available storage space in the playback data save destination is expected to fall below the amount set for this item when new playback data is output, the Controller automatically deletes files with older timestamps from the save destination folder and lower-level folders to secure available space. If the Controller performs control based on this setting, the Variable Log Overwritten event (95760000 hex) will occur.	• SD Memory Card: None, or integer values between 1,024 and 4,096 (MB) • Network storage: None, or integer values between 1,024 and 47,683,716 (MB) If set to None, data will be deleted when the entire storage capacity gets low.	None
Alert for Low Space		Select whether to warn the user when the available storage space gets low.	Yes or No	No
	Ensured free space	Set the threshold of available storage space at which to issue a warning. This is a function that warns of a situation where the available storage space in the destination storage is getting low by means of an event. The Controller generates the Capacity Warning of Variable Log Save Destination event (64050000 hex) when the available data storage space in the playback data save destination falls below the amount set for this item. You can change the event level to Minor Fault although the default setting is Observation.	• SD Memory Card: None, or integer values between 1,024 and 4,096 (MB) • Network storage: None, or integer values between 1,024 and 47,683,716 (MB) If set to None, a warning will be displayed when the entire storage capacity gets low.	None

Precautions for Correct Use

When the save destination is set to the SD Memory Card and video data is selected for the collection, the SD Memory Card will not be unmounted even if the SD Memory Card power supply switch is pressed while the controller is in RUN mode. To remove the SD Memory Card, switch the controller to PROGRAM mode, press the SD Memory Card power supply switch, and then remove the SD Memory Card after the SD PWR indicator turned off.

Performing a Communications Test with Network Storage

When the playback data save destination is set to Network storage, perform a communications test to confirm that the network storage settings are correct.
To perform a communications test, click the **Communications Test** button next to **Communications Test** in **Automation Playback Settings**. You need operation authority of administrator, designer, or maintainer to perform a communications test.
Communications test can be performed when the Sysmac Studio is online with the Controller.



After performing a communications test, the result will be displayed in the communications test result field. If the connection to the specified output folder path in the network storage is successful, *Communications test successful* is displayed. If the connection fails, an error message is displayed.
The table below shows corrective action to take when an error message is displayed.

Error message	Description	Correction
Access to the network storage is denied. Error code: 0240	Connection failed due to a mismatch in the user name or password.	Make sure that the user name and password are correct.
Failed to connect to the network storage. Error code: 0250	Communications with the network storage cannot be established.	Make sure that power is supplied to the network storage, that there are no network failures, and that the settings for the connection destination.
The connection with the network storage has timed-out. Error code: 0260	Connection timed out.	Make sure that there are no network failures.
Cannot be executed while Automation Playback is in initialization status. Error code: 0210	Automation playback is not working.	Make sure that Automation playback is set to **Use**. Make sure that the _APB_Status.Status system-defined variable shows Run(3).
Cannot be executed while download. Error code: 0204	The communications test cannot be performed because synchronization or a download is in progress.	Perform a communications test after the synchronization or download is completed.
The network storage setting is invalid. Error code: 0103	Invalid characters are used for the entered user name or password.	Make sure the characters entered for the user name and password are correct.

Error message	Description	Correction
A communications error occurred. Error code: 9028	Communications cannot be established for reasons other than those listed above.	Select **Communications Setup** under **Controller** from the main menu of the Sysmac Studio, and extend the **Response Monitor Time** in the **Communications Setup** dialog box to 70 seconds or more.

2-6-3 Folder Structure and Files for Saving Playback Data

Playback data is saved in a fixed folder structure, in the folder specified in the Save location and lower-level folders.
The folder structure and files for playback data are as shown in the table below.

Folder or file	Description
<Specified Output Folder Path>\	If the save destination is network storage, playback data is output to the folder specified in the output folder path. If the save destination is set to SD Memory Card, this folder cannot be specified. It is the root of the volume.
APB\	This folder is automatically created under the specified folder path.
YYYYMMDDhhmmss_<Output Setting Name>\	Playback data folder • This folder is automatically created when playback data is saved. • Each part of the folder name string represents the following. YYYY: Year, MM: Month, DD: Day, hh: Hour, mm: Minute, ss: Second • YYYYMMDDhhmmss represents the time when the save trigger condition was met. For example, for a variable log file folder whose save trigger condition was met at 13:45:56 on January 2, 2023, it will be: 20230102134556 The time information is based on the Controller's clock.
VL_YYYYMMDDhhmmss.bin2	Variable log file • The YYYYMMDDhhmmss part of the filename is the same as for the variable log file folder. • Original format
VL_YYYYMMDDhhmmss.ini	Variable log information file • Original format
AutomationPlayBack.omapb (Unit version 1.72 or later)	(For system use)
PRJ\	Project backup folder • This folder is automatically created when a project backup file is saved.
NXBackup.dat AutoCommand.ini RestoreCommand.ini	Project backup files • Original format These are the same as the backup files created by Sysmac Studio Controller Backups when only **User program and settings** for the **CPU Unit** are selected as the target data.
Camera\	Video folder • This folder is automatically created when video data is saved.

Folder or file	Description
CL<Camera Settings Number>_YYYYMMDDhhmmss.mkv	Video file • The YYYYMMDDhhmmss part of the filename is the same as for the variable log file folder.
CL<Camera Settings Number>_YYYYMMDDhhmmss.xml	Video attribute file • The YYYYMMDDhhmmss part of the filename is the same as for the variable log file folder. • Original format
EventLog\	Event log folder • This folder is created automatically when an event log is saved.
EventLog_nnn.arc	Event log files • The nnn part of the file names is a 3-digit serial number starting from 001. New files are created every 10 MB. • Original format

2-6-4 Supported Video Data Formats for Playback

The specifications of video files that can be played using the Sysmac Studio are as shown in the table below.
Use cameras that can output video data conforming to these specifications.

Item	Specification	Remarks
Video codec	H.264	Profile level 5.1 or higher
Audio codec	AAC	
Container	MKV	

2-7 Checking Collected Variable Data

Try to run automation playback and check if it works as expected.

1 Check if automation playback works properly.
Open the Automation Playback Operation Monitor in the Sysmac Studio to see if automation playback works correctly. Refer to *7-3-1 Checking the Operation Status of Automation Playback* on page 7-13 for information on the Automation Playback Operation Monitor.
If automation playback does not work correctly, one of the following events occurs.
Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name	References in this manual
152C0000 hex	Variable Log Save Failed	*7-2-1 What to Do If Automation Playback Does Not Work* on page 7-3
35EF0000 hex	Automation Playback Startup Error	---
95770000 hex (This event occurs for the CPU Unit with unit version earlier than 1.65.)	Upper Limit of Variable Sampling	• When attached information 2 of the event is 0 or 1 *2-1-2 Upper Limit of Variable Data to Collect* on page 2-4 • When attached information 2 of the event is 2 *What to Do When Processing Capacity to Collect Variable Data Is Exceeded* on page 7-3
95790000 hex (This event occurs for the CPU Unit with unit version 1.65 or later.)	Upper Limit of Variable Sampling	
64040000 hex (This event occurs for the CPU Unit with unit version 1.68 or later.)	Upper Limit of Sampling Processing Capacity	*What to Do When Processing Capacity to Collect Variable Data Is Exceeded* on page 7-3

Additional Information

Events whose event level is observation level can be checked in the **Event Log** in the **Troubleshooting** dialog box of the Sysmac Studio.

2 Check if the concurrency in the variable log data is achieved.
Depending on the load of the task and the number and size of the variables to be sampled, all the necessary variable data may not be retrieved within the same task period. In such a case, the concurrency of the variable log data cannot be ensured, and one of the following events occurs. For version 1.68 or later, this information is also displayed in the Playback dialog box during playback.
Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name	References in this manual
64060000 hex	No Variable Log Concurrency	*7-2-2 What to Do If Data Concurrency Cannot be Ensured in Variable Logs* on page 7-5
64070000 hex	Cycle with No Variable Sampling	

3 Check if the time length of the output variable log meets your usage.
When the output of the variable log is complete, one of the following events occurs. The time length of the output variable log can be checked for the following events.
Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name	References in this manual
95780000 hex (This event occurs for the CPU Unit with unit version 1.65 or later.)	Variable Log Output Completed	*7-2-3 What to Do If Variable Logs Are Shorter Than the Set Time* on page 7-8
95750000 hex (This event occurs for the CPU Unit with unit version earlier than 1.65.)	Variable Log Output Completed	

Additional Information

The time length of variable logs that can be collected changes depending on the number and size of the sampled variables and how they change in each task period. Therefore, it may not always be possible to obtain variable logs of the set sampling time.

Version Information

Project unit version 1.68 or later allows you to check the estimated available sampling time in the Automation Playback Operation Monitor dialog box without the output of variable logs on the actual equipment in operation.
Note that the estimated available sampling time is only a guideline for the maximum length of time that can be recorded in a variable log.
Refer to *7-3-1 Checking the Operation Status of Automation Playback* on page 7-13 for details.

2-8 Configuring the Setting to Back Up the Project for Playback

To execute playback in the Sysmac Studio without the project on the computer, configure the setting to back up the project when variable data is collected.

For unit version 1.71 or later, by backing up your project, you can use the centralized data management function to automatically open the corresponding project in the Sysmac Studio when you select playback data. We recommend that you configure the setting to back up the project.

2-8-1 Timing to Back Up the Project

The timing to back up the project varies depending on the unit version.
The Controller will get a backup file of the project at the following timings.

- Unit version 1.70 or later
  Automation playback starts saving the variable log. *1
- Unit version earlier than 1.70
  Automation playback is started. *2

*1. The log output status of automation playback changes to Storing. Refer to *A-1-2 State Transitions in Variable Log Output Based on the Pre/Post Trigger Method* on page A-3 and *A-1-3 State Transitions in Variable Log Output Based on the Start/Save Trigger Method* on page A-5 for information on the state transition for log output of automation playback.
*2. The status of automation playback changes from Idle to Run. Refer to *A-1-1 State Transitions for Automation Playback Function* on page A-2 for details on the status of the automation playback.

2-8-2 Conditions That Must Be Met to Back Up the Project

For the Controller to get a project's backup file, several conditions must be met.
When all of the following conditions are met, the Controller will get the backup file for a project.

- Project backup is set to back up in the Automation Playback Settings.
  Refer to *2-8-3 Procedure for Configuring the Setting to Back Up the Project* on page 2-49 for information on the setting to back up the project.
- The project from which to collect variable data is not yet backed up by automation playback.
- **Data backup prohibition to the SD Memory Card**[*1] is set to **Do not use**.

*1. The setting for **Data backup prohibition to the SD Memory Card** is located in **Security Settings** from **Configurations and Setup** – **Controller Setup** – **Operation Settings** – **Basic Settings** in the Multiview Explorer.

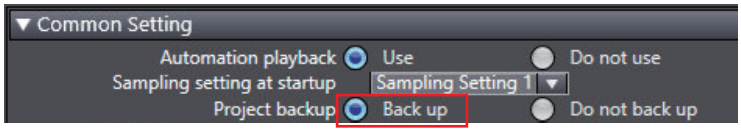
2-8-3 Procedure for Configuring the Setting to Back Up the Project

Enable project backup so that the project will be backed up when variable data is collected.
Make sure that the Sysmac Studio and the Controller are offline before you enable project backup.

1 Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

2 In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
The **Automation Playback Settings** display opens.

3 Select **Back up** for **Project backup** in **Common Setting**.



4 From the Synchronization window, transfer the Controller Setup to the CPU Unit.

Precautions for Correct Use

To enable project backup, you must set Prohibit data backup to the SD Memory Card to **Do not use**. Use the following procedure to set Prohibit data backup to the SD Memory Card.
In the Sysmac Studio, select the **Do not use** option for **Prohibit data backup to the SD Memory Card** in **Security Settings** under **Configurations and Setup** − **Controller Setup** − **Operation Settings** − **Basic Settings**.

2-8-4 Items for Project Backup

There is a setting that specifies whether or not to back up project data.

Item	Description	Setting range	Default
Project backup	Set whether or not to save the backup file to the playback data save destination at the start of variable data collection. You can use the backup file when the project is reproduced.	Back up or Do not back up	Back up

2-8-5 Specifications of Project Backup Data

The save destination, folder structure, file name, and file format of the project backup file are as shown in the table below.
Here, the specifications for unit version earlier than 1.71 are described. Refer to *2-6-3 Folder Structure and Files for Saving Playback Data* on page 2-45 for specifications for unit version 1.71 or later.

Item	Description	Remarks
Save destination	SD Memory Card mounted on the CPU Unit	

Item	Description	Remarks
Folder structure	\APB\(hash code)\PRJ\	• If the APB folder does not exist in the file output destination, an APB folder and lower folders will be created automatically when sampling of variables starts. • A hash code consists of a 32-byte string. You can get it with the GetPrgHashCode (Get Program Hash Code) instruction.
File name	NXBackup.dat, AutoCommand.ini, RestoreCommand.ini	
File format	Original format	

Additional Information

The format of the project backup file is as follows.
- Unit version 1.70 or later
  Same as the backup file created by Sysmac Studio Controller Backups when only **User program and settings** for the **CPU Unit** are selected as the target data
- Unit version earlier than 1.70
  Same as the backup file in SD Memory Card Backup

2-9 Specifying the Operation When Available Data Storage Space Gets Low

Specify whether to issue an event for notification when the available data storage space gets low and how much available space to maintain.
The setting method differs between unit version 1.71 or later and unit version earlier than 1.71.

2-9-1 Unit Version 1.71 or Later

Set the Controller's operation when the available storage space in the data save destination gets low in the **Playback data save location setting**.
Refer to *2-6 Setting the Playback Data Save Destination (Unit Version 1.71 or Later)* on page 2-39.

2-9-2 Unit Version Earlier Than 1.71

The data save destination storage is SD Memory Card.
Set the Controller's operation when the available space on the SD Memory Card gets low in **Common Setting** in the **Automation Playback Settings** display.

Types of Operation Specification Methods When the Available Space on the SD Memory Card Gets Low

There are two settings, i.e., **Ensure free space in SD Memory Card** that specifies how much available space to maintain on the SD Memory Card and **Alert for low space in SD Memory Card** that specifies at what level to issue an event when the available space on the SD Memory Card gets low.

Type	Description
Ensure free space in SD Memory Card	The Controller controls the available space on the SD Memory Card so that it does not fall below the amount set for this item. If the available space on the SD Memory Card is expected to fall below the amount set for this item when a new variable log file is output, the Controller automatically deletes files with older timestamps in the APB folder and lower-level folders on the SD Memory Card to secure available space. If the Controller performs control based on this setting, the Variable Log Overwritten event (95760000 hex) will occur.
Alert for low space in SD Memory Card	This is a function that warns of a situation where the available space on the SD Memory Card is getting low by means of an event. The Controller generates the Capacity Warning of Variable Log Save Destination event (64050000 hex) when the available space on the SD Memory Card falls below the amount set for this item. You can change the event level to Minor Fault although the default setting is Observation.

Procedure for Specifying the Operation When the Available Space on the SD Memory Card Gets Low

Set the operation to perform when the available space on the SD Memory Card gets low in **Ensure free space in SD Memory Card** and **Alert for low space in SD Memory Card**.

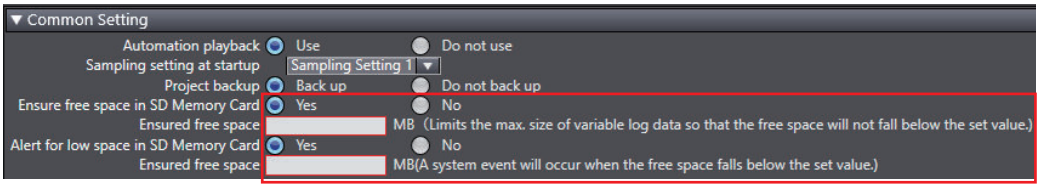
To change the operation settings when the available space on the SD Memory Card gets low, the Sysmac Studio and the Controller must be offline.

1 Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

2 In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
The **Automation Playback Settings** display opens.

3 In **Common Setting**, select **Yes** for **Ensure free space in SD Memory Card** and **Alert for low space in SD Memory Card**.

4 For each item for which you selected **Yes** in step 3, enter the size of available space to specify in **Ensured free space**.



5 From the Synchronization window, transfer the settings to the CPU Unit.

Items for Specifying the Operation When the Available Space on the SD Memory Card Gets Low

There are two settings, i.e., **Ensure free space in SD Memory Card** and **Alert for low space in SD Memory Card**.

Item		Description	Setting range	Default
Ensure free space in SD Memory Card		Select whether to set available storage space to secure available space on the SD Memory Card.	Yes or No	No
	Ensured free space	Set the available storage space to secure. When this item is not specified, the Controller will delete old files to secure available space if the storage space is expected to get low.	None, or numeric value between 1,024 and 4,096 (MB).	None
Alert for low space in SD Memory Card		Select whether to warn the user when the available space on the SD Memory Card gets low.	Yes or No	No
	Ensured free space	Set the threshold of available storage space at which to issue a warning. When not set, you will not be warned if available storage space gets low.	None, or numeric value between 1,024 and 4,096 (MB).	None

Precautions for Correct Use

- It is not possible to set the value of **Alert for low space in SD Memory Card** to be less than or equal to the value of **Ensure free space in SD Memory Card**.
- If a value that exceeds the total capacity of the SD Memory Card is set for both **Ensure free space in SD Memory Card** and **Alert for low space in SD Memory Card**, the Controller will operate as if they were not set.

2-10 Changing Variable Data Sampling Setting While the Controller is in RUN Mode

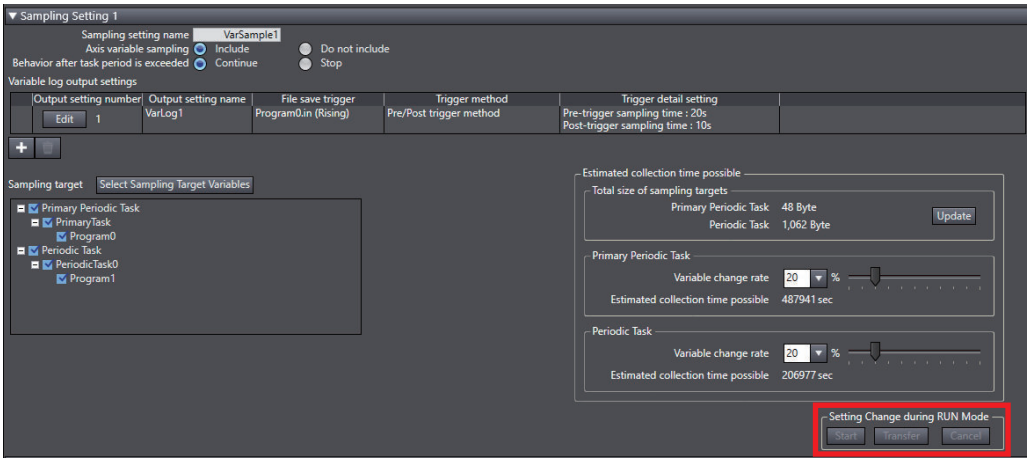
You can change the variable data to be collected without stopping the Controller operation.

Version Information

The function to change the setting of variable data collection while the Controller is running can be used with the CPU Unit with unit version 1.65 or later.

2-10-1 Procedure for Modifying Variable Data Sampling Setting While the Controller is in RUN Mode

You can edit the settings in **Sampling setting** and transfer them while the Controller is running.
After the settings are transferred, the Controller performs sampling with the changed settings.
You can modify the settings for **Sampling Setting 1** and **Sampling Setting 2** individually with the operation buttons in the **Setting Change during RUN Mode** section.



Common Setting cannot be changed.

Precautions for Correct Use

To perform this procedure, **Automation playback** in the **Common Setting** must be set to **Use**.

1. Place the Sysmac Studio online with the Controller.

2. Click the **Start** button for **Setting Change during RUN Mode** in the **Sampling Setting 1** or **Sampling Setting 2** for which you want to change the settings.
Sampling setting can now be edited.

3. Edit the settings for variable data collection.
To cancel the changes, click the **Cancel** button. Changes are discarded and setting change during RUN Mode is cancelled.

4 Click the **Transfer** button.

When the transfer of sampling setting is complete, the following message is displayed.

"Setting change during RUN Mode was successfully completed. Sampling starts with the transferred settings. "

Sampling during execution stops, and sampling restarts with the transferred settings. Data of sampling that was stopped during execution is discarded.

Precautions for Correct Use

- If an error message appears when you click the **Start** or **Transfer** buttons, follow the instruction of the message.
- If the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed while the edited sampling settings are being transferred, the Sampling Setting used will not be changed. At this time, an Input Mismatch (54010401 hex) event occurs.

2-11 Additional Information about Automation Playback Settings

Additional information about automation playback settings is as follows.

Security-related Information

- Users with Maintainer or higher authority are allowed to change Automation Playback Settings. Refer to the *NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)* for information on the operation authority verification.
- To meet the security requirements specified for your operational environment, assign access permissions so that the appropriate users can check the contents of the user program.
- When the settings are changed and synchronized, the Automation Playback Settings Changed event (95720000 hex) is registered.
- Settings related to automation playback are subject to the complete data erasure function. Refer to the *NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)* for information on the complete data erasure function.

Version-related Information

- If you change from a model or unit version that supports automation playback settings to a model or unit version that does not support Automation Playback Settings, the automation playback setting data will be deleted from the project. If you change to a new model or unit version that supports Automation Playback Settings, the automation playback setting data will be returned to the defaults.

3

Capturing Video Using the Camera Control Function

Using the camera control function enables you to save video data in synchronization with variable data collection.
You can play the saved video data in synchronization with the variable data while executing playback. This allows you to visually check how the system operated when a problem occurred, which is useful for troubleshooting.

The camera control function is available on the CPU Unit with unit version 1.71 or later. To use camera control on the CPU Unit with unit version earlier than 1.71, create a user program. A sample program for creating video data using a user program can be downloaded from the following URL. Or, contact your OMRON representative.
https://www.ia.omron.com/product/tool/nx5_apb/download.htm

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3-1 Specifications of the Camera Control Function

The camera control function instructs network cameras to save video data in synchronization with variable data collection. With simple settings, you can save video data according to the timing of variable data collection.

Version Information

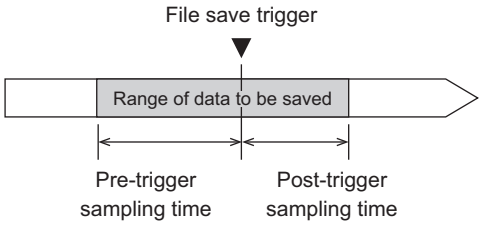
The camera control function is available with unit version 1.71 or later.
To use camera control on the CPU Unit with unit version earlier than 1.71, create a user program. A sample program for creating video data using a user program can be downloaded from the following URL. Or, contact your OMRON representative.
https://www.ia.omron.com/product/tool/nx5_apb/download.htm

3-1-1 Number of Cameras That Can Be Used Simultaneously

The camera control function supports up to 10 cameras for simultaneous use.
While it allows you to configure up to 32 camera control settings, only 10 of them can be enabled at the same time. By enabling 10 camera control settings, you can use 10 cameras.

3-1-2 Operation of Camera Control

In the camera control settings, assign the trigger for saving video data by specifying a data collection output setting number. When the trigger for the assigned output setting number changes to TRUE, video data is saved using the Pre/Post trigger method.
Video data in the same range as the save target range set for the assigned output setting number for data collection is saved to a file.



Precautions for Correct Use

The start/save trigger method does not allow video data collection. To collect video data using the camera control function, use the pre/post trigger method.

3-2 Flow of Using the Camera Control Function

Configure the camera control function settings for network cameras and the Controller, and operate the Controller in RUN Mode to save video data. Then, execute playback to check the video.

The flow of using the function is shown below. Several tools are required.

Precautions for Correct Use

In the camera control settings, you must assign the trigger for the pre/post trigger method as the condition for saving video data. Configure in advance variable data collection with trigger settings for the pre/post trigger method. If you assign a trigger for the start/save trigger method, video will not be captured.

No.	Procedure	Description	Tools used	Reference
1	Configuring network camera settings	Configure user account settings, network settings, and video settings including the frame rate setting for the camera. Refer to *A-6 Cameras That Have Been Tested for Operation* on page A-19 for a list of cameras that have been tested for operation. Update the OS of your cameras based on the OS versions that have been tested for operation. Refer also to *Precautions for Correct Use* below.	Network camera configuration tool	Refer to the manual for your cameras.
2	Enabling the camera control function	Enable the camera control function of the Controller.	Sysmac Studio	*3-3 Enabling the Camera Control Function* on page 3-5
3	Configuring the camera control function	Configure the camera control function of the Controller.	Web UI of the CPU Unit	*3-4 Configuring the Camera Control Function* on page 3-8
4	Operating the system and equipment	Operate the Controller in RUN Mode.	---	---
5	Executing playback	Execute playback and check the variable log and video to identify the causes of problems.	Sysmac Studio	*Section 4 Executing Playback* on page 4-1 *Section 6 Checking Time Series Variable Values, Videos, and HMI Screens Using Playback* on page 6-1

Precautions for Correct Use

This is a note for step 1 above, *Configuring network camera settings*.

- Video files for the camera control function are saved in the output folder specified in the **Playback data save location setting** and lower-level folders. There is no need to configure the destination storage using the network camera settings tool, since it is specified by the camera control function for the network camera.
- To change the user names and passwords for network cameras, log in to the Web UI of the CPU Unit and change them on the **Camera Settings** screen.

3-3 Enabling the Camera Control Function

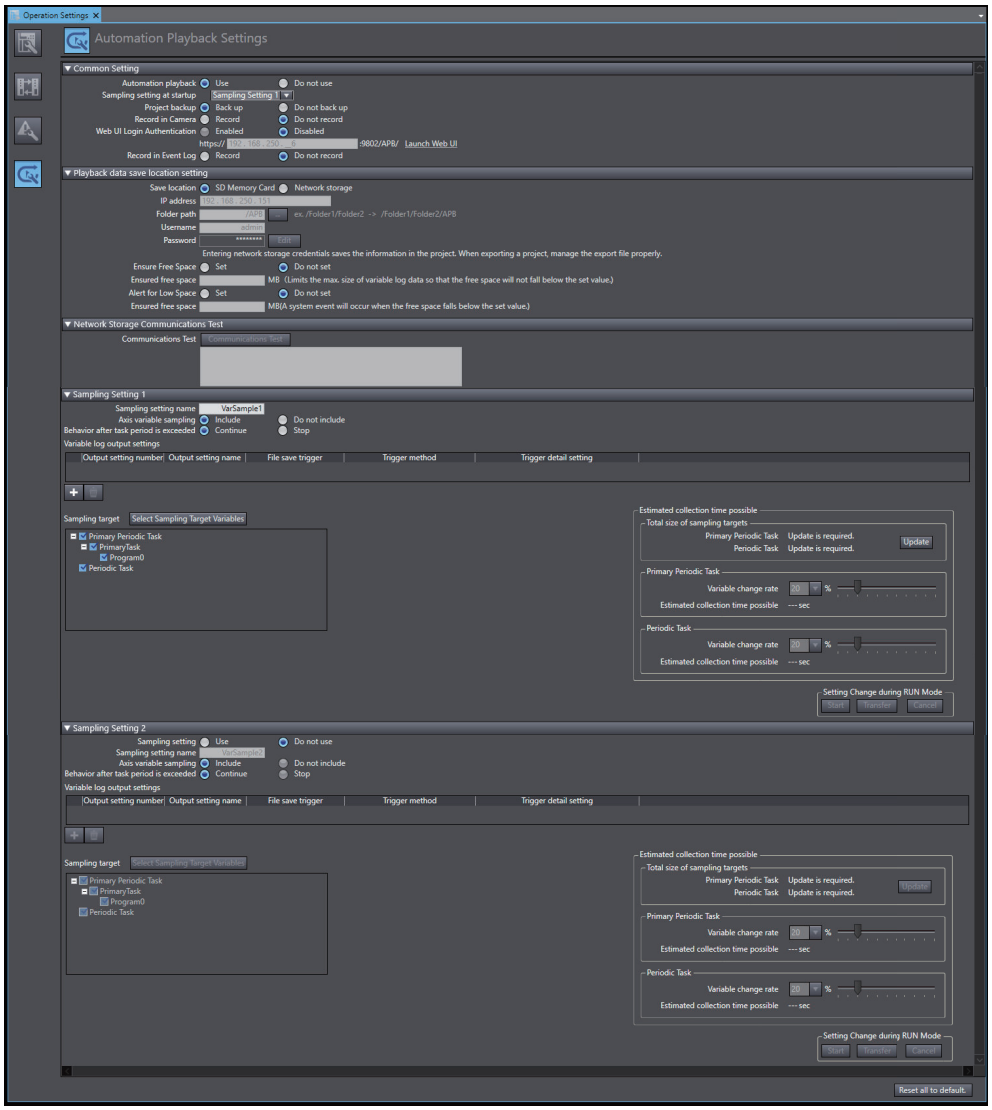
After configuring camera control settings and output settings in the Web UI, enable the camera control function to capture video according to the trigger.

3-3-1 Procedure for Enabling the Camera Control Function

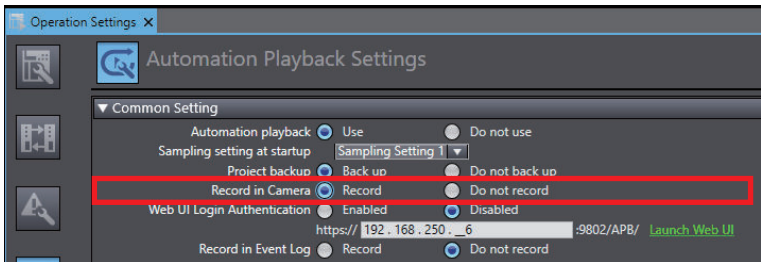
Enable video capturing (camera recording) in the Sysmac Studio.
Make sure that the Sysmac Studio and the Controller are offline before you enable video capturing.
The following procedure assumes that Automation playback is already set to **Use**. Set Automation playback to **Use** if it is not set to **Use**.

1. Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

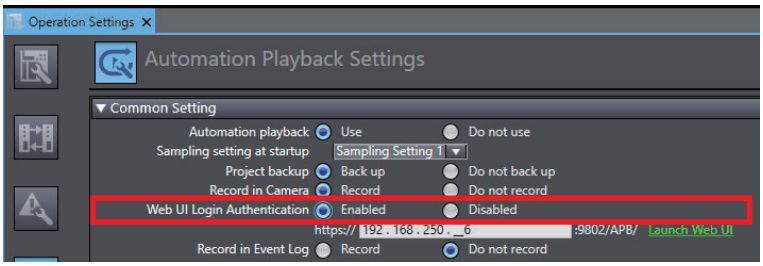
2. In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.
   The **Automation Playback Settings** display opens.



3 Select **Record** for **Record in Camera** in **Common Setting**.



4 To perform login authentication using the Web UI for camera settings, select **Enabled** for **Web UI Login Authentication**.



Refer to *3-4 Configuring the Camera Control Function* on page 3-8 for the Web UI for camera settings.

Version Information

With Sysmac Studio version 1.68 or higher, you can connect to the Web UI from the **Launch Web UI** link text. Refer to *3-4 Configuring the Camera Control Function* on page 3-8 for details.

Precautions for Correct Use

To use the Web UI with login authentication disabled, implement security measures such as controlling access to the area where the Controller is installed or physically locking the area.

5 From the Synchronization window, transfer the Controller Setup to the CPU Unit.

6 Restart the CPU Unit.

3-4 Configuring the Camera Control Function

Configure the camera settings so that you can use the camera control function.
To configure these settings, use the Web UI of the CPU Unit. Connect to the Web UI using a browser to display the setting screen.
Refer to *A-7 Browsers That Have Been Tested for Operation* on page A-21 for a list of browsers that have been tested for operation.

3-4-1 Procedure for Configuring the Camera Control Function

Log in to the Web UI of the CPU Unit and configure each setting of the camera control function.

Precautions for Correct Use

You can connect to the Web UI only via the built-in EtherNet/IP port.
You cannot connect to the Web UI unless the camera control function is enabled. Make sure that the camera control function is enabled before you connect to the Web UI.

Before you configure these settings, refer to the manuals for your network cameras and perform the following settings using the configuration tool for the network cameras.

- User account registration
- IP address and other network settings

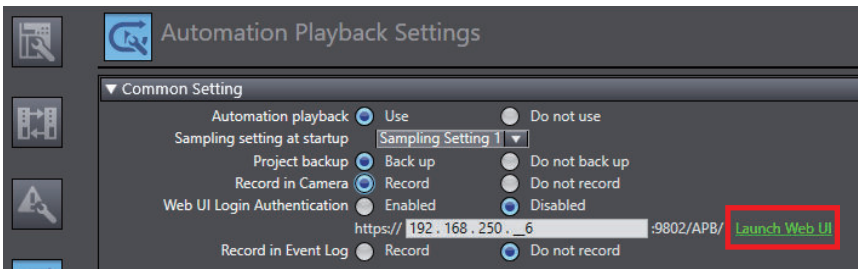
1 Connect the computer to the built-in EtherNet/IP port on the CPU Unit with an Ethernet communications cable.

2 Start a browser on the computer.

3 Enter the URL of the Web UI into the browser and press the Enter key.
The URL is as follows.
https://<IP address of the built-in EtherNet/IP port to which the computer is connected>:9802/APB/

Version Information

With Sysmac Studio version 1.68 or higher, you can also access the Web UI by clicking the **Launch Web UI** link text under **Automation Playback Settings** – **Common Setting**.



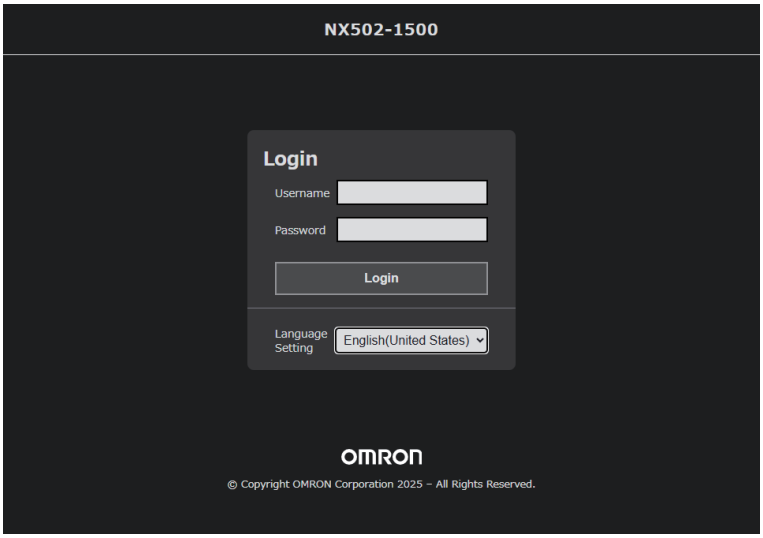
The IP address of the connection destination is set to the IP address configured in the communication settings of Sysmac Studio as default. Change the IP address as needed. If a different IP address other than that of the destination CPU Unit is set, an error message indicating that the connection cannot be established will be displayed in the browser after clicking the **Launch Web UI** link text.

Precautions for Correct Use

Before you connect the computer, change the IP address of the computer to an IP address in the same segment as the IP address of the EtherNet/IP port to connect to.
For example, if you are connecting to EtherNet/IP port 1 with the default IP address (192.168.250.1), set the IP address of the computer to 192.168.250.10, 192.168.250.11, etc., so that it does not conflict with EtherNet/IP port 1 or other devices.

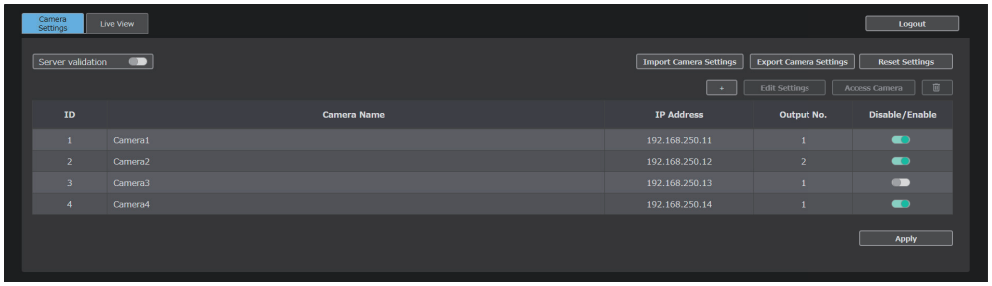
If login authentication for the Web UI is enabled in the camera settings, the Web UI login screen will be displayed. Enter your user name (user ID) and password. For the user name (user ID), use the user account registered in the CPU Unit. If login authentication for the Web UI is disabled in the camera settings, the Web UI login screen will not be displayed.

Refer to *User Authentication* in the *NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)* for information on user accounts.
Refer to *3-3-1 Procedure for Enabling the Camera Control Function* on page 3-5 for enabling and disabling login authentication using the Web UI for camera settings.



The Web UI screen is displayed.

4 Configure the camera control function settings on the **Camera Settings** screen.



3-4-2 Setting Items for the Camera Control Function

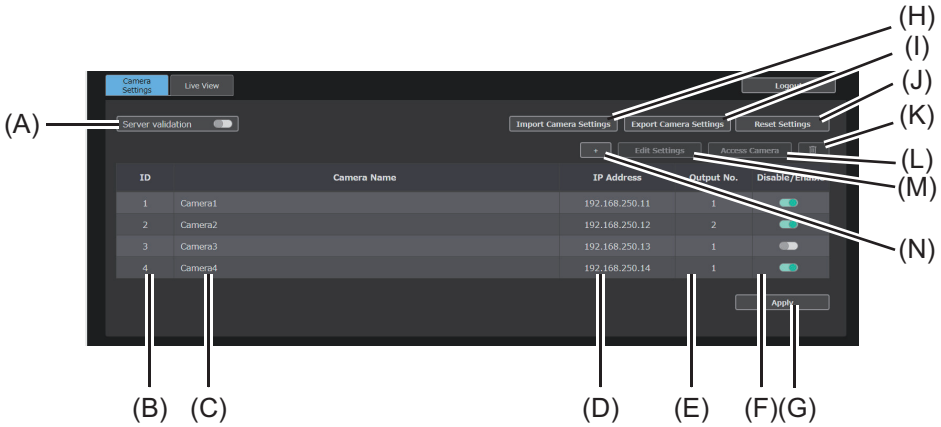
The setting items for the camera control function include camera settings for controlling cameras from the CPU Unit.

Precautions for Correct Use

Since the web UI requires different operation authority depending on the function, the screen displayed and the UI operations that can be performed vary depending on the operation authority. Refer to *3-6 Operation Authority for the Web UI* on page 3-16 for information on the required operation authority.

Items on the Camera Settings Screen

These settings enable the CPU Unit to control cameras.
The items displayed on the **Camera Settings** screen are described below. Each row represents one camera control settings.
Note that the following settings screen is provided mainly for checking purposes and therefore does not allow setting changes except for some items. To change the settings, click the **Edit Settings** button to display the Edit Camera Settings screen.



Sym-bol	Item	Description
A	**Server validation** toggle switch	This switch enables or disables server validation during camera connection. When server validation is enabled, validation will fail if the connection destination is not a camera, and the Controller will not connect to the camera. This enhances security because connection fails if the destination has been replaced with another device. If connection fails, the Camera Connection Failed event (95A40000 hex) occurs. Connections using server validation are available for AXIS cameras with OS version between 10 and 12. Connection will fail when server validation is enabled for other cameras.
B	Setting number	This is the number for the camera control settings. It is automatically assigned in ascending order.
C	Camera name	This indicates the camera name set on the Edit Camera Settings screen.
D	IP address	This indicates the IP address of the connection target camera set on the Edit Camera Settings screen.
E	Output setting number	This indicates the output setting number that you set on the Edit Camera Settings screen. It is the output setting number for the data collection settings serving as the trigger for saving video data.
F	**Disable/Enable** toggle switch	This check box enables or disables the camera control settings. Select the check box to enable the settings. You can enable up to 10 camera settings.
G	**Apply** button	Click this button to register the configured settings in the CPU Unit. Changes made on the Edit Camera Settings screen are not reflected in the CPU Unit until you click this button. If you log out of the Web UI without registering the settings, your edits will be discarded.
H	**Import Camera Settings** button	Click this button to import camera control settings from a file. Use this button to restore settings from a backup file that was created by exporting the settings. In addition, when there are many camera control settings, you can efficiently configure the settings by creating a file (named APBCameraSetting.csv) containing all the settings and importing the file.
I	**Export Camera Settings** button	Click this button to write the camera control settings to a file. Use this button to make a backup of the settings, for example. **Note** Camera settings are excluded from Controller backups. Use this button to back up these settings.
J	**Reset Settings** button	Click this button to erase all the camera settings configured on the CPU Unit.
K	Delete Row button	Use this button to delete the settings for the selected row.
L	**Access Camera** button	Click this button to access the camera at the specified IP address and open its settings in your browser. This button is available for cameras that support configuration using a web browser. To use this function, connect the cameras and the computer from which to use the Web UI to the same network. You cannot use the function if they are connected to different networks.
M	**Edit Settings** button	Use this button to change the settings. Clicking the button displays the Edit Camera Settings screen.
N	Add Row button	Use this button to add camera control settings. You can register up to 32 camera control settings.

Precautions for Correct Use

Take appropriate measures to configure and manage the exported camera settings file to prevent unauthorized use by others.

● Format for Camera Control Settings Export/Import Files

The CSV file format for camera control settings is as follows.
There are the following two files.

APBCameraSetting.csv

The listed items are the setting number, camera name, IP address, output setting number, and comment. An example is shown below.

```
id, Enable, CameraName, IPAddress, OutputNumber, Comment
1, true, 192.168.250.1, 1, comments
2, false, 192.168.250.100, 3
```

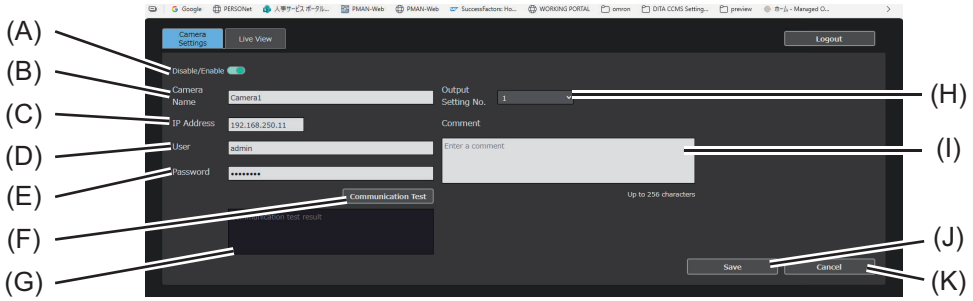
APBCameraAuthentication

The listed items are the user and password. They are listed in encrypted form.

You cannot import CSV files in different formats.

Items on the Edit Camera Settings Screen

These are the camera settings items displayed by clicking the **Edit Settings** button on the **Camera Settings** screen.
Each item is described below.



Symbol	Item	Description
A	**Disable/Enable** toggle switch	This check box enables or disables the camera control settings. Select the check box to enable the settings.
B	Camera Name	Enter any camera name. You can enter up to 256 characters. Available characters are those defined by the UTF-8 character encoding.
C	IP Address	Enter the IP address of the connection target camera. It must be entered in the format of “192.168.250.20”. You cannot set a duplicate IP address with other camera control settings.

Sym-bol	Item	Description
D	User	Enter the user name set for the connection target camera. You can enter up to 64 characters. Available characters are the following ASCII characters with byte codes 0x20 to 0x7E. Single-byte space, 0 to 9, A to Z, a to z, and ! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` { | } ~
E	Password	Enter the user password set for the connection target camera. You can enter up to 64 characters. Available characters are the following ASCII characters with byte codes 0x20 to 0x7E. Single-byte space, 0 to 9, A to Z, a to z, and ! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` { | } ~
F	**Communication Test** button	Click this button to perform a communications test with the network camera.
G	Communications test result display field	This field displays the communications test result. If communications are successful, "Communications test successful" is displayed. If the connection fails, an error message is displayed. Refer to *7-5-1 Error Messages and Corrective Actions in Camera Communications Tests* on page 7-21, and take corrective actions.
H	Output Setting No.	It is the output setting number for the data collection settings serving as the trigger for saving video data. Select from the following: • 1 • 2 • 1 and 2 (Default) You can select only output setting numbers for which the trigger method is set to Pre/Post trigger method.
I	Comment	Enter any comment. You can enter up to 256 characters. Available characters are those defined by the UTF-8 character encoding.
J	**Save** button	Click this button to save your edits and close the Edit Camera Settings screen.
K	**Cancel** button	Click this button to discard your edits and close the Edit Camera Settings screen.

3-5 Checking Video from Cameras in the Live View

You can display a live view of the video from the cameras configured in the Web UI.
Use this function when you check the on-site scenes through the Web UI, for example.

Precautions for Correct Use

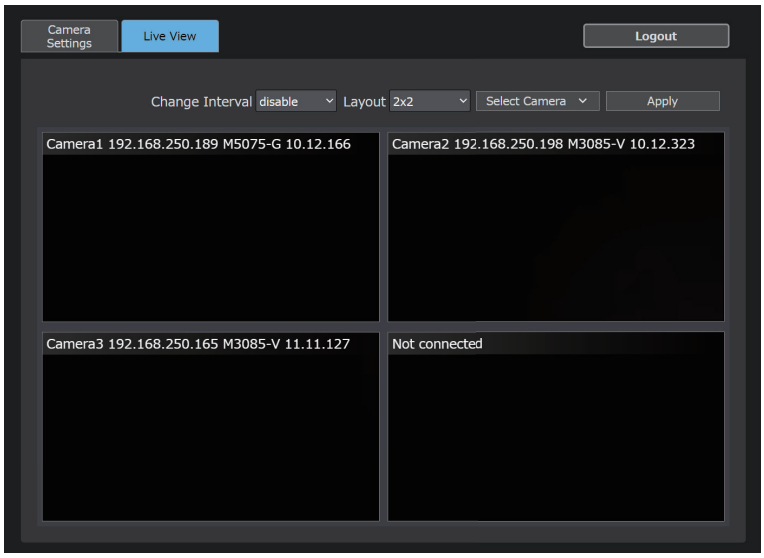
To display the live view, connect the cameras and the computer using the Web UI to the same network. You cannot display the live view if they are connected to different networks.

3-5-1 Procedure for Checking Video from Cameras in the Live View

Display the live view from the cameras on the **Live View** screen of the Web UI.

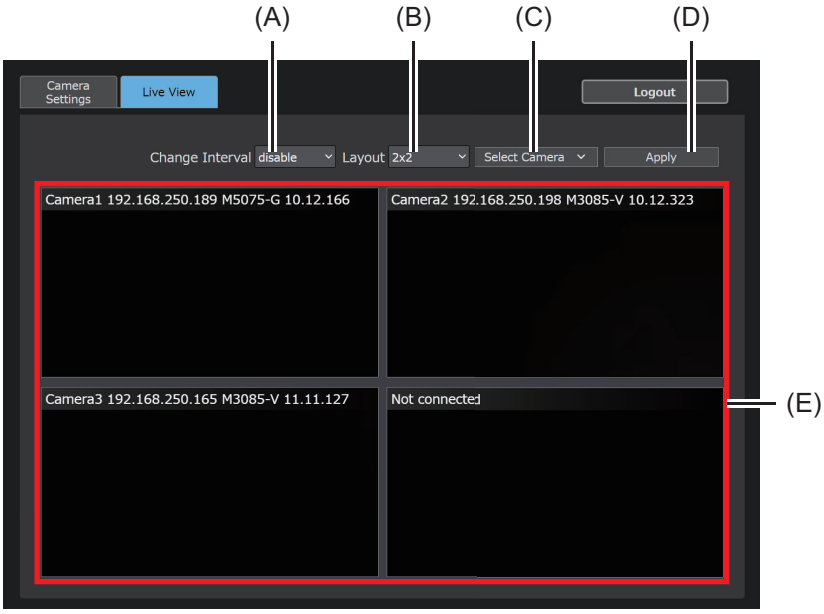
1 Display the Web UI screen.
Refer to the procedure up to step 4 in *3-4-1 Procedure for Configuring the Camera Control Function* on page 3-8 for information on how to display the Web UI screen.

2 Click the **Live View** tab.
The Live View screen is displayed.



3-5-2 Setting Items on the Live View Screen

This screen sets the refreshing interval and number of displayed cameras displayed in the live view.
The items displayed on the **Live View** screen are described below.



Sym-bol	Item	Description
A	**Change Interval** drop-down list	Select the refresh interval for the live view. You can select from the following options. • Disable (Default) • 10 seconds • 30 seconds • 1 minute
B	**Layout** drop-down list	Select the number of divisions (cameras) of the live view display area. You can select from the following options. • 1 × 1 (Default) • 2 × 2 • 3 × 3 • 2 × 5 If the number of cameras (camera control settings) selected in the **Select Camera** drop-down list is larger than the number of cameras set here, the displayed cameras will change with each refresh.
C	**Select Camera** drop-down list	Select the cameras to display in the live view. You can select from cameras that are enabled.
D	**Apply** button	Click this button to apply the selected settings to the live view.
E	Live view display area	This area displays the live view. The number of screens selected in the **Layout** drop-down list will be displayed. Each screen will also display the following information. • Camera name • IP address of the camera • Model of the camera • OS version of the camera

3-6 Operation Authority for the Web UI

To perform operations in the Web UI, you need operation authority.
The required operation authority is different depending on the function. Make sure that users with the required operation authority perform the operations.
However, when user authentication for the Controller is disabled, the Web UI does not prompt the user name and password, allowing all users to perform all operations.

The table below provides an overview of the scope of operations allowed in the Web UI for each operation authority.

Operation authority	Overview of the scope of operations allowed in the Web UI
Administrator	Can perform all operations.
Designer	Can perform all operations.
Maintainer	Can relocate, add, and check the connection of cameras.
Operator	Can view video from cameras in the live view. Can activate and deactivate cameras.
Observer	Can view video from cameras in the live view.

The table below shows whether each operation is allowed/disallowed or not displayed for each operation authority.

(○: Operation allowed, ×: Operation not allowed, ---: Not displayed)

Screen/Operation	Administrator	Designer	Maintainer	Operator	Observer
Displaying the Camera Settings screen	○	○	○	○	---
Enabling and disabling server validation	○	○	○	×	×
Activating and deactivating cameras	○	○	○	○	---
Adding camera settings	○	○	○	×	---
Editing camera settings	○	○	○	×	---
Deleting camera settings	○	○	○	×	---
Exporting camera settings to a file	○	○	×	×	---
Importing camera setting files	○	○	×	×	---
Initializing camera settings	○	○	×	×	---
Applying camera settings to the Controller	○	○	○	○	---
Connecting to web cameras	○	○	○	○	---
Displaying the Live View screen	○	○	○	○	○
Changing and applying the Display refresh, Display format, and Select cameras to display settings	○	○	○	○	○

4

Executing Playback

To execute playback, read the data collected by the Controller into the Sysmac Studio and then start playback.

4-1 Copying Playback Data to a Computer 4-2
4-1-1 How to Copy Playback Data from an SD Memory Card to a Computer 4-2
4-1-2 Data to Copy 4-2
4-1-3 Procedure for Copying Playback Data from an SD Memory Card to a Computer Using the Sysmac Studio Function 4-3

4-2 Starting Playback 4-5
4-2-1 Procedure for Starting Playback 4-5
4-2-2 Items in the Start Playback Dialog Box (Unit Version 1.71 or Later) 4-6
4-2-3 Items in the Start Playback Dialog Box (Unit Version Earlier Than 1.71) 4-9
4-2-4 How to Shorten the Time to Reload the Variable Log File That Has Been Loaded Once 4-11
4-2-5 Automatic Screen Display at Playback Start (Sysmac Studio Version 1.68 or Higher) 4-11

4-3 Restoring the Project When There Is No Project Corresponding to the Variable Log 4-13
4-3-1 Procedure for Restoring the Project File from Playback Data (Unit Version 1.71 or Later) 4-13
4-3-2 Procedure for Restoring the Project File from Playback Data (Unit Version Earlier Than 1.71) 4-13

4-4 Ending the Playback 4-15
4-4-1 Procedure for Ending the Playback 4-15

4-1 Copying Playback Data to a Computer

To execute playback using playback data, first copy the playback data to a computer.
If the playback data is saved to network storage, check the data to copy as described in *4-1-2 Data to Copy* on page 4-2, and then use the Windows function to copy it.

Additional Information

If the playback data is saved to network storage, you can directly specify the saved playback data for playback. However, since this may reduce the stability of playback depending on network performance, we recommend copying the playback data to a computer before playing it.

Refer to *4-1-1 How to Copy Playback Data from an SD Memory Card to a Computer* on page 4-2 if the playback data is saved to an SD Memory Card mounted on the CPU Unit.

4-1-1 How to Copy Playback Data from an SD Memory Card to a Computer

One method to copy playback data to a computer on which the Sysmac Studio is installed is using the Sysmac Studio function.
Other methods to do so include using the Windows function to copy it to an SD Memory Card mounted on the computer or using the FTP server to copy it to the computer.

For how to use the FTP server to copy playback data to a computer, refer to the *NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)*.

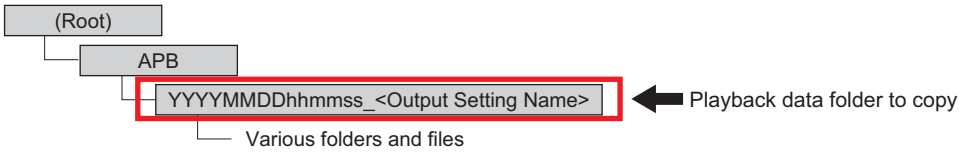
4-1-2 Data to Copy

The playback data to copy to the computer for playback varies depending on the unit version.

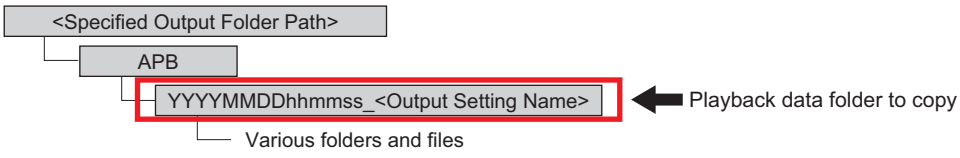
Data to Copy (Unit Version 1.71 or Later)

For unit version 1.71 or later, copy the folder one level lower than the APB folder, which is the playback data save destination.

- When the playback data save destination is SD Memory Card
  Copy the playback data folder created under the APB folder on the SD Memory Card mounted on the CPU Unit.

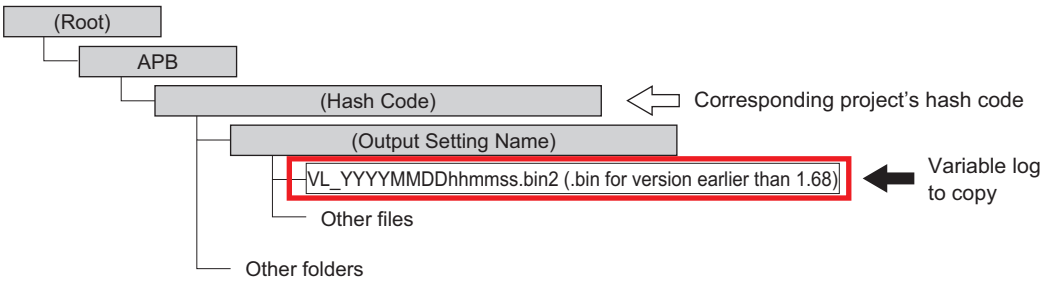


- When the playback data save destination is network storage
  Copy the playback data folder created under the APB folder under the specified output folder path.



Data to Copy (Unit Version Earlier Than 1.71)

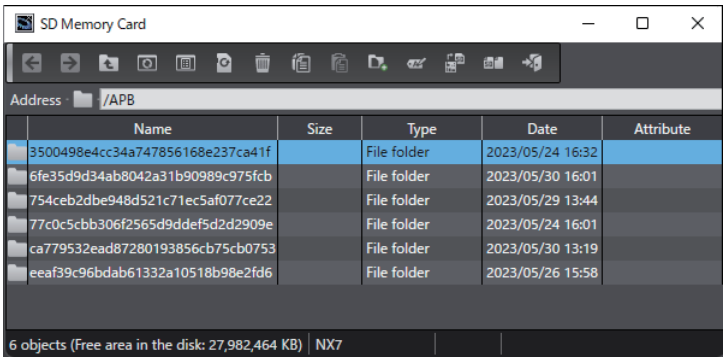
For unit version earlier than 1.71, copy the variable log file located in the Hash Code folder under the APB folder on the SD Memory Card.



4-1-3 Procedure for Copying Playback Data from an SD Memory Card to a Computer Using the Sysmac Studio Function

Copy playback data from the SD Memory Card on the Controller to the computer on which the Sysmac Studio is installed.
You can copy playback data when the Sysmac Studio is online with the Controller.

1 Select **Automation Playback** – **Get Variable Log from Controller** from the **Tools** menu of the Sysmac Studio.
The **SD Memory Card** dialog box is displayed.



If the APB folder, which is the automation playback data folder, does not exist on the SD Memory Card, an error message will appear after this dialog box is displayed.

2 In the **SD Memory Card** dialog box, select and copy the data to copy as described in *4-1-2 Data to Copy* on page 4-2.

3 Paste it into any folder in Windows Explorer.
The variable logs are copied to the specified folder.

Additional Information

A program hash code is used to check the link between variable logs and projects. For unit version earlier than 1.71, select the variable log whose program hash code matches. If the program hash code does not match, data may not be played correctly. The current project's program hash code is displayed in the **Start Playback** dialog box. Refer to *4-2-3 Items in the Start Playback Dialog Box (Unit Version Earlier Than 1.71)* on page 4-9 for information on the **Start Playback** dialog box.
For unit version 1.71 or later, selection of data by the hash code is not performed because folder names do not contain hash codes. By backing up your project, you can use the centralized data management function to automatically open the corresponding project in the Sysmac Studio when you select playback data. We recommend that you configure the setting to back up the project.

4-2 Starting Playback

Start playback using the variable logs and video data that you copied to the computer.
When playback starts, the Sysmac Studio enters playback mode. Refer to *5-7 Restrictions during Execution of Playback* on page 5-13 for operations that you cannot perform in playback mode.

4-2-1 Procedure for Starting Playback

Specify the data to play back and start playback function.
To start playback function, the Sysmac Studio and the Controller must be offline.

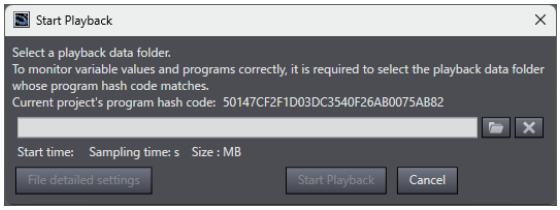
1 Open the project to use for playback in the Sysmac Studio.

2 Select **Automation Playback** – **Start Playback** from the **Tools** menu of the Sysmac Studio.

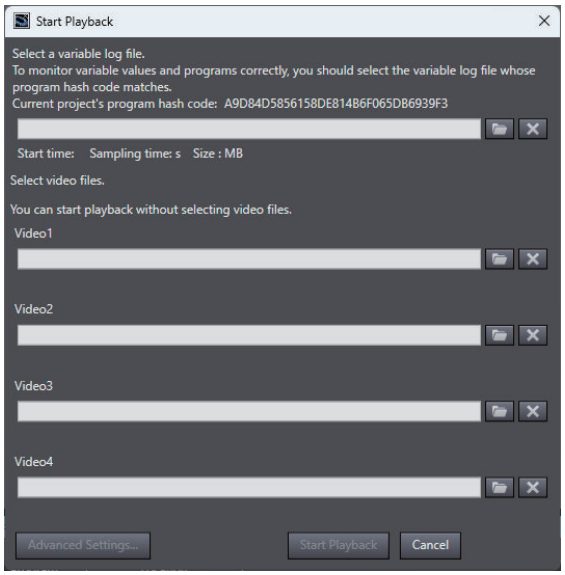
Or, click the **Start Playback** icon ( ) in the toolbar.

The **Start Playback** dialog box is displayed.

- Unit Version 1.71 or Later



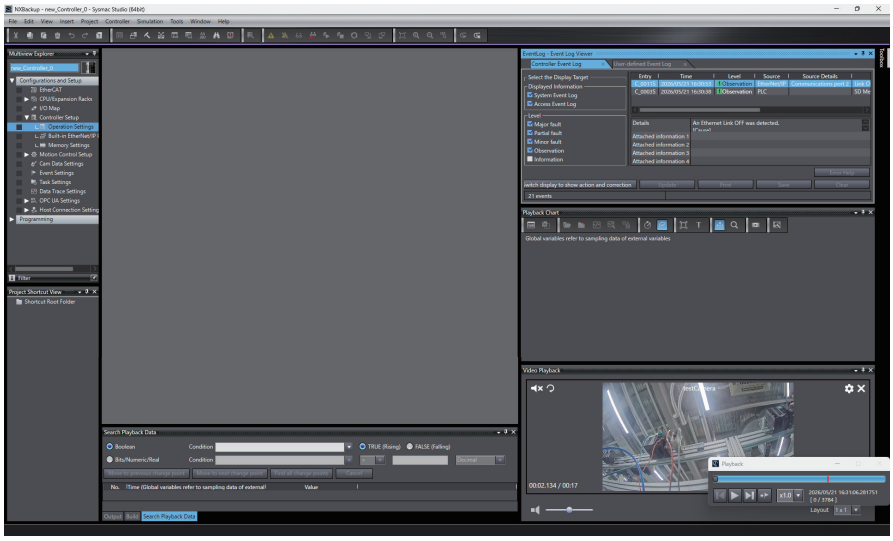
- Unit Version Earlier Than 1.71



3 In the **Start Playback** dialog box, specify the playback data folder (unit version 1.71 or later) or specify the variable log and video data (unit version earlier than 1.71) to use for playback.

4 Click the **Start Playback** button.

After a display or the **Starting Playback...** dialog box, the **Playback** dialog box and the **Search Playback Data** tab page are displayed. When video data is specified, the **Video Playback** window is displayed. In addition, some windows will be displayed showing data according to the specified method.



The top of the Edit pane is shown in purple.

Additional Information

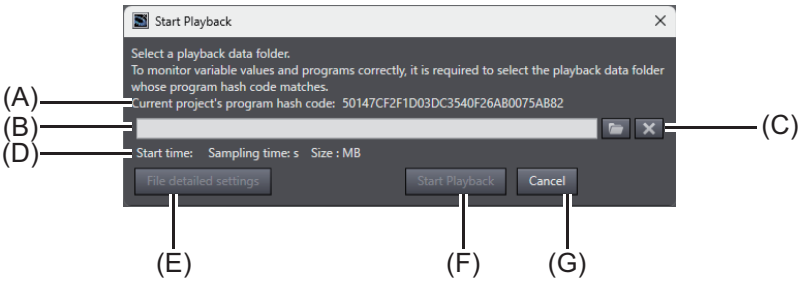
- The **Controller Status** pane is not displayed during execution of playback function.
- The **Search Playback Data** tab page is displayed in a floating state, separate from the Sysmac Studio window. You can cancel the floating state and place it in the window, and bring it back to the floating state again. Refer to the Sysmac Studio Version 1 Operation Manual (Cat. No. W504) for details.

Version Information

With Sysmac Studio version 1.68 or higher, when playback starts, the playback chart and other screens will also be displayed automatically. Refer to *4-2-5 Automatic Screen Display at Playback Start (Sysmac Studio Version 1.68 or Higher)* on page 4-11 for details.

4-2-2 Items in the Start Playback Dialog Box (Unit Version 1.71 or Later)

The Start Playback dialog box allows you to select a variable log.
For unit version 1.71 or later, the items in the **Start Playback** dialog box are as shown in the table below.



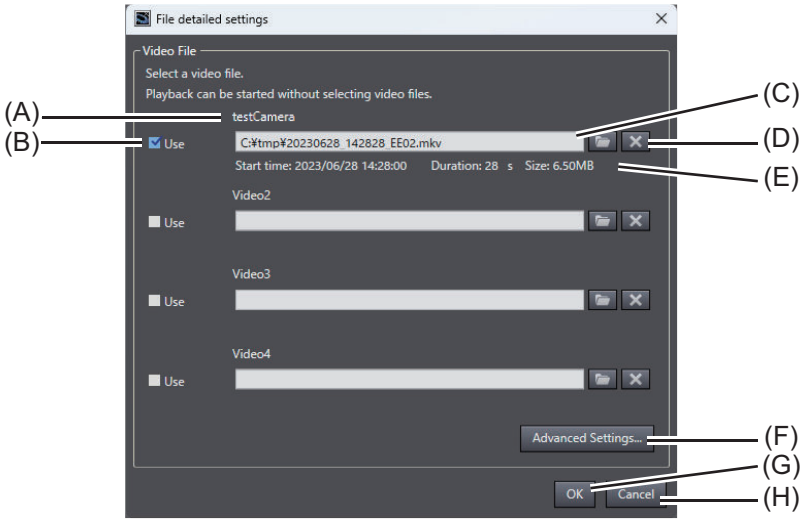
Symbol	Item	Description
A	Current project's program hash code	The program hash code for the current project is displayed. If the selected playback data does not match the current project's program hash code, the project backup data corresponding to the selected playback data can be opened.
B	Playback data folder path	Specify the path to the playback data folder to play in the project currently open.*1 Click the button and select the folder in the Open dialog box of Windows. **Note** When you directly specify playback data saved to network storage for playback, the Controller may not allow you to select the folder as intended due to network storage settings, Windows specifications, permissions, security settings, etc. Perform operational verification in your own environment.
C	Path delete button	Click this button to delete the playback data folder path.
D	Variable log file information	Information on the variable log for the playback data in (B) is displayed. The following items are displayed. • Start time • Sampling time [s] • Size [MB] If there is a significant difference between the start time of data in one task and the start time of data in the other task among the data contained in the variable log, the start time of each is displayed.
E	**File detailed settings** button	Click this button to display **File detailed settings** dialog box.
F	**Start Playback** button	Click this button to load the playback data and start the playback. It is enabled when the playback data file path is selected correctly.
G	**Cancel** button	Click this button to cancel the playback without starting it. The specified file path and the settings configured in the **File detailed settings** dialog box are not saved.

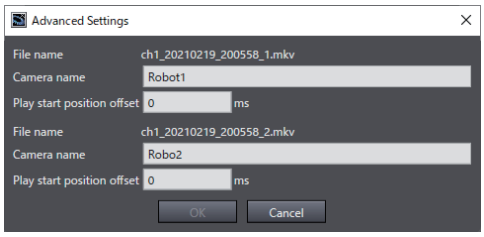
*1. To correctly execute playback, you need to select playback data corresponding to the project currently open. If the specified playback data does not match the project currently open, a message appears because the playback content may not be displayed correctly. Follow the message and select the method to execute the playback, or cancel the playback.

Items in the File Detailed Settings Dialog Box

To play videos, specify the video files.

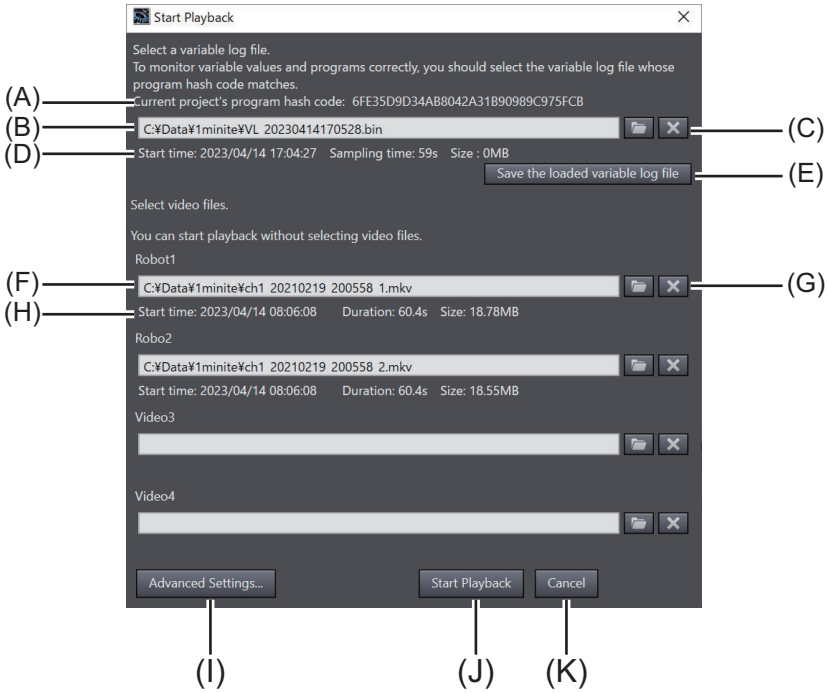
The items displayed in the **File detailed settings** dialog box are shown in the table below.



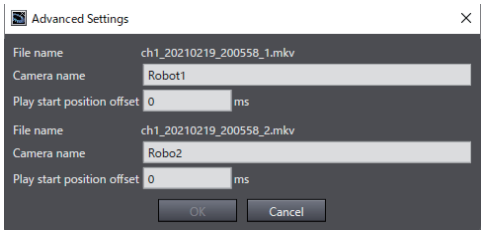
Symbol	Item	Description
A	Camera name	The camera name is shown if video information is successfully obtained.
B	Use camera	Select this check box to use the video file for playback. Clearing this check box suppresses playback even when a video file is specified.
C	File path of video	This is automatically set based on the content of the playback data folder. To change it, click the button and select the file in the Open dialog box of Windows. Specify **Video 1** through **Video 4** in the same way. For the Sysmac Studio (32 bit), only one video can be specified in the **Start Playback** dialog box.
D	File path of video delete button	Click this button to delete the file path of the video.
E	Video file information	The following information on the video file is displayed. • Size [MB] • Start date and time (if information is successfully obtained) • Sampling time (if information is successfully obtained)
F	**Advanced Settings** button	Click this button to display the **Advanced Settings** dialog box when video files are specified.  In the **Advanced Settings** dialog box, you can configure the settings for a specified video. Refer to *6-7-4 Items in the Video Settings Dialog Box* on page 6-33 for details on each item.
G	**OK** Button	Click this button to save the change made and close the window.
H	**Cancel** button	Click this button to cancel the changes made and close the window. The selected file paths and the settings configured in the **Advanced Settings** dialog box are not saved.

4-2-3 Items in the Start Playback Dialog Box (Unit Version Earlier Than 1.71)

The Start Playback dialog box allows you to select a variable log and video files.
For unit version earlier than 1.71, the items in the **Start Playback** dialog box are as shown in the table below.

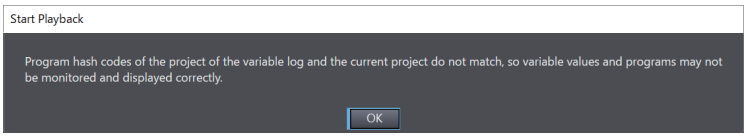


Symbol	Item	Description
A	Current project's program hash code	The program hash code for the current project is displayed. The program hash code is used to check whether a specified variable log was obtained in the project currently open. When you select a variable log, select the variable log whose program hash code matches.
B	File path of variable log	Specify the file path of the variable log to play in the project currently open.*1 Click the button and select the file in the Open dialog box of Windows.
C	Path delete button	Click this button to delete the file path of the variable log.
D	Variable log file information	Information on the variable log file in (B) is displayed. The following items are displayed. • Start time • Sampling time [s] • Size [MB] If there is a significant difference between the start time of data in one task and the start time of data in the other task among the data contained in the variable log, the start time of each is displayed.

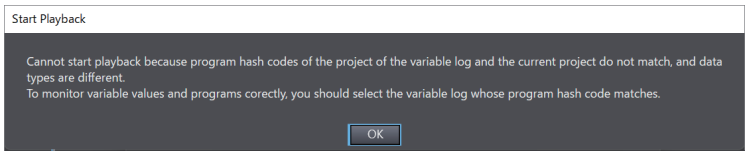
Symbol	Item	Description
E	**Save the loaded variable log file** button (Sysmac Studio version lower than 1.66*2)	Click this button to save the loaded variable log to the computer. The variable log obtained from the Controller may take a few minutes to load. If you start playback again with the same variable log or specify it as a comparison target, you can shorten the loading time when you save the variable log that has already been loaded. The file size of the loaded variable log may increase, so be careful for the amount of available space on the disk when you save.
F	File path of video	Specify the file path of the video. Click the button and select the file in the Open dialog box of Windows. Specify **Video 1** through **Video 4** in the same way. For the Sysmac Studio (32 bit), only one video can be specified in the **Start Playback** dialog box.
G	Path delete button	Click this button to delete the file path of the video.
H	Video file information	The following information on the video file is displayed. • Size [MB]
I	**Advanced Settings** button	Click this button to display the **Advanced Settings** dialog box when video files are specified.  In the **Advanced Settings** dialog box, you can configure the settings for a specified video. Refer to *6-7-4 Items in the Video Settings Dialog Box* on page 6-33 for details on each setting item.
J	**Start Playback** button	Click this button to read the variable log and video selected in (B) and (E) and start playback. It is enabled when the file path of the variable log is selected.
K	**Cancel** button	Click this button to cancel the playback without starting it. The selected file paths and the settings configured in the **Advanced Settings** dialog box are not saved.

*1. To correctly display variable values and monitor programs, you need to select the variable log corresponding to the project currently open.

- If the specified variable log does not match the project currently open, the variable values and programs may not be monitored and displayed correctly, although you can start the playback. In this case, when you select the variable log, the following message is displayed.



- If the specified variable log does not match the project currently open and furthermore the data types do not match, you cannot start playback. In this case, the following error message is displayed.

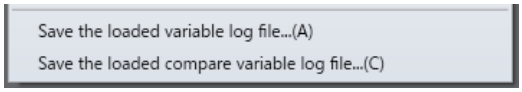


*2. Refer to *4-2-4 How to Shorten the Time to Reload the Variable Log File That Has Been Loaded Once* on page 4-11 for information on this function in Sysmac Studio version 1.66 or higher.

4-2-4 How to Shorten the Time to Reload the Variable Log File That Has Been Loaded Once

The variable log obtained from the Controller may take a few minutes to load. If you start playback again with the same variable log or specify it as a comparison target, you can shorten the loading time by saving the variable log that has already been loaded and opening the file for the second playback and later.
The file size of the loaded variable log may increase, so be careful for the amount of available space on the disk when you save.
Note that the loading time may not be shortened depending on the data. If so, when saving the variable log, a message indicating that the loading time cannot be shortened will be displayed.

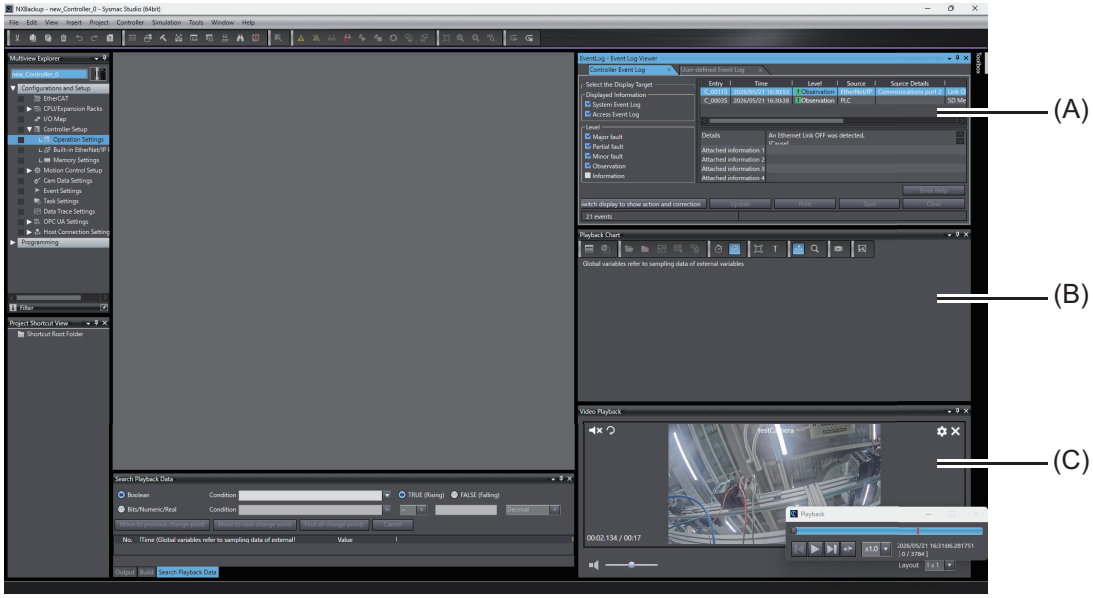
- Sysmac Studio Version 1.66 or Higher
  Select **Automation Playback** from the **Tools** menu of the Sysmac Studio and then click one of the following menu items.
  a) **Save the loaded variable log file**
  b) **Save the loaded compare variable log file**



  In either case, the last loaded variable log file is saved as a loaded variable log file.
- Sysmac Studio Version Lower Than 1.66
  Save the loaded log file from the **Start Playback** dialog box and the **Load Compare Data** dialog box.
  Refer to *4-2-3 Items in the Start Playback Dialog Box (Unit Version Earlier Than 1.71)* on page 4-9 and *6-6-4 Items in the File Selection Dialog Box for Comparison Target Data (Unit Version Earlier Than 1.71)* on page 6-27.

4-2-5 Automatic Screen Display at Playback Start (Sysmac Studio Version 1.68 or Higher)

At the start of playback, in addition to the **Playback** dialog box and the **Search Playback Data** window, the following screens will be displayed automatically.



Sym-bol	Screen	Description
A	Event Log Viewer	Displayed automatically if event log data exists in the playback data folder.
B	Playback Chart	Always displayed automatically.
C	**Video Playback** Window	Displayed automatically if a video data exists in the playback data folder.

Precautions for Correct Use

Each screen is automatically positioned on the right side of the main window when playback starts. The position moved by the user is not saved.

4-3 Restoring the Project When There Is No Project Corresponding to the Variable Log

If there is no project corresponding to the variable log on the computer to execute playback, for example, when you use different computer to copy playback data for playback and play the data, restore the project using the backup file to which you saved the project when collecting the variable log.

4-3-1 Procedure for Restoring the Project File from Playback Data (Unit Version 1.71 or Later)

When you open a variable log at the start of playback, or open comparison target variable log data, if the project corresponding to the variable log is not open, a confirmation dialog box appears asking: *Do you want to start playback using the backup file?* If you click the **Yes** button, the project corresponding to the variable log automatically opens.

As a preparation, configure the setting to save a projects backup file when collecting the variable log. Refer to *2-8 Configuring the Setting to Back Up the Project for Playback* on page 2-49 for the configuration procedure.

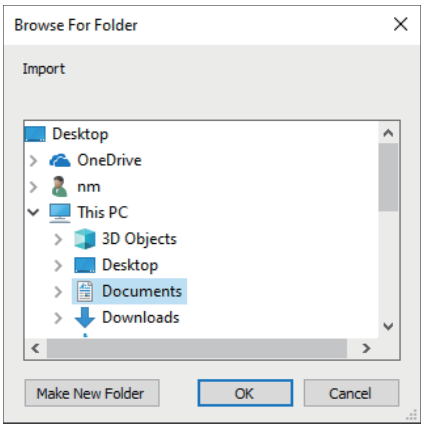
4-3-2 Procedure for Restoring the Project File from Playback Data (Unit Version Earlier Than 1.71)

When you execute playback, you can import the project backup file into the Sysmac Studio and create a project.
As a preparation, save the project backup in advance or when collecting the variable log. To save the project backup file when collecting variable logs, you need to configure the setting. Refer to *2-8 Configuring the Setting to Back Up the Project for Playback* on page 2-49 for the configuration procedure.

1 Create a project in the Sysmac Studio.

2 Select **Backup** – **Import Backup File** from the **Tools** menu of the Sysmac Studio.

3 Specify the folder where the backup files of the project are stored.



A project for the specified backup file is created.

4-4 Ending the Playback

End the playback.
When the playback function is ended, the Sysmac Studio goes offline from playback mode.

4-4-1 Procedure for Ending the Playback

End the playback from the Sysmac Studio menu.

1 Select **Automation Playback** – **Exit Playback** from the **Tools** menu of the Sysmac Studio. Or, click the **Exit Playback** icon ( ) in the toolbar.

The playback function is ended after the **Playback** dialog box, the **Search Playback Data** tab page, and the **Playback Chart** window are closed.
When the playback function is ended, the Sysmac Studio goes offline from playback mode.

5

Checking Program Behavior Using Playback

Play playback data, display the program and variables, and search for variable change points.

5-1 Playing Playback Data 5-2
5-1-1 Procedure for Playing Playback Data 5-2
5-1-2 Items in the Playback Dialog Box 5-3

5-2 Displaying the Ladder Program to Check with Playback 5-4
5-2-1 Procedure for Displaying the Ladder Program to Check with Playback 5-4

5-3 Displaying the ST Program to Check with Playback 5-5
5-3-1 Procedure for Displaying the ST Program to Check with Playback 5-5

5-4 Displaying the Variable Values to Check with Playback 5-6
5-4-1 Procedure for Displaying the Variable Values to Check with Playback 5-6

5-5 Searching for Variable Change Points with Playback 5-7
5-5-1 Procedure for Searching for Variable Change Points with Playback 5-7
5-5-2 Items in the Search Playback Data Tab Page 5-9

5-6 Displaying the Event Log to Check with Playback (Unit Version 1.71 or Later) 5-11
5-6-1 Procedure for Displaying the Event Log to Check with Playback 5-11

5-7 Restrictions during Execution of Playback 5-13

5-1 Playing Playback Data

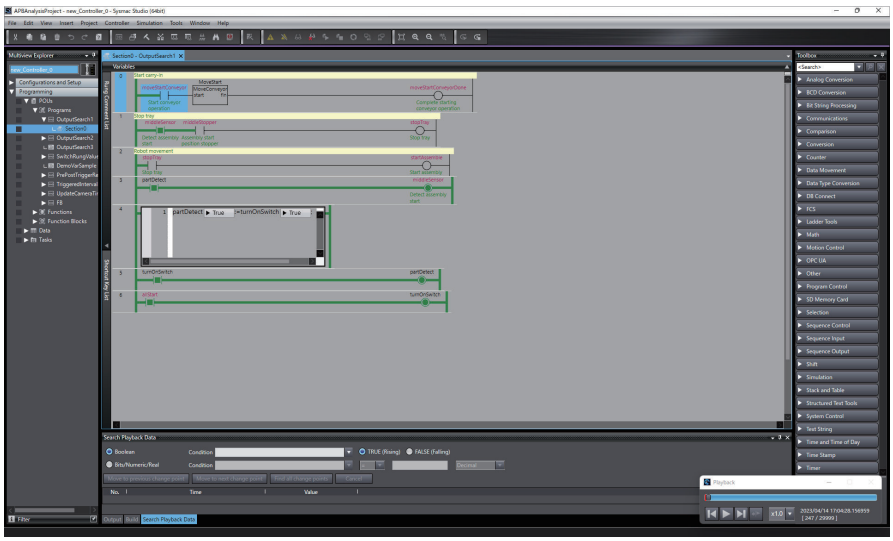
Play, stop, and perform backward/forward playback data.
Playback data is played so that the play operation of the playback data is synchronized with the monitor display of the ladder or ST program and the Watch tab page.

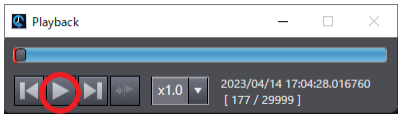
5-1-1 Procedure for Playing Playback Data

In the **Playback** dialog box that appears automatically when playback starts, you can play, stop, and perform backward/forward playback data.
To start playback, the Sysmac Studio and the Controller must be offline.

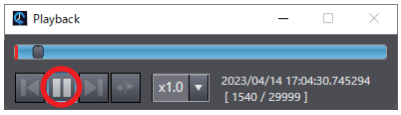
1 Start playback.
The **Playback** dialog box is displayed.

2 In the **Playback** dialog box, click the **Play** button.
The play operation of the playback data causes playback data to be played synchronously with the monitor display of the ladder or ST program and the Watch tab page.





3 To pause playback, click the **Pause** button in the **Playback** dialog box.

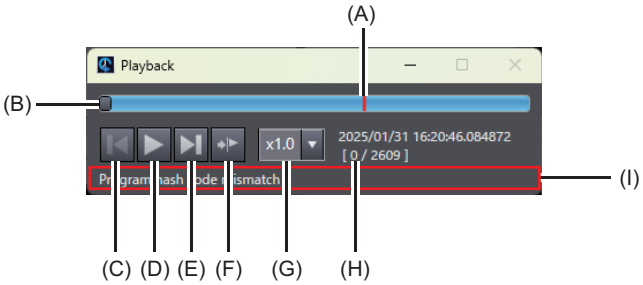


Playback is paused.

When playback is ended, the **Playback** dialog box automatically closes.

5-1-2 Items in the Playback Dialog Box

You can perform various operations while playing playback data.
The items in the **Playback** dialog box are as shown in the table below.



Symbol	Name	Type	Description
A	Trigger position	Button	Click this button to display the time at which the file save trigger changed to TRUE. (The position is displayed on the seek bar. It is inoperable.)
B	Seek bar	Slider	Use this slider to seek the play position. You can drag the slider or click on the bar to move the playback time.
C	Previous frame	Button	Click this button to move the time one sampling period backward. If you press and hold for 0.3 seconds, continuous frames will be sent backward.
D	Play/Pause	Button	Click this button to play or pause the data. During play, the button shows ⏸, so you can click it to pause the playback.
E	Next frame	Button	Click this button to move the time one sampling period forward. If you press and hold for 0.3 seconds, continuous frames will be sent forward.
F	Move to trigger position	Button	Click this button to move to the time at which the file save trigger changed to TRUE.
G	Playback speed multiplier	Drop-down list	You can select the playback speed from among x0.1, x0.5, x1.0, x2.0, x4.0, and x8.0.
H	Time information	Label	The playback time, data number, and total quantity of data are displayed. The total data quantity is displayed to the right of '/'.
I	Message display area	Label	A message is displayed when the loaded variable log data requires attention. • Program hash code mismatch • No Variable Log Concurrency/Cycle with No Variable Sampling (Sysmac Studio version 1.62 or higher)

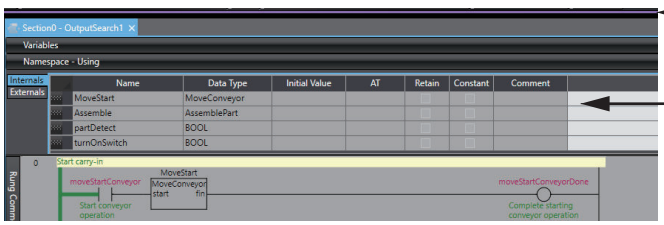
5-2 Displaying the Ladder Program to Check with Playback

If you check the ladder program while playing playback data, select and display the target program or section.
When you start play of playback data, rungs in monitor status in the Ladder Editor will be displayed.

5-2-1 Procedure for Displaying the Ladder Program to Check with Playback

Select and display the ladder program or section to check with playback.

1 Double-click the ladder program or ladder function block under **Programming** in the Multiview Explorer.
The ladder program is displayed in monitor status in the Ladder Editor. The execution status of rungs and the present values of variables are displayed synchronously with the play position specified in the **Playback** dialog box.



Purple indicates that the data is being played back.

Light gray indicates that the data cannot be edited.

When playback is ended, the monitoring of the ladder program ends.
Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for details on monitoring ladder programs.

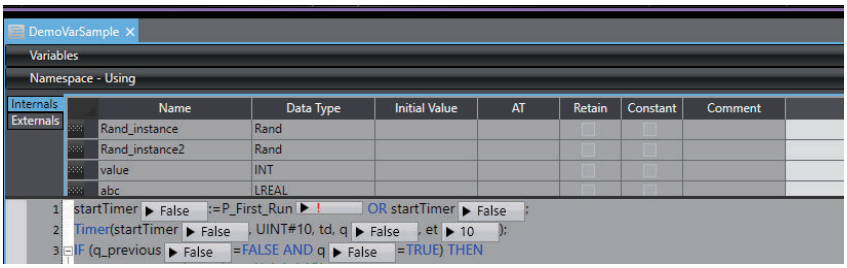
5-3 Displaying the ST Program to Check with Playback

If you check the ST program while playing playback data, select and display the target program.
When you start play of playback data, the program in monitor status in the ST Editor will be displayed.

5-3-1 Procedure for Displaying the ST Program to Check with Playback

Select and display the ST program to check with playback.

1 Double-click the ST program or ST function block under **Programming** in the Multiview Explorer.
The ST Editor is displayed. The present values of variables are displayed synchronously with the play position specified in the **Playback** dialog box.



When playback is ended, the monitoring of the ST program ends.
Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for details on monitoring ST programs.

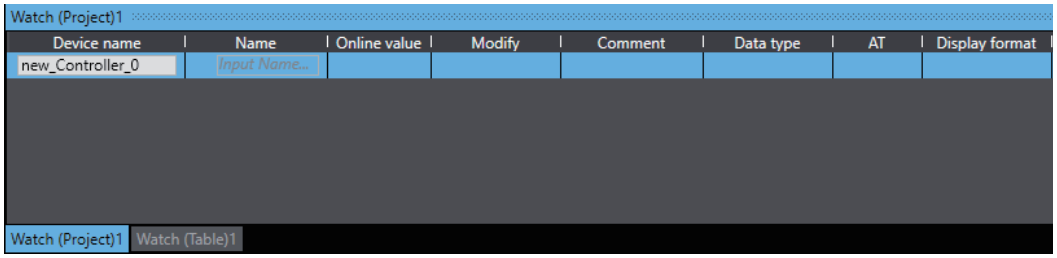
5-4 Displaying the Variable Values to Check with Playback

Display the variable values to check with playback.

5-4-1 Procedure for Displaying the Variable Values to Check with Playback

If you check the values of more than one variable at a time while playing playback data, select and display the Watch tab page.

1 Select **Watch Tab Page** from the **View** menu. If you display the Watch (Table) tab page, select **Watch Tab Page (Table)**.
The Watch (Project) 1 or Watch (Table) 1 tab page is displayed.



When playback is ended, the monitoring in the Watch tab page ends.
Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for details on monitoring in the Watch tab page.

Precautions for Correct Use

When you specify a global or system-defined variable, specify the external variable in which the global or system-defined variable is registered, using the format of **ProgramName.VariableName**.
Unit version 1.71 or later supports referencing using global variable names.

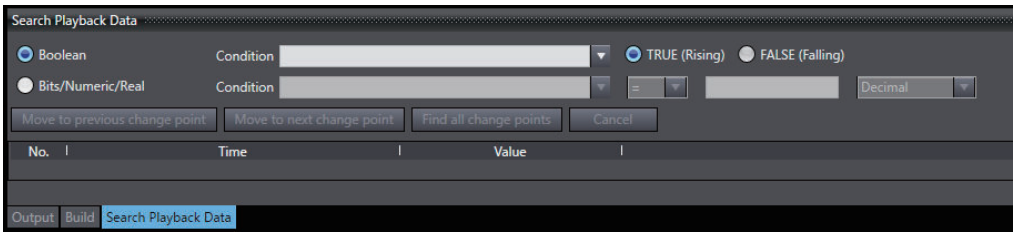
5-5 Searching for Variable Change Points with Playback

Search playback data by specifying variable search conditions, such as the rising edge of a variable. You can jump to the timing when a device variable changes and check the behavior of the device.

5-5-1 Procedure for Searching for Variable Change Points with Playback

Search (previous, next, all) playback data by specifying variable search conditions, such as the rising edge of a variable.

1 When playback starts, the **Search Playback Data** tab page is automatically displayed. Or, select **Automation Playback** – **Search Playback Data Tab Page** from the **Tools** menu of the Sysmac Studio.



2 Select the Boolean or Bits/Numeric/Real option according to the data type of the variable to search.

3 In the variable name input box for **Condition**, enter a variable name in the format of **ProgramName.VariableName**.
When you enter a text string, a drop-down list of candidate variable names is displayed, and then you can select the target variable name.

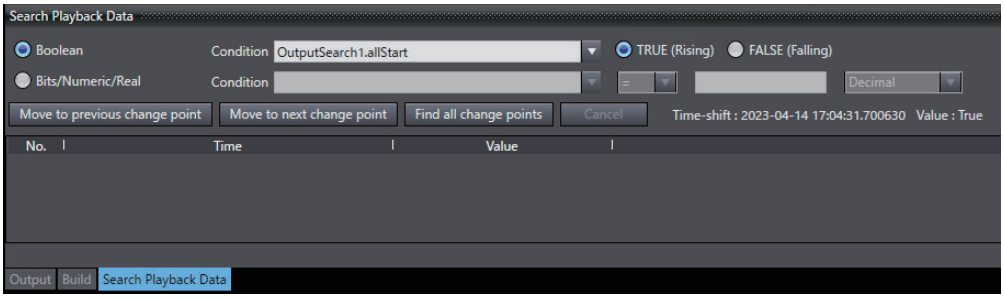
Precautions for Correct Use

When you specify a global or system-defined variable, enter the external variable in which the global or system-defined variable is registered, using the format of **ProgramName.VariableName**.
Unit version 1.71 or later supports referencing using global variable names.

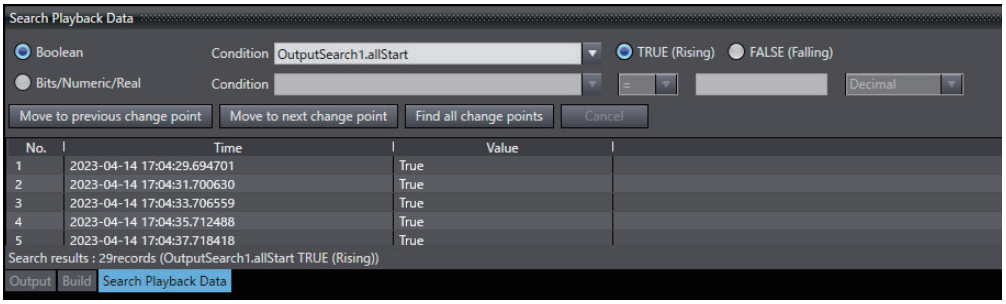
4 If it is a Boolean variable, select the **TRUE (Rising)** or **FALSE (Falling)** option. If it is a Bits/Numeric/Real variable, select the comparison condition and enter the comparison constant in the text box.

5 Depending on the range you want to search, click the **Move to previous change point**, **Move to next change point**, or **Find all change points** button.
The search results are displayed.

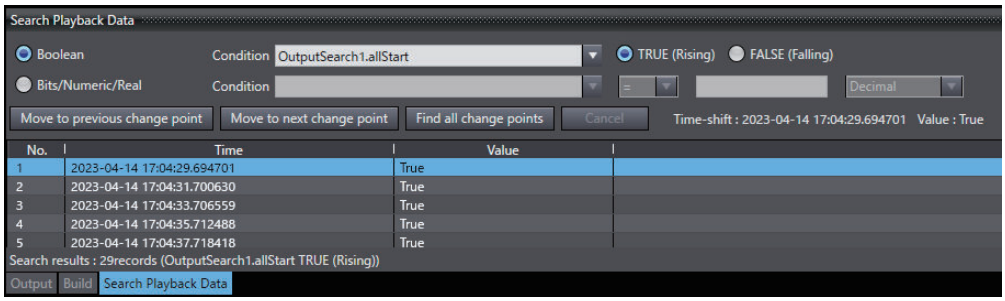
- **Move to previous change point** or **Move to next change point** button:
  Each time you click **Move to previous change point**, you move backward in time to the target time in order.
  Each time you click **Move to next change point**, you move forward in time to the target time in order.



- **Find all change points** button:
  A list of times and variable values for the corresponding playback data is displayed.



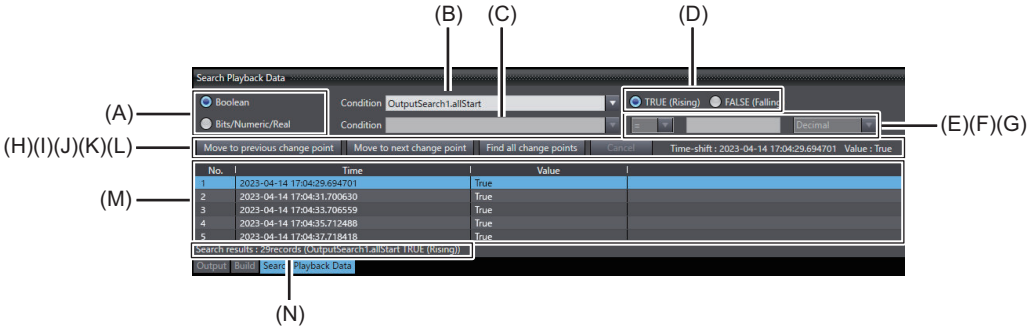
When you search by **Find all change points**, double-click or press the **Enter** key on the item to check in the list of search results, and then you can move to the search results.
When you are monitoring a ladder program or ST program, or when the Watch tab page is displayed, the variable value at the target time is shown.
When the playback chart is displayed, the current time line on the time series variable graph moves to the target time.
The video for the target time is displayed in the Video Playback window. Refer to *Section 6 Checking Time Series Variable Values, Videos, and HMI Screens Using Playback* on page 6-1 for details on the Video Playback window.



If you move to the search results while playing playback data, the play will pause before moving to the search results.

5-5-2 Items in the Search Playback Data Tab Page

Specify the variable name and search conditions in the **Search Playback Data** tab page.
The **Search Playback Data** tab page has the items shown in the table below.



Symbol	Name	Description
A	Data type options	Set the data type of the variable to search for. Select Boolean or Bit String/Integer/Real.
B	Boolean variable name input box	Set the name of the Boolean variable to search for with one of the following methods. • Enter a search string in the format of **ProgramName.VariableName** (When you enter a text string, a drop-down list of candidate variables is displayed, and then you can select the target variable.) • Select a previously entered string from the drop-down list • Drag and drop a variable from the Program Editor.
C	Bit string, integer, or real variable name input box	Set the comparison constant for the bit string, integer, or real variable to search for. Use one of the following methods. • Enter a search string in the format of **ProgramName.VariableName** (When you enter a text string, a drop-down list of candidate variables is displayed, and then you can select the target variable.) • Select a previously entered string from the drop-down list
D	Boolean variable search condition options	Set the search condition for the Boolean variable to search for. Select **TRUE (Rising)** or **FALSE (Falling)**.

Sym-bol	Name	Description
E	Bit string, integer, or real variable search condition input box	Set the search condition for the bit string, integer, or real variable to search for. Select from the following conditions. =: When equal to **comparison constant** ≠: When not equal to **comparison constant** >: When greater than **comparison constant** <: When less than **comparison constant** ≥: When greater than or equal to **comparison constant** ≤: When less than or equal to **comparison constant**
F	Comparison constant input box	Set the comparison constant for the bit string, integer, or real variable to search for.
G	Number system list	Select the number system for the comparison constant from Decimal or Hexadecimal.
H	**Move to previous change point** button	Click this button to search for the variable in playback data backward in time.
I	**Move to next change point** button	Click this button to search for the variable in playback data forward in time.
J	**Find all change points** button	Click this button to search all playback data. The search results are listed.
K	**Cancel** button	Click this button to cancel the execution of **Find all change points**.
L	Movement result	When you move to the search results by clicking the **Move to previous change point** or **Move to next change point** button, or jumping from the search results of **Find all change points**, the time at which you move and the value of the variable will be displayed. Also, if an error occurs during the execution of the search or move, the relevant error message will be displayed.
M	Search results	When you execute **Find all change points**, the list of times and values of the search results is displayed. When you double-click the target line in the list, or select the target line and press the **Enter** key, you can jump to the search results. You can right-click on the list and execute **Copy**, **Select All**, or **Clear All**.
N	Number of search hits	When you execute **Find all change points**, the number of search results, the target variables, and search conditions are displayed.

5-6 Displaying the Event Log to Check with Playback (Unit Version 1.71 or Later)

If you check event logs while playing playback data, display the Event Log Viewer.
When you start play of playback data, events will be highlighted at the time they occurred.
You can also click an event to jump to that time during playback.

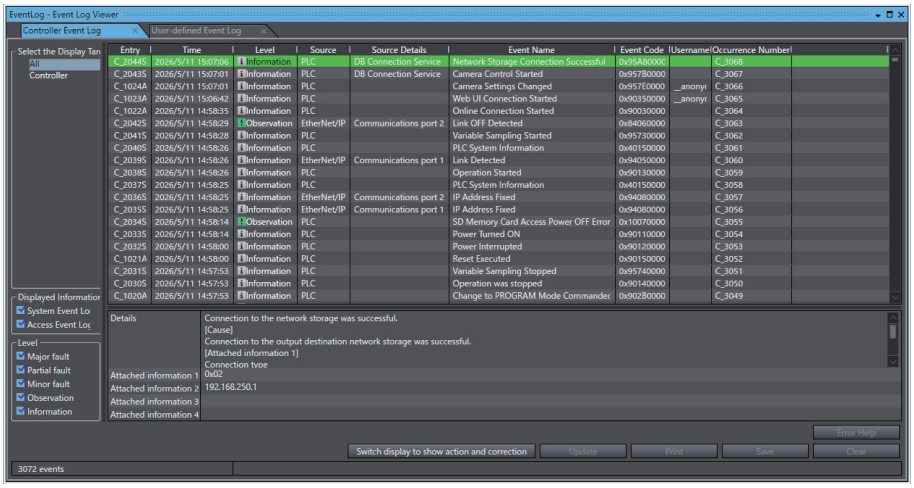
Precautions for Correct Use

To check event logs during playback, you need to collect them in advance when collecting variable data.
Refer to *2-4 Collecting Event Logs (Unit Version 1.71 or Later)* on page 2-36 for collecting event logs.

5-6-1 Procedure for Displaying the Event Log to Check with Playback

Display the Event Log Viewer.

1 Select **Automation Playback** – **Event log** from the **Tools** menu of the Sysmac Studio.
The Event Log Viewer is displayed. The event row is highlighted in green according to the time it occurred.
You can also click an event row to jump to that event's time during playback.



When playback is ended, the event log viewer ends.

Precautions for Correct Use

Unlike the normal Event Log Viewer, the following functions in the Event Log Viewer cannot be used during playback.

- Properties tab page
- Saving
- EtherCAT configuration information display
- Printing

5-7 Restrictions during Execution of Playback

You cannot perform the following operations during execution of playback.

- Editing the Controller configurations and setup
- Editing programs and tasks
- Going online with the Controller
- Axis Status Monitor
- Monitoring in the I/O Map
- Monitoring task execution status and task execution times
- Data tracing
- Changing present values of data
- Online editing
- Simulation

6

Checking Time Series Variable Values, Videos, and HMI Screens Using Playback

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6-1 Playback Chart

You can display changes in variable values during playback in a graph, and play the video. You can also compare their waveforms with those of other playback data.

6-1-1 Applications of the Playback Chart

You can use the playback chart to perform various types of analysis, such as the following.

- Registering variables that are considered to be relevant and checking changes in the variables in time series when an error is detected during video playback or on the program monitoring display.
- Compare data during an error with that of normal operation using the waveform comparison feature.

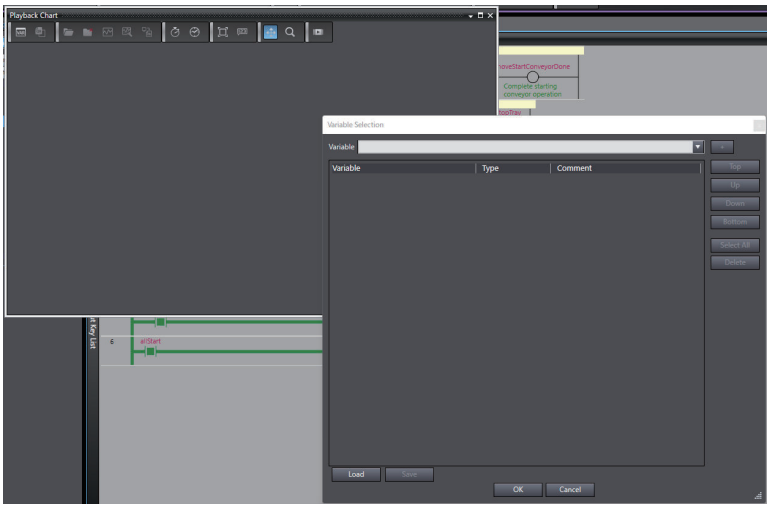
Additional Information

We recommend that you use this function in the Sysmac Studio (64 bit).

6-1-2 Procedure for Starting the Playback Chart

Use the following procedure to start the playback chart. You can perform it in playback mode.

1 Select **Automation Playback** – **Playback Chart** from the **Tools** menu of the Sysmac Studio. The Playback Chart window is displayed.



You can display a time series variable graph when you add variables from the Playback Chart window or the Program Editor.
Refer to *6-2-1 Procedure for Displaying a Time Series Variable Graph* on page 6-8 for how to add variables to the time series variable graph from the Playback Chart window.
Refer to *6-3-6 Procedures for Adding Variables Selected in the Program Editor to the Playback Chart* on page 6-15 for how to add variables to the time series variable graph from the Program Editor.

You can open the Video Playback window from the Playback Chart window.
Refer to *6-7-2 Procedures for Playing Videos* on page 6-31 for how to display the Video Playback window.

The Playback Chart window and the Video Playback window are displayed in a floating state, separate from the Sysmac Studio window. You can cancel the floating state and place it in the window, and bring it back to the floating state again.
Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for details.

6-1-3 Procedure for Exiting the Playback Chart

Use the following procedure to exit the playback chart.

1 Click the × button in the upper right corner of the Playback Chart window.
The playback chart is exited.

Additional Information

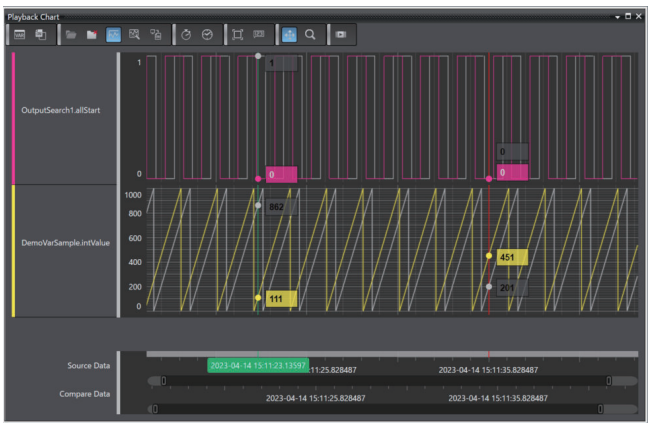
When the playback is ended, automatically exit the playback chart.

6-1-4 Overview of the Playback Chart Window

When you start the playback chart, a time series variable graph is displayed. You can also display the Video Playback window separate from the Playback Chart window.

Time Series Variable Graph

Display the time series variable graph. You can select the variables to display from the variable list or specify the variables used in the rung or program selected in the Ladder Editor or ST Editor at once. You can also specify the variable log to compare and superimpose its waveforms on the displayed waveforms.



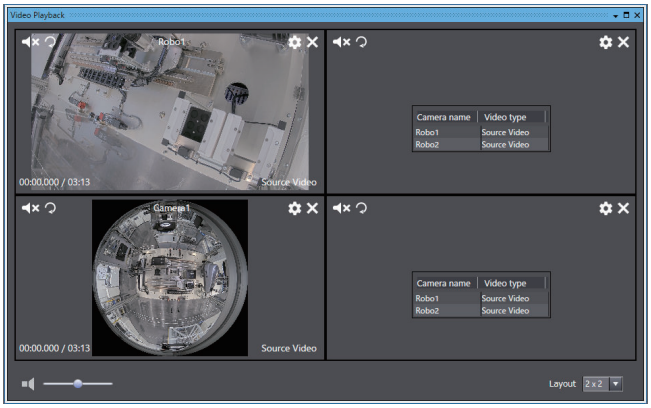
On the time series variable graph, the play position of playback data is indicated by the current time line.

Current Time Line

The playback time specified in the **Playback** dialog box is displayed as a vertical line on the time series variable graph. You cannot move the vertical line.

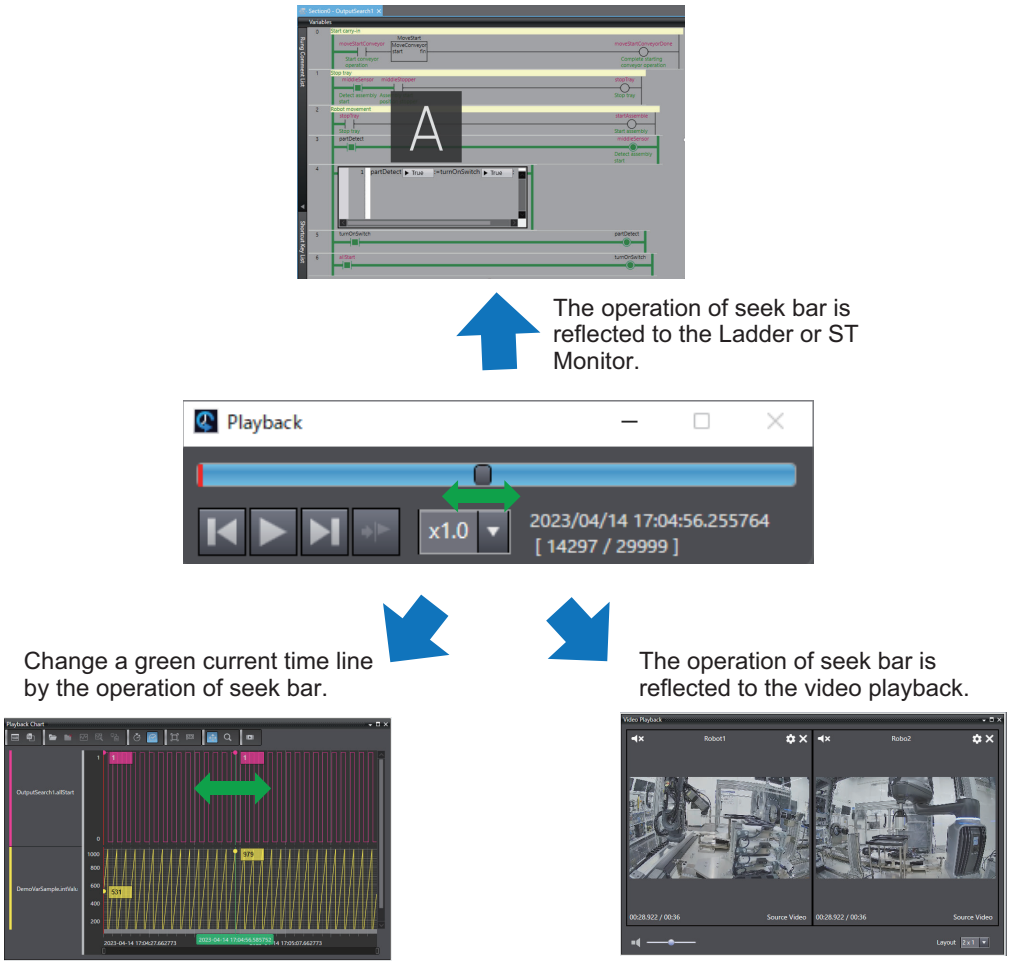
Video Playback Window

In this window, video is played synchronously with play operations that you perform in the **Playback** dialog box.
You can also specify the video data to compare and display its videos side by side. For both comparison source and target data, you can play up to four videos, respectively.



6-1-5 Synchronization between the Playback Chart and the Program Monitoring Display

The time series variable graph on the playback chart and the Video Playback window are displayed synchronously with the Program Monitor display.



6-1-6 Playback Chart Toolbar Items and Mouse Operations

You can use the toolbar at the top of the time series variable graph on the playback chart with mouse operations to customize the graph display as you prefer.

The table below shows the toolbar items that you can use for the time series variable graph in the playback chart.

Icon	Name	Description
	Variable Selection	Selects the variables to display in the time series variable graph.
	Export Source Data	Exports the comparison source variable data displayed in the time series variable graph in CSV format.
	Load Compare Data	Opens the **Load Compare Data** dialog box.
	Unload Compare Data	Unloads the comparison target data from the playback chart.
	Show/Hide Compare Data	Shows or hides the comparison target data in the playback chart.

Icon	Name	Description
	Align Data	Displays the area to set the waveform alignment conditions.
	Export Compare Data	Exports the comparisons target variable data displayed in the playback chart in CSV format.
	Relative time mode	Displays the time on the time series variable graph as elapsed time.
	Absolute time mode	Displays the time on the time series variable graph as time.
	Fit To Window	Displays the entire variable data on the time series variable graph.
	Show Cursor Values	Switches between showing and hiding the value cursor on the time series variable graph.
	Panning Mode	Switches to Panning Mode in which you drag (pan) while holding down the left mouse button on the time series variable graph to move in the X direction. You can drag while holding down the right mouse button to zoom in a selected range.
	Zoom Mode	Switches to Zoom Mode in which you drag while holding down the left mouse button on the time series variable graph to zoom in and move a selected range in the X direction. Drag while holding down the right mouse button to move in the X direction.
	Show Video Playback	Opens the Video Playback window.
	Show Extended Controls in Chart	Shows or hides extended control buttons in each chart. This button is available on the Sysmac Studio version 1.67 or higher.

The table below shows the mouse operations that you can perform on the time series variable graph in the playback chart.

Mouse operation	Description
Mouse wheel	Zooms in or zooms out on the time series variable graph in the X direction.
Shift + mouse wheel	Zooms in or zooms out on the time series variable graph in the Y direction.

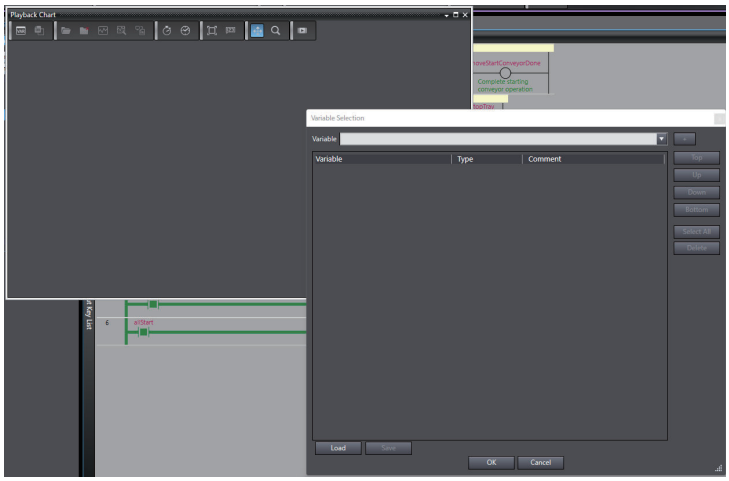
6-2 Checking Variable Values on the Time Series Variable Graph in the Playback Chart

Check variable values on the time series variable graph.

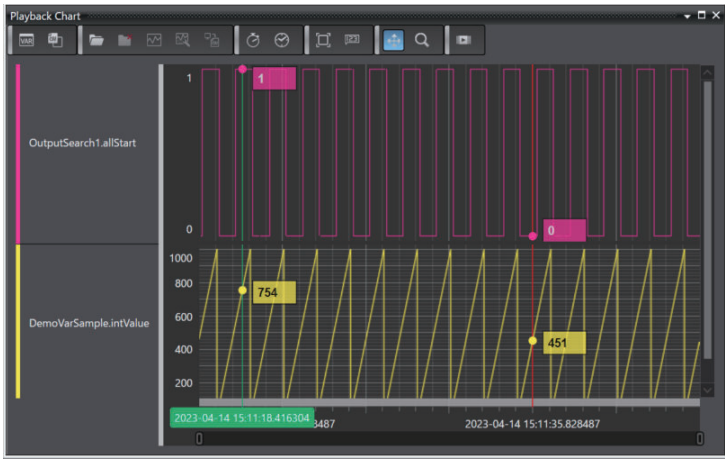
6-2-1 Procedure for Displaying a Time Series Variable Graph

You can display a time series variable graph by adding variables from the Playback Chart window or the Program Editor.
Use the following procedure to display a time series variable graph from the Playback Chart window.

1 Select **Automation Playback** – **Playback Chart** from the **Tools** menu of the Sysmac Studio.
The Playback Chart window is displayed.



2 Click the **Variable Selection** icon in the playback chart toolbar to display the **Variable Selection** dialog box, and add variables.
A time series variable graph is displayed. When you start the playback chart for the first time, the **Variable Selection** dialog box is automatically displayed.



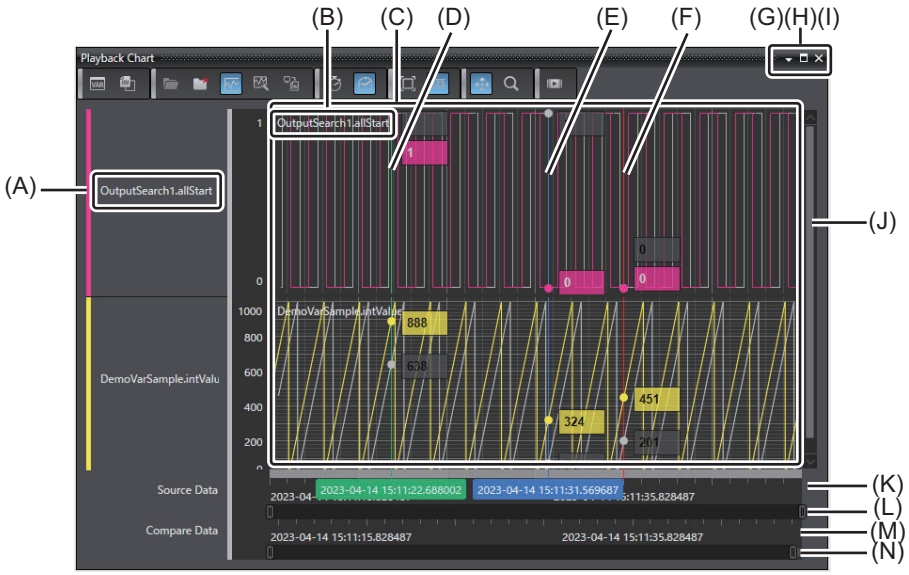
Refer to *6-3-2 Procedure for Selecting the Variables to Display in the Playback Chart* on page 6-12 for how to display the **Variable Selection** dialog box and add a variable.

From the next time on, the Playback Chart window will be displayed with the time series variable graph of the variables selected the last time. Once variables are added, the variables will be retained until the playback is ended.

Refer to *6-3-6 Procedures for Adding Variables Selected in the Program Editor to the Playback Chart* on page 6-15 for the procedure to display a time series variable graph by adding variables from the Program Editor.

6-2-2 Items on the Time Series Variable Graph

The table below shows the detailed menu items that you can use for the time series variable graph in the playback chart.

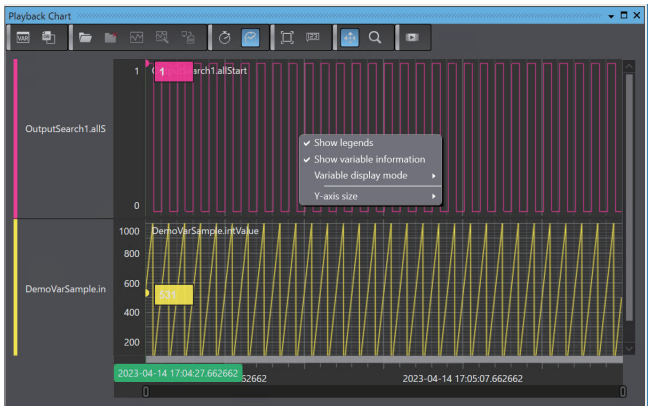


Sym-bol	Name	Description
A	Variable information display	Displays variable names, comments, and data types according to the item selected in Variable display mode.
B	Show legends	Displays variable names, comments, and data types on the graph according to the item selected in Variable display mode.
C	Trend graph display area	Displays the trend graph of the comparison source data in the foreground in automatically set colors. The trend graph of the comparison target data is displayed in gray on the background. For mouse operations in Panning Mode and Zoom Mode, and mouse operations common to these modes, refer to *6-1-6 Playback Chart Toolbar Items and Mouse Operations* on page 6-6.

Symbol	Name	Description
D	Current time line	This is a green vertical line cursor displayed at the target time in the comparison source data that moves synchronously with the play position in the **Playback** dialog box to indicate the current time. The line cannot be manipulated. If the target time data is not displayed, the vertical line will be shown at the target time by reading the data that contains the target time.
E	Variable value cursor	Displays a blue vertical line cursor with the values in the X and Y directions on the graph. In Sysmac Studio version 1.67 or higher, double-clicking causes playback to jump to the time indicated by the cursor value.
F	Trigger time line	This is a red vertical line cursor displayed at the trigger time corresponding to the trigger position. The line cannot be manipulated.
G	Minimize button	Minimizes the window.
H	Maximize button	Maximizes the window.
I	Close button	Exits the playback chart.
J	Y direction scroll bar	Enables the trend graph display area to be scrolled vertically.
K	X axis of comparison source data	Displays the X axis values of the comparison source data. Displays the time when the **Absolute time mode** toolbar icon is selected, or the elapsed time when the **Relative time mode** toolbar icon is selected. When you drag the scrall bar while holding the left mouse button, you can horizontally scroll through the comparison source and target data.
L	X direction scroll bar for comparison source data	Displays the ratio of the data displayed in the window with a black bar as a percentage of the comparison source data. You can drag the bar while holding the left mouse button to move the displayed time. At this time, the X direction scroll bar for the comparison target data also moves synchronously.
M	X axis of comparison target data	Displays the X axis values of the comparison target data. Displays the time when the **Absolute time mode** toolbar icon is selected, or the elapsed time when the **Relative time mode** toolbar icon is selected.
N	X direction scroll bar for comparison target data	Displays the ratio of the data displayed in the window with a black bar as a percentage of the comparison target data. The bar cannot be manipulated.

6-2-3 Context Menu Items for the Time Series Variable Graph

The table below shows menus that appear when you right-click on the time series variable graph. They are available when either comparison source or target data are read.



Menu	Submenu	Description
Show legends	---	Select whether to show variable information on the graph according to the item selected in Variable display mode.
Show variable information	---	Select whether to show variable information on the left side of the graph according to the item selected in Variable display mode.
Variable information	Name, Comment, or Name and comment	Select the display method for legend and variable information from Name, Comment, or Name and comment.
	Show data types	Select whether to display the data type in the legend and variable information.
Y-axis size	Smallest, Small, Medium, Large, or Largest	Select the display size of the Y axis for each variable on the time series variable graph.

6-3 Selecting the Variables to Display in the Playback Chart

You can select and display any variables in the playback chart.
For both the comparison source and target data, the variables that you select will be displayed.

6-3-1 Variables That You Can Add to the Playback Chart

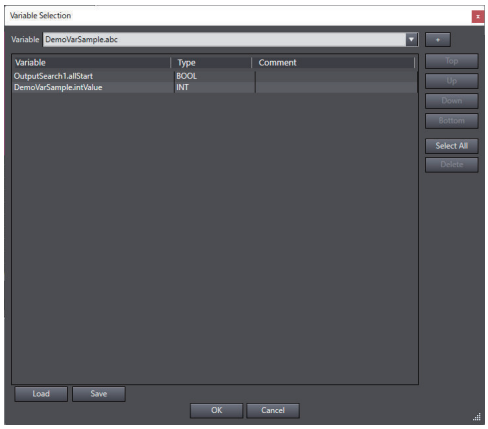
You can add variables that meet all of the following conditions to the playback chart.

- Variables of data types to display on the time series variable graph, which are included in the variable log of the comparison source data
- Variables that are not targets for display on the time series variable graph in the playback chart

6-3-2 Procedure for Selecting the Variables to Display in the Playback Chart

You can select any variables from the comparison source data so that the selected variables will be displayed in the playback chart.
Use the following procedure to select the variables to display in the playback chart.

1 Click the **Variable Selection** icon in the playback chart toolbar.
The **Variable Selection** dialog box is displayed.



2 In the variable name input box for **Variable** in the upper part of the dialog box, enter a variable name in the format of **ProgramName.VariableName**.
When you enter a text string, a drop-down list of candidate variable names is displayed, and then you can select the target variable name.

Precautions for Correct Use

When you specify a global or system-defined variable, specify the external variable in which the global or system-defined variable is registered, using the format of **ProgramName.VariableName**.

3 Click the **+** button.
The selected variable name is added to the variable list.

4 Click the **OK** button.
The **Variable Selection** dialog box closes, and the selected variables are added to the time series variable graph.

6-3-3 Procedure for Saving the Variable List Displayed in the Playback Chart

You can save a list of the variables selected in the playback chart to a file.
The saved file is referred to as a variable selection state file. By loading the variable selection state file, you can easily display the previously selected variables in the playback chart.
Use the following procedure to save the variable list displayed in the playback chart.

1 With the selected variables displayed in the display variable list in the **Variable Selection** dialog box, click the **Save** button.
The **Save Variables** dialog box is displayed.

2 Specify the file name and where you want to save the file, and save the list.
A variable selection state file with the .var extension, which summarizes the information in the display variable list, is saved in the specified location.

6-3-4 Procedure for Restoring the Saved Variable List

Use the following procedure to restore the saved variable list.

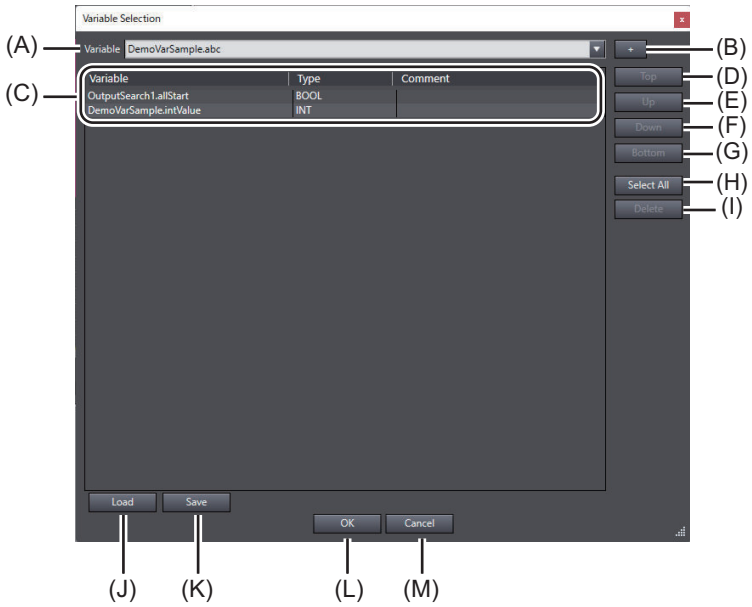
1 In the **Variable Selection** dialog box, click the **Load** button.
The **Load Variables** dialog box is displayed.

2 Select the variable selection state file (extension .var) to restore and click the **OK** button.
The variables saved in the variable selection state file are displayed in the display variable list in the **Variable Selection** dialog box.

3 Click the **OK** button.
The **Variable Selection** dialog box closes. The selected variables are added to the time series variable graph.

6-3-5 Items on the Variable Selection Dialog Box

The items displayed in the **Variable Selection** dialog box are as shown in the table below.



Sym-bol	Name	Description
A	Variable name input box	Enter a variable name in the format of **ProgramName.VariableName**. When you enter a text string, a drop-down list of candidate variables is displayed, and then you can select the target variable. Variables of the following data types can be filtered. Data type: BOOL/BYTE/WORD/DWORD/LWORD/SINT/INT/DINT/LINT/USNT/UINT/UDINT/ULINT/REAL/LREAL For structures and unions, members of the above data types are targeted. For members of FB instances, variables of the above data types are targeted. For array variables of the above data types, each element is targeted. For enumerations, enumerators are targeted.
B	**+** button	Adds the variable specified in Variable name input box (A) to the end of Display variable list (C).
C	Display variable list	Lists variable names (variable names, their data types and comments) added from Variable name input box (A). An item is selected when you click it, and the item is cleared when you click another item. You can select a range by clicking any two unselected items while holding down the **Shift** key. You can select more than one item by clicking any unselected items while holding down the **Ctrl** key.
D	**Top** button	Moves the variable selected in Display variable list (C) to the top of the list. You can move two or more items at a time.
E	**Up** button	Moves the variable selected in Display variable list (C) one line up in the list. You can move two or more items at a time.
F	**Down** button	Moves the variable selected in Display variable list (C) one line down in the list. You can move two or more items at a time.
G	**Bottom** button	Moves the variable selected in Display variable list (C) to the bottom of the list. You can move two or more items at a time.
H	**Select All** button	Selects all variables.
I	**Delete** button	Deletes the variables selected in Display variable list (C) from the list.

Sym-bol	Name	Description
J	**Load** button	Displays the **Load Variables** dialog box. In the dialog box that appears, you can load the selected variable selection state file and restore the variable selection state in Display variable list (C).
K	**Save** button	Displays the **Save Variables** dialog box. In the dialog box that appears, you can save Display variable list (C) as a file with the extension .var (variable selection state file) in a specified location.
L	**OK** button	Applies the changes. When you click the **OK** button, this window is closed.
M	**Cancel** button	Closes this window. You can also close the window by pressing the **Esc** key.

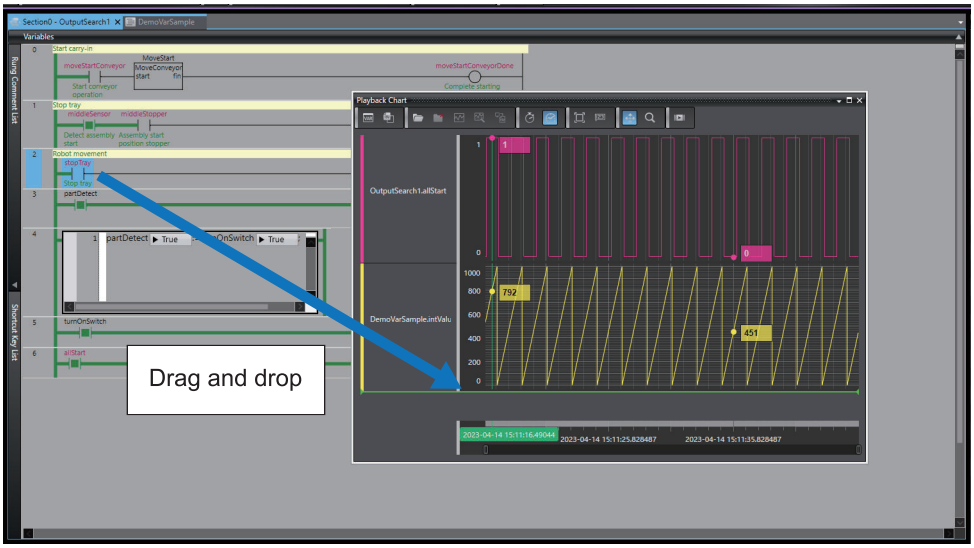
6-3-6 Procedures for Adding Variables Selected in the Program Editor to the Playback Chart

You can add variables used in the rung or program selected in the Ladder Editor or ST Editor.
Use the following procedures to add variables selected in the Program Editor to the playback chart.

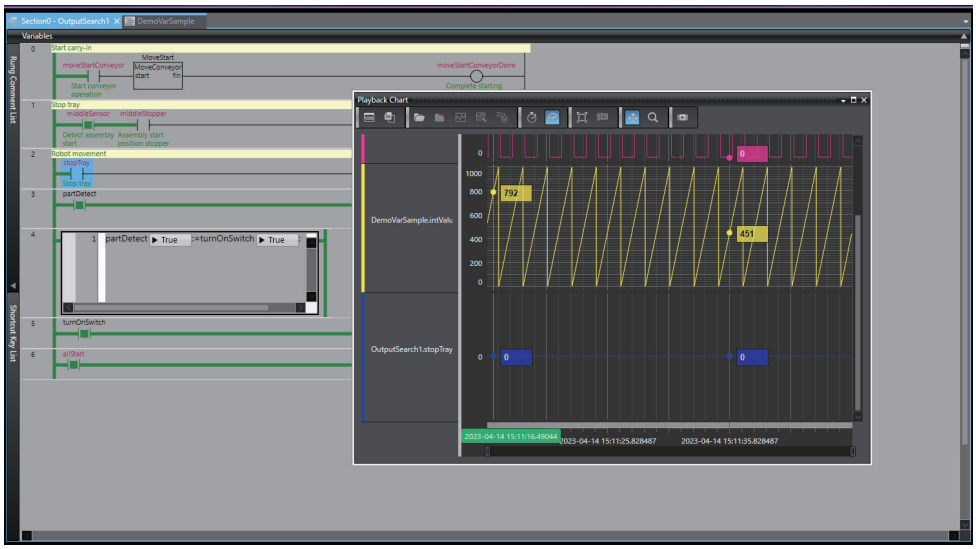
Procedure for Adding Variables Selected in the Ladder Editor to the Playback Chart

● Adding Variables by Drag and Drop

1 In the Ladder Editor, select the rung element to add, and drag and drop it into the Playback Chart window.

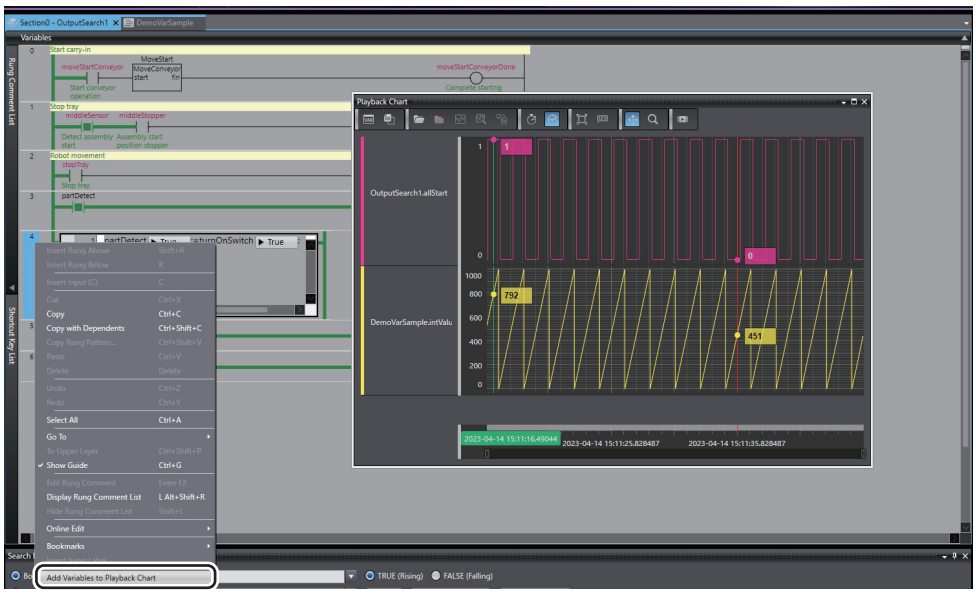


A variable is added to the playback chart.
You can add only one variable per drag and drop.

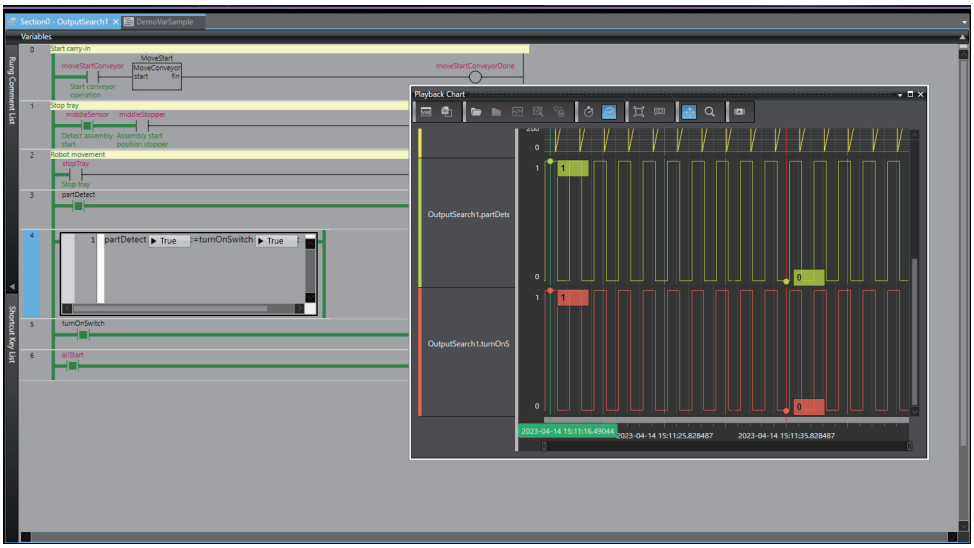


Adding Variables from the Context Menu

1 Right-click one or more rungs in the Ladder Editor and select **Add Variables to Playback Chart** from the menu.



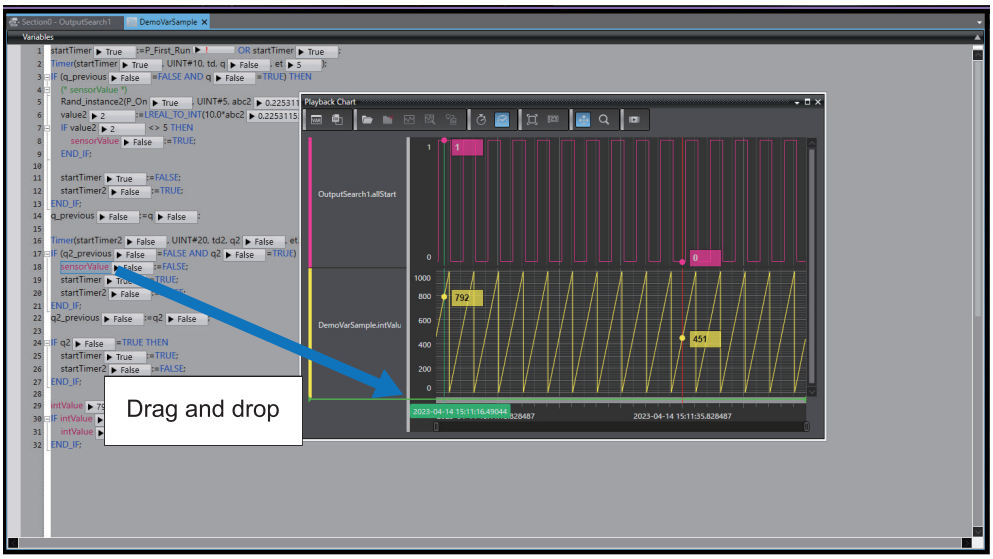
Variables in the selected rungs are added to the playback chart.



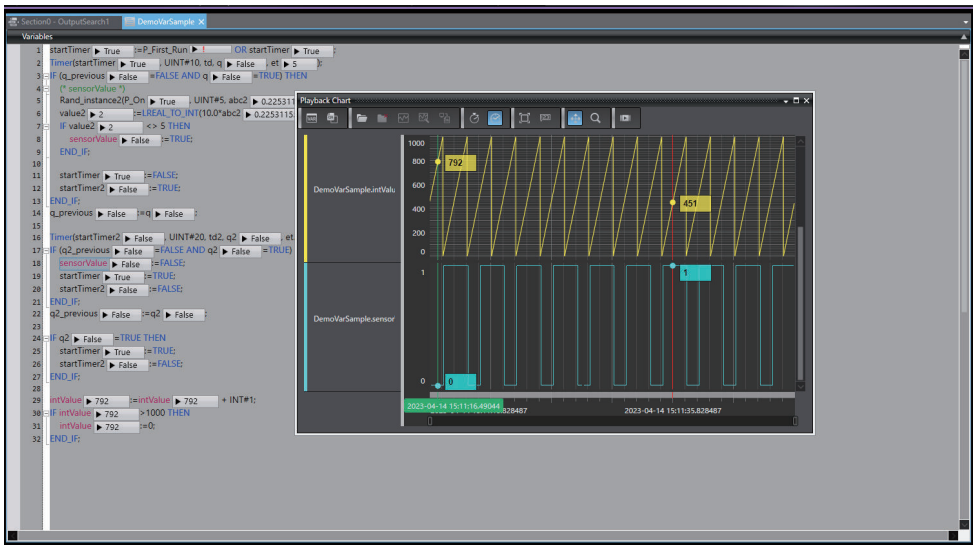
Adding Variables Selected in the ST Editor to the Playback Chart

● Adding Variables by Drag and Drop

1 Select a variable to add in the ST Editor, and drag and drop it into the Playback Chart window.

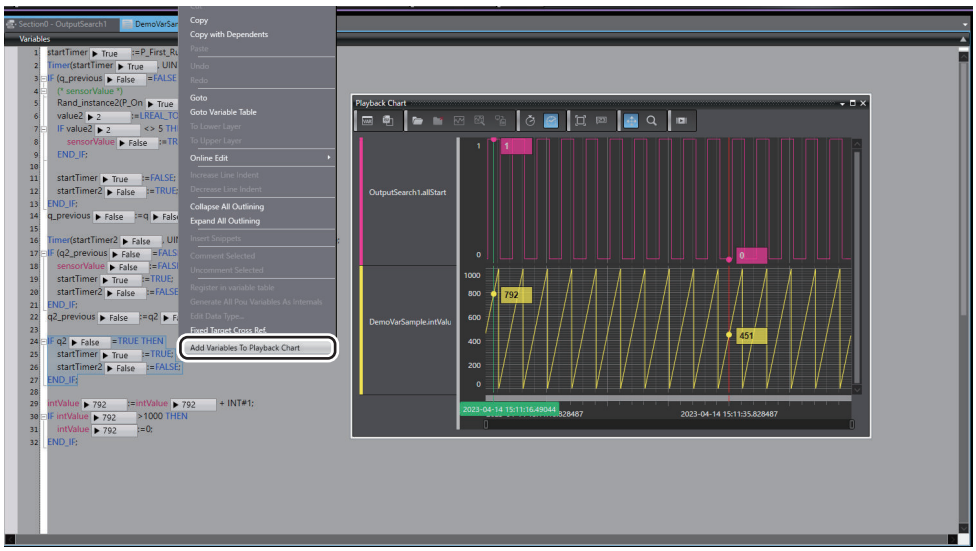


A variable is added to the playback chart.
You can add only one variable per drag and drop.

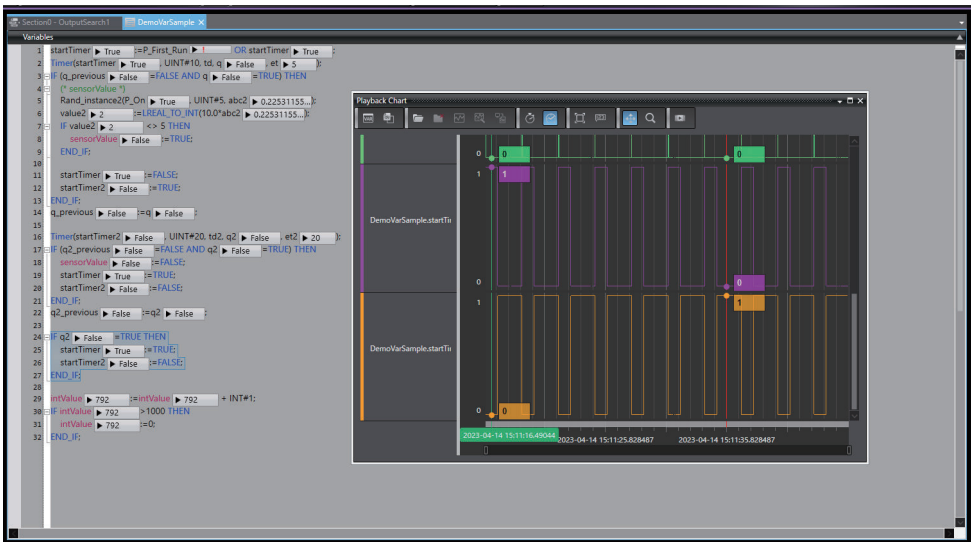


● Adding Variables from the Context Menu

1 Right-click a range in the ST Editor and select **Add Variables to Playback Chart** from the menu.



Variables in the selected range are added to the playback chart.


Section0 - OutputSearch1
DemoVarSample
Variables
startTimer True :=P_First_Run OR startTimer True ;
Timer(startTimer True , UINT#10, td, q False , et 5);
IF (q_previous False =FALSE AND q False =TRUE) THEN
(* sensorValue *)
Rand_instance2(P_On True , UINT#5, abc2, 0.22531155...);
value2 2 :=LREAL_TO_INT(10.0*abc2 0.22531155...);
IF value2 2 <> 5 THEN
sensorValue False :=TRUE;
END_IF;
startTimer True :=FALSE;
startTimer2 False :=TRUE;
END_IF;
q_previous False :=q False ;
Timer(startTimer2 False , UINT#20, td2, q2 False , et2 20);
IF (q2_previous False =FALSE AND q2 False =TRUE) THEN
sensorValue False :=FALSE;
startTimer True :=TRUE;
startTimer2 False :=FALSE;
END_IF;
q2_previous False :=q2 False ;
IF q2 False =TRUE THEN
startTimer True :=TRUE;
startTimer2 False :=FALSE;
END_IF;
intValue 792 :=intValue 792 + INT#1;
IF intValue 792 >1000 THEN
intValue 792 :=0;
END_IF;
Playback Chart
DemoVarSample.startTi
DemoVarSample.startTi
2023-04-14 15:11:16.49044
2023-04-14 15:11:25.828487
2023-04-14 15:11:35.828487

6-4 Checking the Difference in Values between Two Points in the Playback Chart

You can check the difference in values between two points by moving cursors in the playback chart.

Version Information

This function is available in Sysmac Studio version 1.67 or higher.

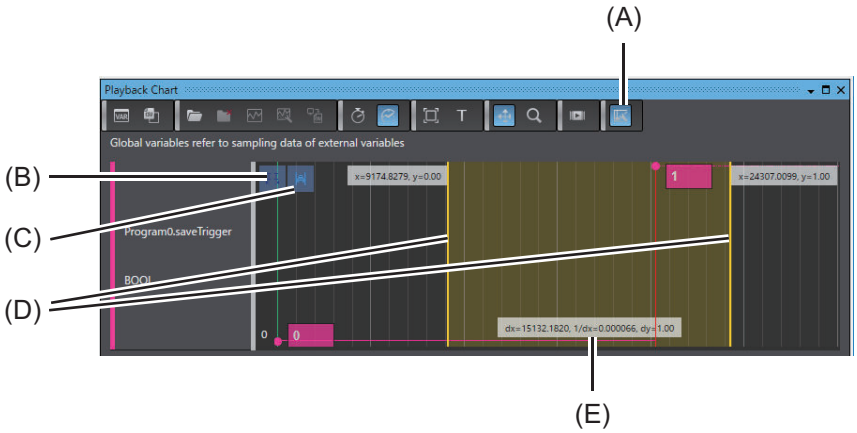
6-4-1 Procedure for Checking the Difference in Values between Two Points in the Playback Chart

Specify two points using the **two-point measurement cursors**.

1 Click the **Show Extended Controls in Chart** button above the variable graph in the playback chart.
The **Two-point Measurement Cursors** button and the **Fix Two-point Cursor Width** button appear.

2 Click the **Two-point Measurement Cursors** button to turn it ON.
The two-point measurement cursors appear.

3 Drag the two cursors to the left or right to move them to the left and right ends of the range for which you want to check the difference.
The distance (dx, dy) between the cursors is indicated on the graph.



Symbol	Item	Description
A	**Show Extended Controls in Chart** button	Shows or hides extended control buttons in each chart.

Sym-bol	Item	Description
B	**Two-point Measurement Cursors** button	Shows or hides the two-point measurement cursors.
C	**Fix Two-point Cursor Width** button	Fixes or unfixes the spacing between the two cursors. Fixing the spacing is useful when you compare changes over the same time span.
D	Two-point measurement cursors	Drag these cursors to the left or right to specify the points you want to compare. The x (time) and y (value) coordinates are indicated.
E	Difference indication	The difference between the two points is indicated as dx and dy.

6-5 Jumping to a Specified Time in the Playback Chart during Playback

You can jump to a specified time in the playback chart during playback.

Version Information

This function is available in Sysmac Studio version 1.67 or higher.

6-5-1 Procedure for Jumping to a Specified Time in the Playback Chart during Playback

In the playback chart, position the variable value cursor at the point you want to jump to and double-click in the chart.

1. Move the variable value cursor to the point you want to jump to.
2. Double-click in the chart.
   Playback jumps to the time at the variable value cursor position.

6-6 Displaying Waveforms of the Variable Data to Compare in the Playback Chart

The playback chart allows you to compare and analyze waveforms by superimposing waveforms of the time series variable data to compare on the waveforms displayed in the playback chart.
To superimpose waveforms on the displayed waveforms, select the comparison target data file to compare.

6-6-1 Definition of Data to Compare

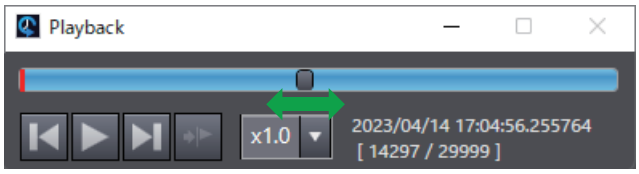
The playback chart allows you to compare variable data on the time series variable graph with video data.
To compare these, “comparison source data” and “comparison target data” are used.
The definitions of “comparison source data” and “comparison target data” are as follows.

Comparison Source Data

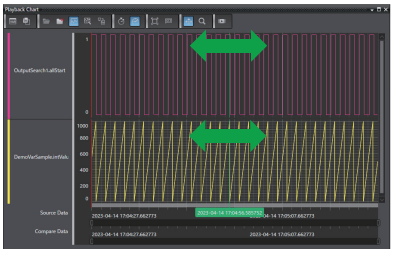
Comparison source data is the variable log and video data specified when you start playback in the Sysmac Studio. Comparison source data is read at startup of the playback chart.

Comparison Target Data

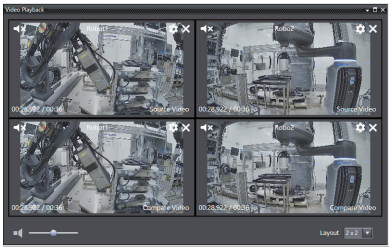
Comparison target data is the variable log and video data to compare in the playback chart. Comparison target data is read when it is specified in the Playback Chart window. Comparison target data is played synchronously with playback operations that you perform on the comparison source data in the **Playback** dialog box.



Change the times for comparison source and target data by the operation of seek bar.



The operation of seek bar is reflected to the video playback for the comparison source and target data.

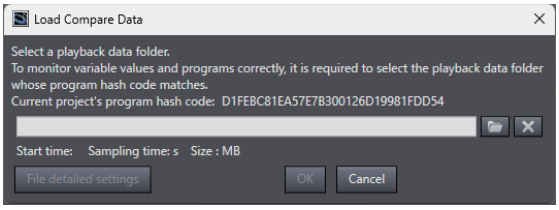


6-6-2 Procedure for Selecting the Comparison Target Data File to Use for Playback

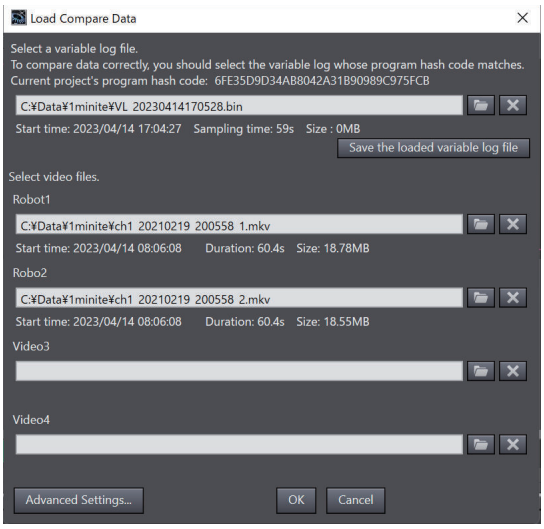
Select the comparison target data file to use for playback.
Use the following procedure to select the file.

1 Click the **Load Compare Data** icon in the playback chart toolbar.
The **Load Compare Data** dialog box is displayed.

- Unit Version 1.71 or Later



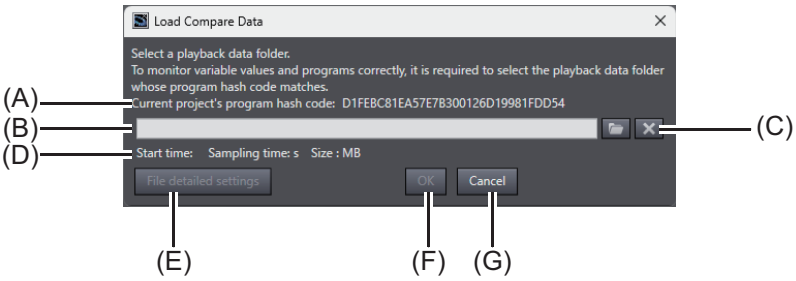
- Unit Version Earlier Than 1.71



2 Specify the file paths of the variable log file and video data to add as targets for waveform comparison, and click the **OK** button.
Variables with the same variable names and data types as those in the comparison source data displayed on the time series variable graph are displayed. In addition, the specified video files are displayed in the Video Playback window.

6-6-3 Items in the File Selection Dialog Box for Comparison Target Data (Unit Version 1.71 or Later)

In the **Load Compare Data** dialog box, select the comparison target variable log and video files.
For unit version 1.71 or later, the items in the **Load Compare Data** dialog box are as shown in the table below.



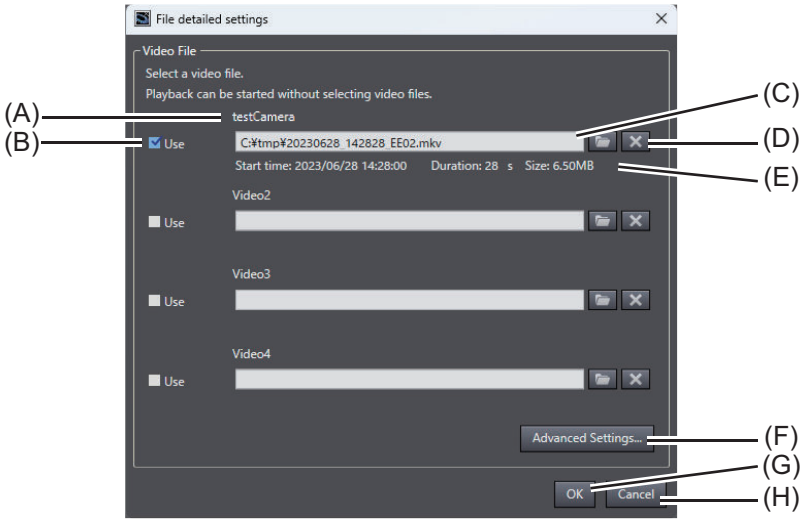
Symbol	Item	Description
A	Current project's program hash code	The program hash code for the current project is displayed. When you select playback data, select the playback data containing the variable log whose program hash code matches.
B	Playback data folder path	Specify the path to the playback data folder to play in the project currently open.*1 Click the button and select the folder in the Open dialog box of Windows. **Note** When you directly specify playback data saved to network storage for playback, the Controller may not allow you to select the folder as intended due to network storage settings, Windows specifications, permissions, security settings, etc. Perform operational verification in your own environment.
C	Path delete button	Click this button to delete the playback data folder path.
D	Variable log file information	Information on the variable log for the playback data in (B) is displayed. The following items are displayed. • Start time • Sampling time [s] • Size [MB] If there is a significant difference between the start time of data in one task and the start time of data in the other task among the data contained in the variable log, the start time of each is displayed.
E	**File detailed settings** button	Click this button display **File detailed settings**dialog box.
F	**OK** button	Click this button to add and display only variables with the same names and data types as those in the comparison source data displayed in the time series variable graph. It is enabled when the playback data file path is selected correctly. You cannot add variables that are not included in the comparison source data.
G	**Cancel** button	Click this button to cancel the playback without starting it. The specified file path and the settings configured in the **File detailed settings** dialog box are not saved.

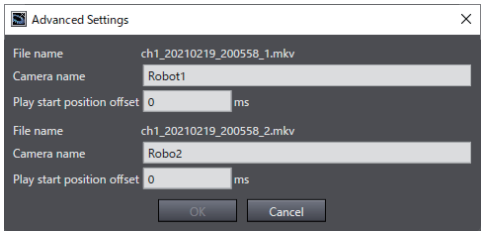
*1. To correctly execute playback, you need to select playback data corresponding to the project currently open. If the specified playback data does not match the project currently open, a message appears because the playback content may not be displayed correctly. Follow the message and select the method to execute the playback, or cancel the playback.

Items in the File Detailed Settings Dialog Box

To play videos, specify the video files.

The items displayed in the **File detailed settings** dialog box are shown in the table below.

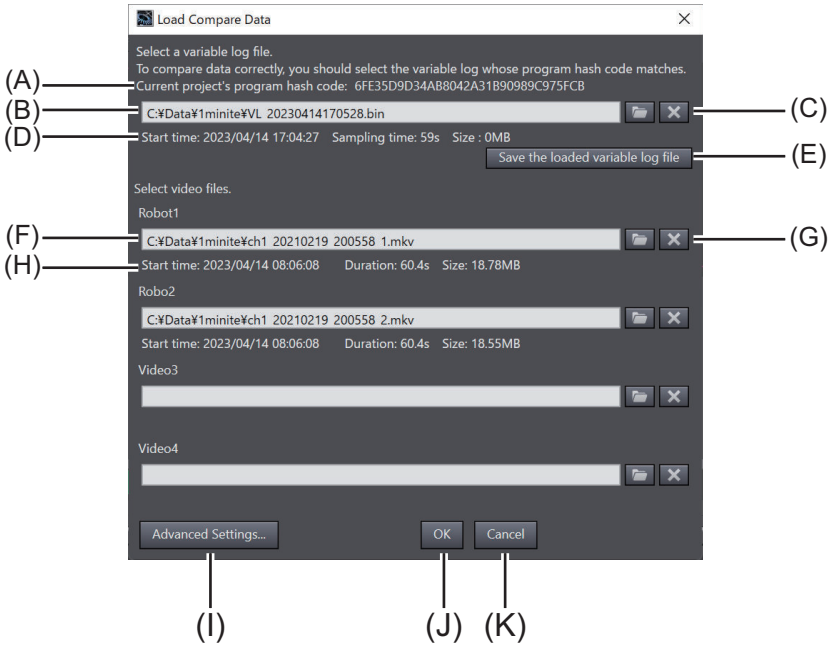


Symbol	Item	Description
A	Camera name	The camera name is shown if video information is successfully obtained.
B	Use camera	Select this check box to use the video file for playback. Clearing this check box suppresses playback even when a video file is specified.
C	File path of video	This is automatically set based on the content of the playback data folder. To change it, click the button and select the file in the Open dialog box of Windows. Specify **Video 1** through **Video 4** in the same way. For the Sysmac Studio (32 bit), only one video can be specified in the **Start Playback** dialog box.
D	File path of video delete button	Click this button to delete the file path of the video.
E	Video file information	The following information on the video file is displayed. • Size [MB] • Start date and time (if information is successfully obtained) • Sampling time (if information is successfully obtained)
F	**Advanced Settings** button	Click this button to display the **Advanced Settings** dialog box when video files are specified.  In the **Advanced Settings** dialog box, you can configure the settings for a specified video. Refer to *6-7-4 Items in the Video Settings Dialog Box* on page 6-33 for details on each item.

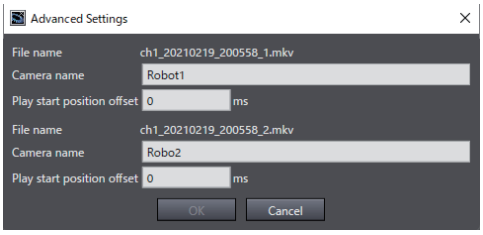
Symbol	Item	Description
G	**OK** Button	Click this button to save the change made and close the window.
H	**Cancel** button	Click this button to cancel the changes made and close the window. The selected file paths and the settings configured in the **Advanced Settings** dialog box are not saved.

6-6-4 Items in the File Selection Dialog Box for Comparison Target Data (Unit Version Earlier Than 1.71)

In the **Load Compare Data** dialog box, select the comparison target variable log and video files.
For unit version earlier than 1.71, the items in the **Load Compare Data** dialog box are as shown in the table below.

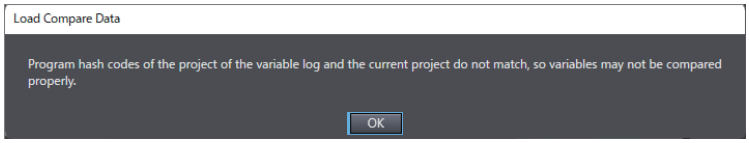


Symbol	Item	Description
A	Current project's program hash code	The program hash code for the current project is displayed. The program hash code is used to check whether a specified variable log was obtained in the project currently open. When you select a variable log, select the variable log whose program hash code matches.
B	File path of variable log	Specify the file path of the variable log to add as waveform comparison targets in the playback chart. *1 Click the button and select the file in the Open dialog box of Windows.
C	Path delete button	Click this button to delete the file path of the variable log.

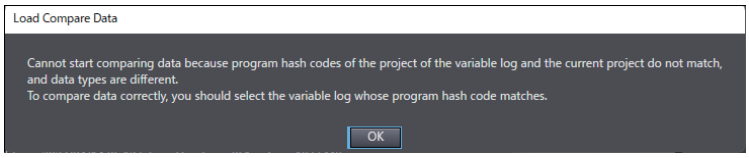
Symbol	Item	Description
D	Variable log file information	Information on the variable log file in (B) is displayed. The following items are displayed. • Start time • Sampling time [s] • Size [MB] If there is a significant difference between the start time of data in one task and the start time of data in the other task among the data contained in the variable log, the start time of each is displayed.
E	**Save the loaded variable log file** button (Sysmac Studio version lower than 1.66*2)	Click this button to save the loaded variable log to the computer. The variable log obtained from the Controller may take a few minutes to load. If you start playback again with the same variable log or specify it as a comparison target, you can shorten the loading time when you save the variable log that has already been loaded. The file size of the loaded variable log may increase, so be careful for the amount of available space on the disk when you save.
F	File path of video	Specify the file path of the video. Click the button and select the file in the Open dialog box of Windows. Specify **Video 1** through **Video 4** in the same way. For the Sysmac Studio (32 bit), only one video can be specified in the **Load Compare Data** dialog box.
G	Path delete button	Click this button to delete the file path of the video.
H	Video file information	The following information on the video file is displayed. • Size [MB]
I	**Advanced Settings** button	Click this button to display the **Advanced Settings** dialog box when video files are specified.  In the **Advanced Settings** dialog box, you can configure the settings for a specified video. Refer to *6-7-4 Items in the Video Settings Dialog Box* on page 6-33 for details on each setting item.
J	**OK** button	Click this button to add and display only variables with the same names and data types as those in the comparison source data displayed in the time series variable graph. In addition, the specified video files are displayed in the Video Playback window. You cannot add variables that are not included in the comparison source data.
K	**Cancel** button	Click this button to cancel the files specified in (B) and (E) without reading them. The selected file paths and the settings configured in the **Advanced Settings** dialog box are not saved.

*1. To correctly display variable values, you need to select the variable log corresponding to the project currently open.

- If the specified variable log does not match the project currently open, the variable values may not be displayed correctly, although they can be compared. In this case, when you select the variable log, the following message is displayed.



- If the specified variable log does not match the project currently open and furthermore the data types do not match, data cannot be compared. In this case, the following error message is displayed.



*2. Refer to *4-2-4 How to Shorten the Time to Reload the Variable Log File That Has Been Loaded Once* on page 4-11 for information on this function in Sysmac Studio version 1.66 or higher.

6-6-5 Procedure for Aligning Waveforms of the Variable Data to Compare According to the Waveform Alignment Condition

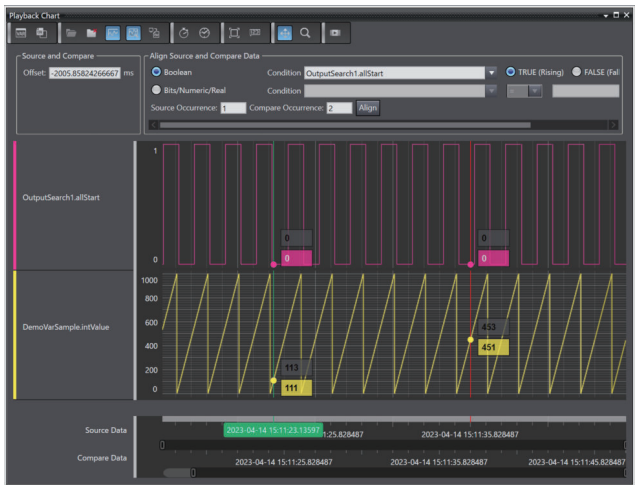
You can superimpose the waveforms of comparison source and target data when you set the waveform aliment condition on the comparison source and target data.

1 Click the **Align Data** icon in the playback chart toolbar.
An area to set the waveform alignment conditions appears in the upper part of the Playback Chart window.

2 Select the Boolean or Bits/Numeric/Real option according to the data type of the variable to set the waveform alignment condition and enter the variable name to search for in the **Condition** drop-down list.

3 If it is a Boolean variable, select the **TRUE (Rising)** or **FALSE (Falling)** option. If it is a Bits/Numeric/Real variable, select the comparison condition and enter the comparison constant in the text box.

4 Enter the number of times that the matching value condition must be met for the comparison source and target data in the **Source Occurrence** and **Compare Occurrence** text boxes and click the **Align** button.
The waveforms of the comparison source and target data are aligned and displayed on the playback chart based on the set conditions.


Playback Chart
Source and Compare
Offset: -2005.858242666667 ms
Align Source and Compare Data
Boolean
Condition: OutputSearch1.allStart
TRUE (Rising)
FALSE (Fal
Bits/Numeric/Real
Condition
Source Occurrence: 1
Compare Occurrence: 2
Align
OutputSearch1.allStart
DemoVarSample.intValue
1
0
1000
800
600
400
200
0
113
111
453
451
Source Data
Compare Data
2023-04-14 15:11:23.13597
2023-04-14 15:11:35.828487
2023-04-14 15:11:25.828487
2023-04-14 15:11:35.828487
2023-04-14 15:11:45.828487

6-7 Playing Videos

Play video data in the Video Playback window of the playback chart.

Additional Information

We recommend that you use this function in the Sysmac Studio (64 bit).

6-7-1 Video Files That Are Initially Displayed

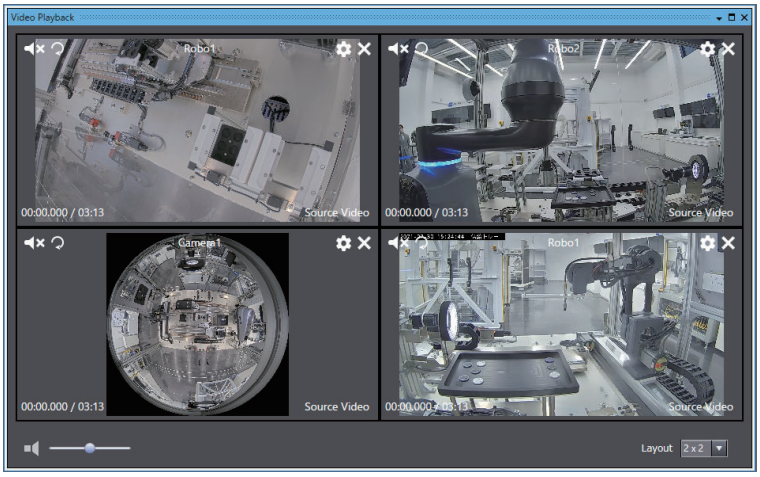
a. When playback is started by selecting the comparison source video data in the **Start Playback** dialog box
All video files selected in the video play frames are displayed.

b. When video data from the comparison target is selected in the **Load Compare Data** dialog box
All video files selected in the video play frames are displayed. If videos are already displayed in a., they will be added to the videos in a. and displayed in the remaining video play frames.

6-7-2 Procedures for Playing Videos

Use the following procedure to play video data. You can perform it in playback mode.

1 Select **Automation Playback** – **Video Playback** from the **Tools** menu of the Sysmac Studio.
Or, click the **Show Video Playback** icon in the toolbar of the Playback Chart window.
The **Video Playback** window is displayed.

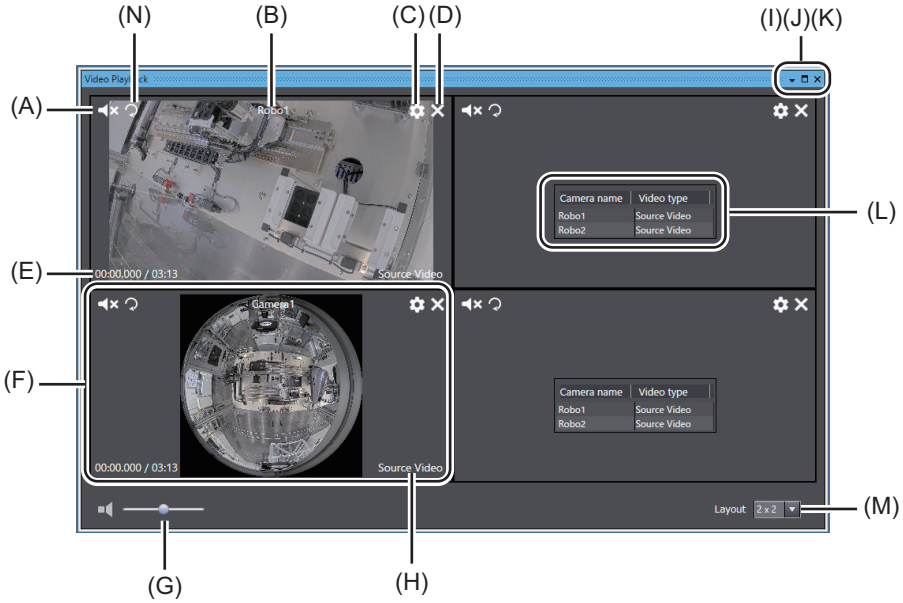


If you select a video file in the **Start Playback** dialog box and start playback, the **Video Playback** window will be automatically displayed.

2 In the **Playback** dialog box, click the **Play/Pause** button.
Video data is played according to the play operations in the **Playback** dialog box.

6-7-3 Items in the Video Playback Window

You can perform various operations in the Video Playback window.
The table below shows the items displayed in the Video Playback window.



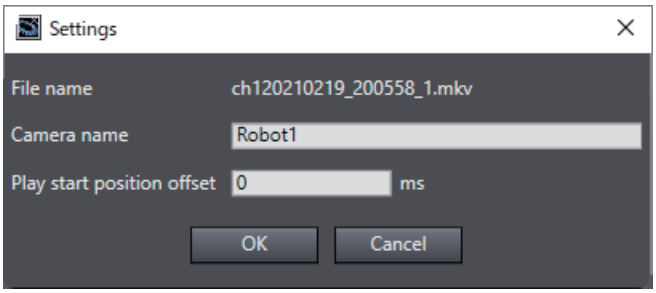
Sym-bol	Name	Description
A	Mute/Unmute button	Click this button to mute or unmute the audio of the video in each frame.
B	Camera name	The camera name is displayed. If no camera name has been set, **Video N** is displayed (a number from 1 to 4 is entered to N).
C	Settings button	Click this button to open the **Settings** dialog box, and you can set the camera name and start time offset for the video. Refer to *6-7-4 Items in the Video Settings Dialog Box* on page 6-33 for details on each item.
D	Close button	Click this button to close the video file.
E	Time	The elapsed time of the video and the total length of the video are displayed.
F	Video play frames	The video selected from the video selection drop-down list.
G	Volume slider	Use this slider to change the volume for all videos.
H	Video type	The **Source Video** and **Compare Video** are displayed.
I	Minimize button	Click this button to minimize this window.
J	Maximize button	Click this button to maximize this window.
K	Close button	Click this button to close this window.
L	Video selection drop-down list	From the list, select videos for comparison source data and comparison target data that are not displayed in the video play frame. The list shows camera names and video types.
M	**Layout** drop-down list	Select the layout of the video play frames (i.e., number of horizontal frames × number of vertical frames) to display in the Video Playback window. You can select one of the following combinations. 1×1, 1×2, 1×3, 1×4, 2×1, 2×2, 2×3, 2×4, 3×1, 3×2, 4×1, and 4×2
N	Rotate video button*1	Click this button to rotate the video 90 degrees clockwise.

*1. The rotate video button is available in Sysmac Studio version 1.62 or higher.

6-7-4 Items in the Video Settings Dialog Box

You can configure the settings for a specific video in the **Settings** dialog box.
To display the **Settings** dialog box, click the Settings button displayed above each video.

The items displayed in the **Settings** dialog box are shown below.



Name	Description
File name	The video file name is displayed.
Camera name	Enter any camera name.
Play start position offset	Set the offset time in ms for the play start date and time of the video file based on the start date and time of the variable data. The offset is calculated when the recording time of the video overlaps the range of recording time for the variable. If there is no overlap, the offset is 0.
OK button	Click this button to apply the settings.
Cancel button	Click this button to cancel the settings.

6-8 Performing Playback in Sync with HMI Devices (Unit Version 1.71 or Later)

You can perform playback in sync with HMI devices.
HMI devices that can be synchronized are NA-series Programmable Terminals with Runtime version 1.19 or higher. You can use the NA Simulator to simultaneously play back up to four HMI screens, including the comparison target.

Precautions for Correct Use

- To view HMI screens during playback, you need to collect the Controller's global variable data mapped to the HMI devices in advance when collecting variable data.
  Refer to *2-5 Collecting Playback Data in Sync with HMI Devices (Unit Version 1.71 or Later)* on page 2-38 for details on collecting the Controller's global variable data mapped to the HMI devices.
- There are differences between the NA-series physical HMI and the NA Simulator. Refer to *Differences between the Physical HMI and Simulator* of the *NA-series Software User's Manual (Cat. No. V118)* for the differences.

6-8-1 Procedure for Playing Back HMI Screens

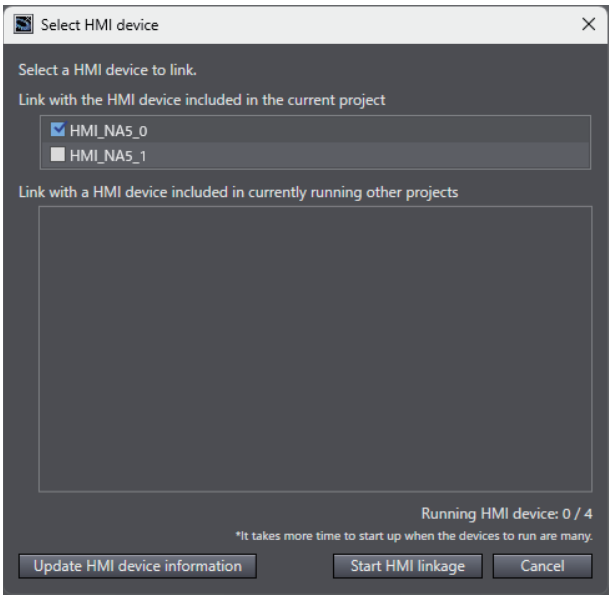
Select the HMI device to play back and display the NA Simulator.

1 According to the procedure described in *5-1 Playing Playback Data* on page 5-2, play the project data to synchronize.

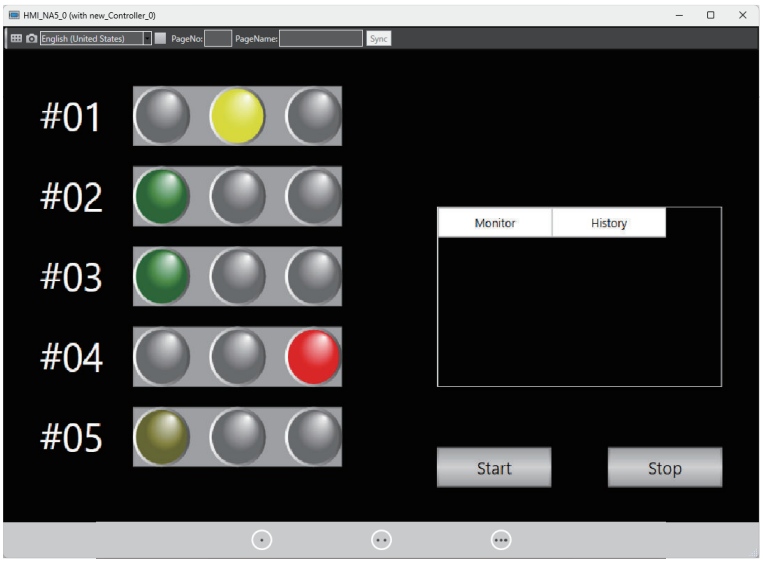
2 In the Sysmac Studio, open the project containing the HMI device to play back.
In addition to the project used for playback, you can also use HMI devices contained in other projects. In that case, along with the project used for playback, open the project containing the HMI devices to use.
Step 1 is unnecessary if the project opened for playback contains all HMI devices to play back.

3 Select **Automation Playback** – **Link with NA Simulator** from the **Tools** menu of the Sysmac Studio.
The **Select HMI device** dialog box is displayed.
The HMI devices contained in all open projects are listed.

4 Select the HMI device to use for playback.



5 Click the **Start HMI linkage** button.
The NA Simulator corresponding to the selected HMI device is displayed.



6 To play back HMI screens using the comparison target variable log, select **Automation Playback** – **Link with NA Simulator (Compare)** from the **Tools** menu of the Sysmac Studio.
The **Select HMI device** dialog box is displayed.

7 After completing step 4, select the HMI device to use for playback of the comparison target.
The NA Simulator corresponding to the selected HMI device is displayed.

When playback is ended, the NA Simulator ends.

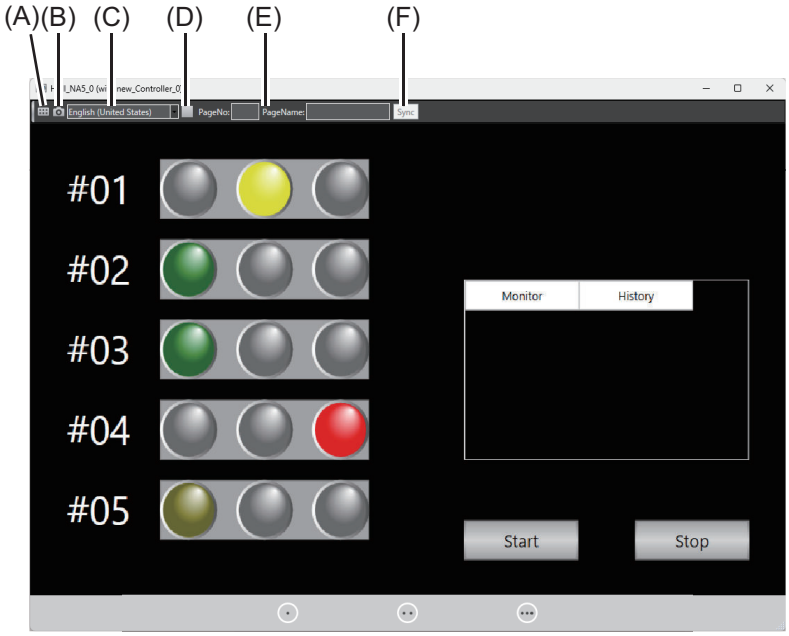
Additional Information

When the NA Simulator is started from Automation Playback, the following functions cannot be used.

- Watch tab page for the NA Simulator
- Functions related to subroutine debugging, such as breakpoints and step execution

Items in the NA Simulator Window

The table below shows the setting and information display items in the NA Simulator window.



Sym-bol	Name	Description
A		Click this button to select the page to display in the simulator when page synchronization is disabled in (F).
B		Click this button to copy the currently displayed page to the clipboard.
C	Language selection	Click this button to select the project language to display.
D		Click this button to exit the simulator.
E	**PagNo** and **PageName**	The page number and page name according to the variable log are displayed when page synchronization is enabled in (F).
F	**Sync** button	Click this button to set whether to enable or disable page synchronization. When page synchronization is enabled, the page number and page name according to the variable log are displayed in (E). You cannot select a page in (A). When page synchronization is disabled, the page set as the startup screen is displayed, and you can select a page using (A).

Precautions for Correct Use

To display the page number and page name, you need to collect the Controller's global variable data mapped to the HMI device's _HMI_CurrentPageIndex and _HMI_CurrentPage when collecting variable data. If this data is not collected, these items will be blank.

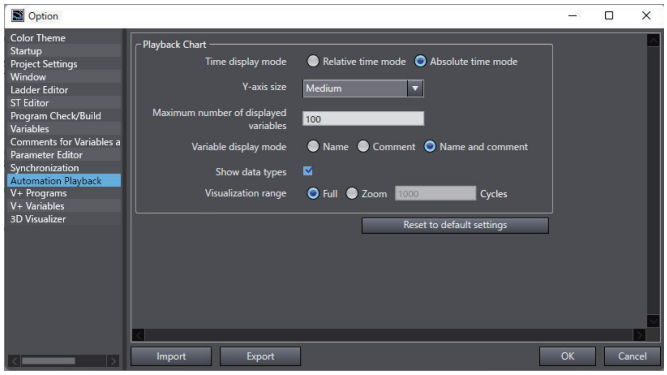
6-9 Configuring the Automation Playback Option Settings

Configure the automation playback option settings.

6-9-1 Procedure for Configuring the Automation Playback Option Settings

Use the following procedure to configure the automation playback option settings.

1 Select **Option** from the **Tools** menu of the Sysmac Studio.
The **Option** dialog box is displayed.



2 Select **Automation Playback** from the menu on the left side of the dialog box.
The Option view for automation playback is displayed.

6-9-2 Items for Automation Playback Option Setting

The table below shows the option setting items that you can configure for automation playback.

Catego-ry	Name	Description	Setting range	Default
Automa-tion Playback	Time display mode	Set the display mode for the time displayed on the time series variable graph in the Playback Chart window.	Relative time mode or Absolute time mode	Absolute time mode
	Y-axis size	Set the height of the time series variable graph displayed in the Playback Chart window.	Smallest, Small, Medium, Large, or Largest	Medium
	Maximum number of displayed variables	Set the maximum number of variables that can be displayed as a graph in the Playback Chart window at once.	Sysmac Studio (32 bit): 10 to 16 Sysmac Studio (64 bit): 10 to 256	Sysmac Studio (32 bit): 10 Sysmac Studio (64 bit): 100
	Variable display mode	Select from Name, Comment, and Name and comment to display in the variable information and legend displayed on the graph in the Playback Chart window.	Name, Comment, or Name and comment	Name and comment
	Show data types	Select whether or not to display the data type of the variable in the variable information and legend displayed on the graph in the Playback Chart window.	Selected or Not selected	Selected
	Visualization range	Set the time range of the variables to display in a time series variable graph.	Full or Zoom Cycles (1 to 3,600,000) when Zoom is selected	Full
	Reset to default settings button	Click this button to reset the automation playback option setting items to the default values.	---	---

7

Troubleshooting

Check and correct errors based on the error management method for the NJ/NX-series Controller and troubleshoot problems specific to the automation playback function.

7-1 Overview of Troubleshooting 7-2

7-2 Troubleshooting for Variable Data Collection 7-3

7-2-1 What to Do If Automation Playback Does Not Work 7-3
7-2-2 What to Do If Data Concurrency Cannot be Ensured in Variable Logs 7-5
7-2-3 What to Do If Variable Logs Are Shorter Than the Set Time 7-8

7-3 Checking Information on Sampling for Automation Playback 7-13

7-3-1 Checking the Operation Status of Automation Playback 7-13
7-3-2 Checking Variables and Memory Usage 7-17

7-4 Errors Related to the Playback Data Save Destination 7-20

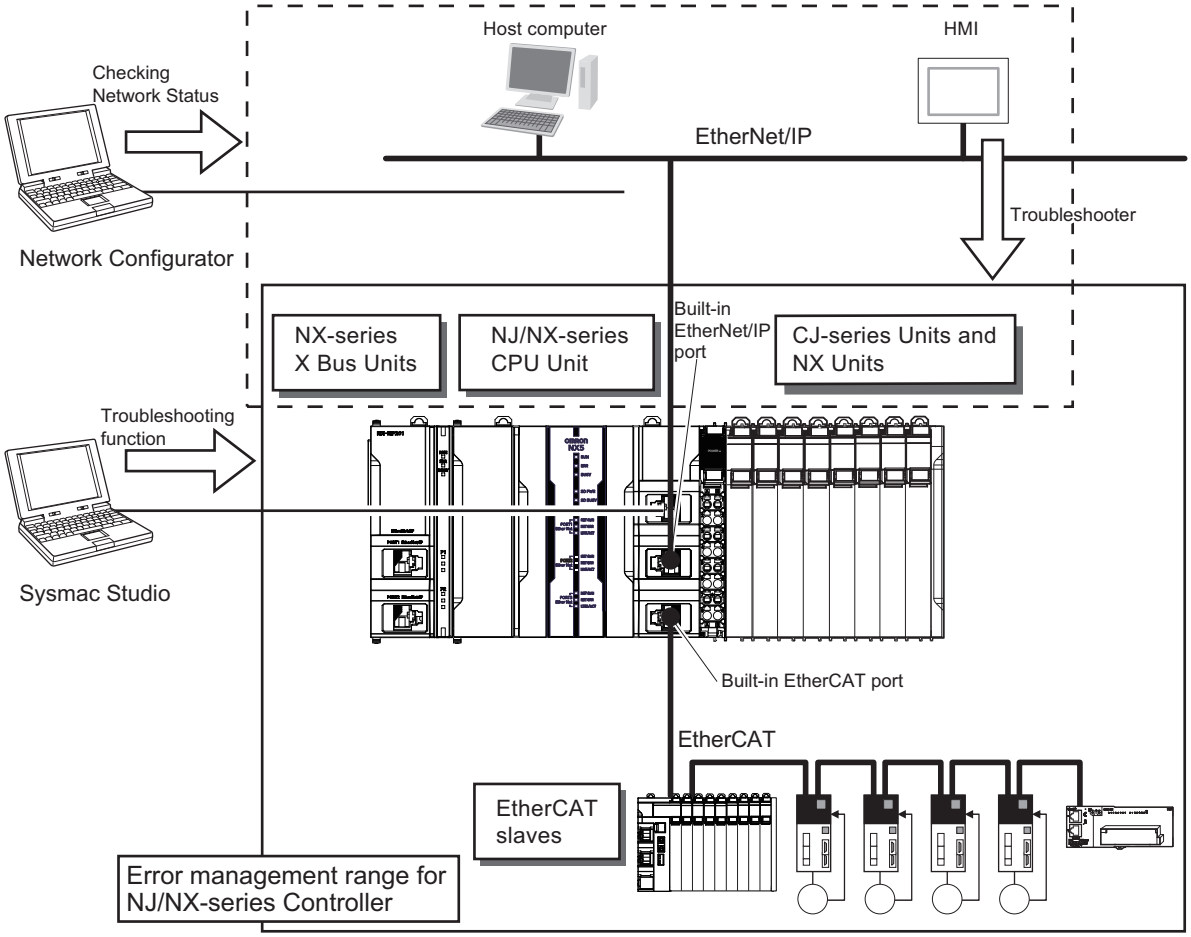
7-5 Errors Related to the Camera Control Function 7-21

7-5-1 Error Messages and Corrective Actions in Camera Communications Tests . 7-21

7-1 Overview of Troubleshooting

You manage all of the errors that occur on the NJ/NX-series Controller as events.
This allows you to see what errors have occurred and find corrections for them with the same methods for the entire range of errors that is managed (i.e., CPU Unit, X Bus Units, NX Units, NX-series Slave Terminals, EtherCAT slaves*1, and CJ-series Units).

*1. Only Sysmac devices are supported.



You can use the troubleshooting functions of the Sysmac Studio or the Troubleshooter on an HMI to quickly check for errors that have occurred and find corrections for them.

Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for error types and details, specific corrections when errors occur, and troubleshooting information on the entire NJ/NX-series Controllers.

7-2 Troubleshooting for Variable Data Collection

This section provides information on troubleshooting variable data collection.

7-2-1 What to Do If Automation Playback Does Not Work

To see if automation playback works correctly, use the Automation Playback Operation Monitor in the Sysmac Studio. Refer to *7-3-1 Checking the Operation Status of Automation Playback* on page 7-13 for information on the Automation Playback Operation Monitor.
If the automation playback does not work correctly, check the event log and take action according to the events.

The automation playback does not work in the following cases.

- The number and size of variable data to be collected are large and exceed the collection processing capacity of the Controller.
  The collection processing capacity may be exceeded even if the number and size of the sampled variables is less than the upper limit in *2-1-2 Upper Limit of Variable Data to Collect* on page 2-4.

If the following applies, the variable log is not output even if the automation playback is working.

- When the start/save trigger method is used and time from the establishment of the start trigger condition to the establishment of the file save trigger condition exceeds the time length that the CPU Unit can store data.
- When the storage to output the variable log is unavailable.

What to Do When Processing Capacity to Collect Variable Data Is Exceeded

When the processing capacity to collect variable data is exceeded for a Controller project, automation playback may stop operation. In such cases, variable data cannot be collected.

Problem	Cause	Correction
Automation playback does not work.	Since the number and size of variable data to be collected are large and the collection processing capacity has been exceeded, it is impossible to collect variable data.	Perform one or more of the following corrections. • Exclude POUs and variables that are not required to be collected from the sampling targets. • Exclude large-size variables, such as structure and array variables from the sampling targets. • Increase the task period.

When this problem occurs, the following event occurs.
Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name
95770000 hex (This event occurs for the CPU Unit with unit version earlier than 1.65.)	Upper Limit of Variable Sampling
95790000 hex (This event occurs for the CPU Unit with unit version 1.65 or later.)	Upper Limit of Variable Sampling
64040000 hex (This event occurs for the CPU Unit with unit version 1.68 or later.)	Upper Limit of Sampling Processing Capacity

When this problem occurs, the following event may have occurred beforehand.

Event code	Event name
64070000 hex	Cycle with No Variable Sampling

What to Do If the Time That the CPU Unit Can Accumulate Data is Exceeded

The start/save trigger method has the following characteristics.

- Sampling of variable data does not stop until the **file save trigger** condition is met.
  Sampling starts when the **start trigger** condition is met and does not stop only after the set sampling time has elapsed, but continues until the **file save trigger** condition is met.
- The sampled data accumulates a certain amount in the memory of the CPU Unit, and if sampling does not stop, the update continues.
  When the **file save trigger** condition is met, data stored in the memory of the CPU Unit is output to the variable log after variable sampling is stopped.

From the above characteristics, depending on the timing when the **file save trigger** condition is met, the time length of the data output to the variable log may be shorter than the set sampling time, or the variable log may not be output.

Problem	Cause	Correction
Variable logs are not output.	Since the interval between establishment of the **start trigger** condition and the **file save trigger** condition is long, the sampled data from the **start trigger** accumulated in the CPU Unit was updated with the subsequent sampled data.	When the start/save trigger method is used and variable log is output, make sure to promptly establish the **file save trigger** condition.
Time length of variable log data is shorter than the set time.	Refer to *7-2-3 What to Do If Variable Logs Are Shorter Than the Set Time* on page 7-8 for details.	

If the variable log cannot be output, the following event occurs.

Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name
152C000 hex	Variable Log Save Failed

What to Do If the Storage of Output Files Is Unavailable

Variable logs will not be output when the storage at the variable log output destination is unavailable.

Problem	Cause	Correction
Variable logs are not output.	The storage at the variable log output destination is unavailable. • There is no SD Memory Card. • The SD Memory Card has no available space. • The SD Memory Card or the SD Memory Card folder is write-protected. • Power supply to the SD Memory Card has stopped. • The SD Memory Card is unable to write data due to a data error. • The SD Memory Card is damaged. • The SD Memory Card is formatted during output of variable logs.	Check and remove the causes listed on the left.

When this problem occurs, the following event occurs.
Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name
152C0000 hex	Variable Log Save Failed

7-2-2 What to Do If Data Concurrency Cannot be Ensured in Variable Logs

Depending on the project in the Controller, it may not be possible to ensure data concurrency in variable logs. Data concurrency means that all variable data in a task period is read as data in the same task period. As explained in *2-1-3 Sampling Operation of Variable Data* on page 2-7, automation playback acquires variable data for a task period during the unused time in the task period. The "concurrency of variable data cannot be ensured" if all variable data within a task period is not acquired in the same task period and is obtained over multiple task periods.
When variable logs are used to investigate applications such as high-speed, high-precision motion control where a periodic gap of changes in variable values can cause problems, it is important that data concurrency is ensured in the variable logs. When you use the automation playback, make sure during testing operation with the Automation Playback Operation Monitor that data concurrency of the variable logs is ensured in the actual operating environment. Refer to *7-3-1 Checking the Operation Status of Automation Playback* on page 7-13 for information on the Automation Playback Operation Monitor.

Version Information

In Sysmac Studio version 1.62 or later, if a variable log for which data consistency cannot be ensured is loaded, the message "No data concurrency/Cycle with no sampling occurred" will appear in the **Playback** dialog box.

Problem	Cause	Correction
• Data concurrency cannot be ensured in variable logs. • There are periods in which sampling of variables is not performed.	• Number of variables to be sampled If the the number of variables is large, the time required for variable sampling is long. Therefore, if the number of variables is large, sampling of the target variables cannot be completed within the same task period. • Task period If the task period is short, the number of sampling target variables that can be processed in one task period is small. Therefore, if the task period is short, sampling of the target variables cannot be completed within the same task period. • Time required for sampling variables in the primary periodic task If the time required for sampling variables in the primary periodic task is long, the time available for sampling variables in periodic tasks will be short and the sampling in the periodic tasks may not be completed.	Perform one or more of the following corrections. • Reduce the number of sampling target variables. • Reduce the task execution time ratio by setting a longer task period or reducing the number of POUs assigned to the task. • For the primary periodic task, you may exclude axis variables from the sampling target. Refer to *Procedure for What to Do If Data Concurrency Cannot be Ensured in Variable Logs* on page 7-7 for the detailed procedure.

When this problem occurs, the following event occurs.
Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

Event code	Event name
64060000 hex	No Variable Log Concurrency
64070000 hex	Cycle with No Variable Sampling

Precautions for Correct Use

If playback is executed in the Sysmac Studio with a variable log that contains data subject to the Cycle with No Variable Sampling event, the time of the data may not be displayed correctly. For example, if a variable log has 50 non-sampling periods when data was collected for 10,000 periods with the task period set to 1 ms, the sampling time of the data collected at 1,000 ms may be displayed as 1,005 ms. This occurs because the data collected in 9,950 cycles is averaged to 10,000 periods for playback.

Additional Information

- For the procedure to change the variables to be sampled, refer to *Procedure for Setting the Variable Data Sampling Target* on page 2-15.
- Guideline for task execution time ratio is given in the table below. Refer to the *NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)* for how to design tasks.

Task period of primary periodic task	Guideline for task execution time ratio
250μs	60% or less
500μs or more	80% or less

Procedure for What to Do If Data Concurrency Cannot be Ensured in Variable Logs

The following is the procedure for what to do if data concurrency cannot be ensured in variable logs.

Precautions for Correct Use

The ability to ensure data concurrency in variable logs and sampling variables changes mainly due to the following factors.
- Task period
- Task execution time ratio
- Number of variables included in the sampling target
- Data types of variables included in the sampling target

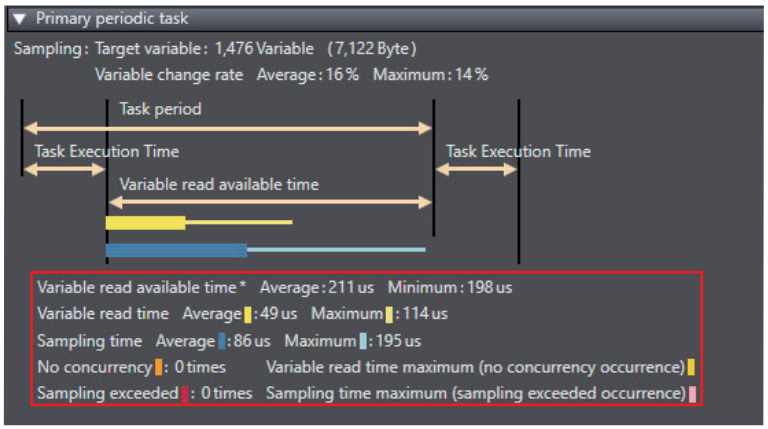
Since these are not uniquely determined by the system environment or program structure that you use, the automation playback function does not place function restrictions on these changing factors. Make the testing operation to confirm whether it can perform as expected in the environment that you use.

1 From the event log, find a task for which data concurrency of variable logs cannot be ensured.
The task type for which concurrency of variable log cannot be ensured is shown in Attached information 1 of the No Variable Log Concurrency event (64060000 hex) and Cycle with No Variable Sampling event (64070000 hex).

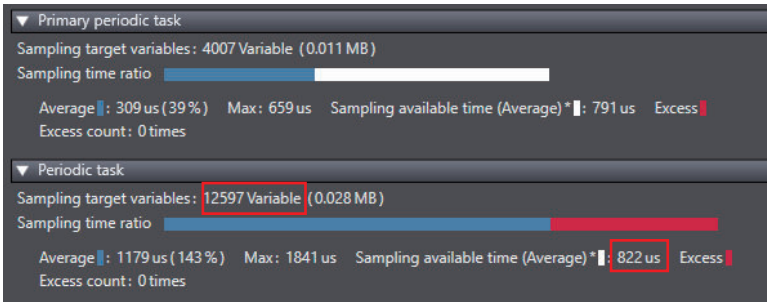
2 Display the **Automation Playback Operation Monitor**.
Refer to *7-3-1 Checking the Operation Status of Automation Playback* on page 7-13 for how to display the **Automation Playback Operation Monitor**.

3 In the **Automation Playback Operation Monitor** dialog box, check the current number of sampling target variables and the sampling operation status in tasks where data concurrency in the variable logs is not ensured.

- Project unit version 1.68 or later
  Check if the *Variable read time* exceeds the *Variable read available time* or if the *No concurrency* count continues increasing.



- Project unit version earlier than 1.68



4 Reduce the number of sampling target variables in Automation Playback Settings.
Refer to *2-3-1 Setting the Variable Data Sampling Target* on page 2-15 for how to reduce the number of sampling target variables.

5 If data concurrency cannot be ensured in variable logs even after sampling targets are reduced, set a longer task period.

7-2-3 What to Do If Variable Logs Are Shorter Than the Set Time

Depending on the project in the Controller, the length of output variable log data may be shorter than the set collection time. You can check the time output to the variable log in the event.
When you use the automation playback, make sure during the testing operation that variable logs for the set time are output in the actual environment.

Problem	Cause	Correction
Variable log data is shorter than the set time	The set sampling data size is larger than the memory size of the CPU Unit available for storing the sampling data. • Number of variables to be sampled The larger the number of variables, the larger the size of the variable sampling data, so the time allowed for output to the variable log is shorter. • Variable data type The automation playback handles structure variables and array variables as single variables. Even if the number of variables is small, the sampling data size is large when it contains a large number of structure variables and array variables. Therefore, when structure variables or array variables are sampled, the time allowed for output to variable logs is shorter than when the same number of basic data types is sampled.	Perform one or more of the following corrections. • Reduce the number of sampling target variables. • For the primary periodic task, you can exclude axis variables from the sampling target. Refer to *2-3-1 Setting the Variable Data Sampling Target* on page 2-15 for how to select program POUs and variables to be included in the sampling target and exclude axis variables from the sampling target.

You can check the time output to the variable log in the attached information of the following event. Refer to the *NJ/NX-series Troubleshooting Manual (Cat. No. W503)* for information on the event.

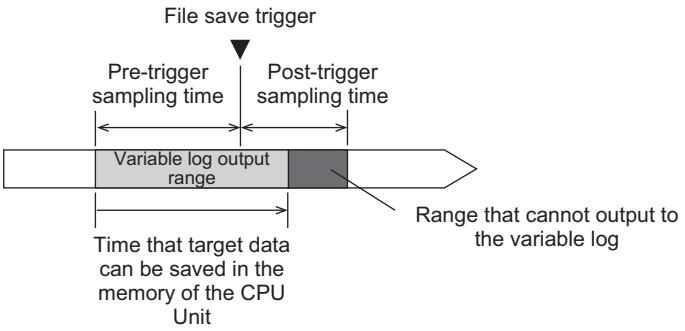
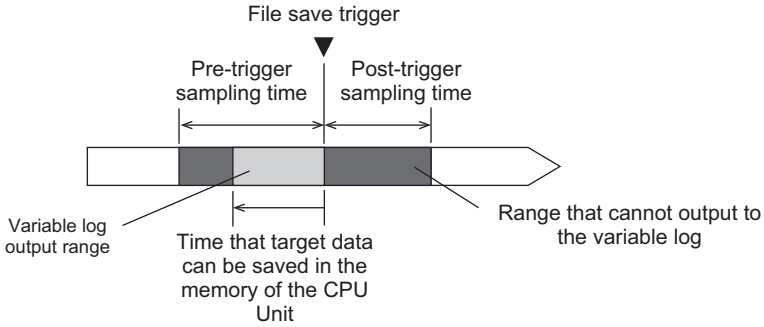
Event code	Event name
95750000 hex	Variable Log Output Completed

Variable Log Output Range If Variable Logs Are Shorter Than the Set Time

If the size of the set sampling data is larger than the memory size of the CPU Unit that can save the sampling data, the time for data output in the variable log will be shorter than the set time.
The range of data output to the variable logs is as follows.

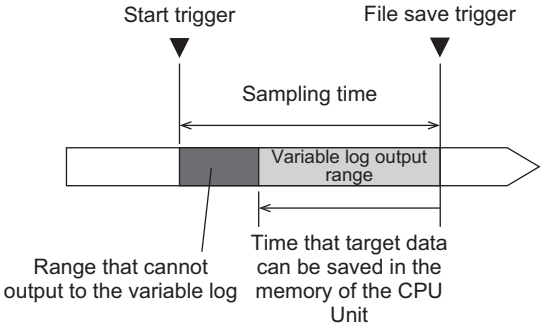
Pre/Post Trigger Method

Data from the pre-trigger sampling time is output to the variable log with priority over data from the post-trigger sampling time. Also, data collected around the time the file save trigger condition is met is prioritized and save to the variable log.

Condition	Variable log output range
The time that target data can be saved in the memory of the CPU Unit is shorter than the sum of the pre-trigger sampling time and post-trigger sampling time, and it is longer than the pre-trigger sampling time.	All data collected in the pre-trigger sampling time and the data in the post-trigger sampling time around the time the file save trigger condition is met are output to the variable log. 
The time that target data can be saved in the memory of the CPU Unit is shorter than the pre-trigger sampling time.	Of the data collected in the pre-trigger sampling time, the data collected around the time the file save trigger condition is met is output to the variable log. 

Start/Save Trigger Method

Data collected around the time the file save trigger condition is met is prioritized and output to the variable log.

Condition	Variable log output range
The time that target data can be saved in the memory of the CPU Unit is shorter than the sampling time.	Of the data collected in the sampling time, the data collected around the time the file save trigger condition is met is output to the variable log. 

Checking the Sampling Data Size

Check the sampling data size. You can know which POU or variable to exclude from the sampling target when you want to reduce the sampling data size.

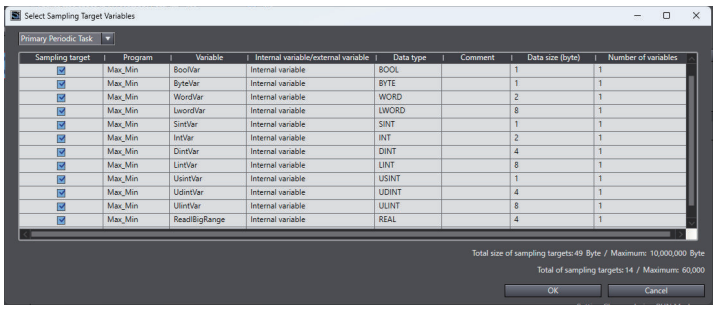
● Checking the Sampling Data Size for Each Variable (Ver. 1.65 or Later)

You can check the sampling data size for each variable in the **Select Sampling Target Variables** dialog box.

Version Information

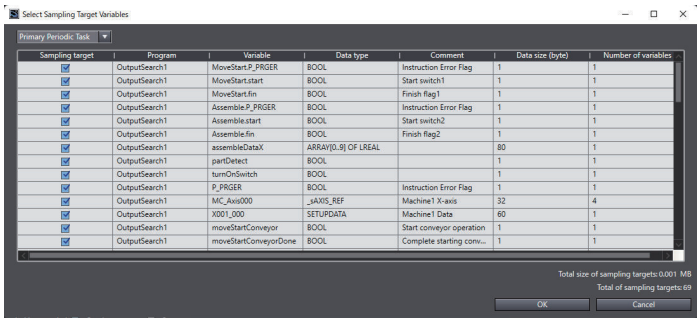
This function is available in project unit version 1.65 or later.

- Project unit version 1.68 or later



Sampling target	Program	Variable	Internal variable/external variable	Data type	Comment	Data size (byte)	Number of variables
☑	Max_Min	BoolVar	Internal variable	BOOL		1	1
☑	Max_Min	ByteVar	Internal variable	BYTE		1	1
☑	Max_Min	WordVar	Internal variable	WORD		2	1
☑	Max_Min	LwordVar	Internal variable	LWORD		8	1
☑	Max_Min	SintVar	Internal variable	SINT		1	1
☑	Max_Min	IntVar	Internal variable	INT		2	1
☑	Max_Min	DintVar	Internal variable	DINT		4	1
☑	Max_Min	LintVar	Internal variable	LINT		8	1
☑	Max_Min	UsintVar	Internal variable	USINT		1	1
☑	Max_Min	UdintVar	Internal variable	UDINT		4	1
☑	Max_Min	UlintVar	Internal variable	ULINT		8	1
☑	Max_Min	ReadBigRange	Internal variable	REAL		4	1

- Project unit version earlier than 1.68



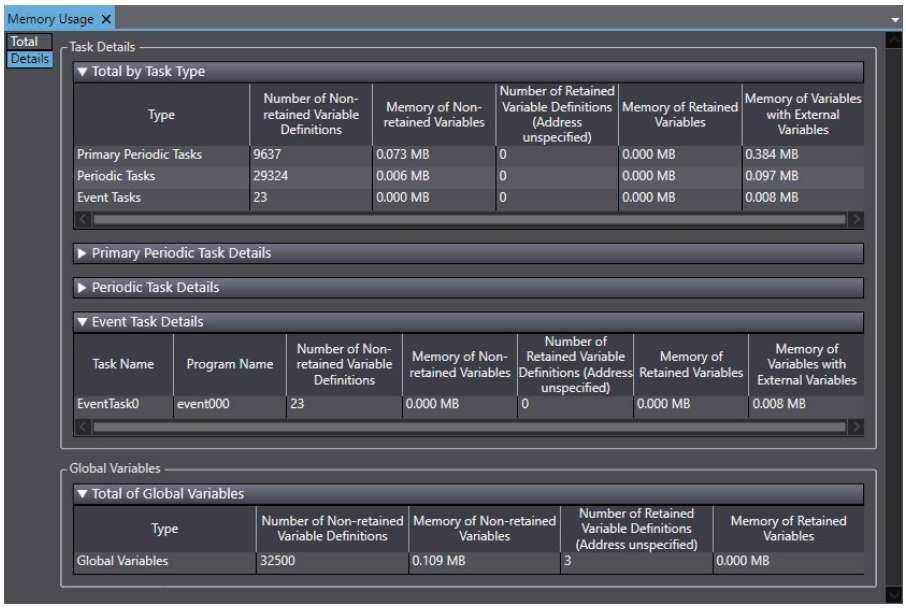
Sampling target	Program	Variable	Data type	Comment	Data size (byte)	Number of variables
☑	OutputSearch1	MoveStart.P_PRGER	BOOL	Instruction Error Flag	1	1
☑	OutputSearch1	MoveStart.start	BOOL	Start switch1	1	1
☑	OutputSearch1	MoveStart.fin	BOOL	Finish flag1	1	1
☑	OutputSearch1	Assemble.P_PRGER	BOOL	Instruction Error Flag	1	1
☑	OutputSearch1	Assemble.start	BOOL	Start switch2	1	1
☑	OutputSearch1	Assemble.fin	BOOL	Finish flag2	1	1
☑	OutputSearch1	assembleDataX	ARRAY[0..9] OF LREAL		80	1
☑	OutputSearch1	partDetect	BOOL		1	1
☑	OutputSearch1	turnOnSwitch	BOOL		1	1
☑	OutputSearch1	P_PRGER	BOOL	Instruction Error Flag	1	1
☑	OutputSearch1	MC_Axis000	_sAXIS_REF	Machine1 X-axis	32	4
☑	OutputSearch1	X001_000	SETUPDATA	Machine1 Data	60	1
☑	OutputSearch1	moveStartConveyor	BOOL	Start conveyor operation	1	1
☑	OutputSearch1	moveStartConveyorDone	BOOL	Complete starting conv...	1	1

You can see the size of each variable in **Data size** column in the **Select Sampling Target Variables** dialog box. Sort by variable data size to see which variable has large data size.
Refer to *Checking the Number of Variables and Memory Usage of Each Variable (Ver. 1.65 or Later)* on page 7-17 for how to display the **Select Sampling Target Variables** dialog box.

● How to Check Sampling Data Size Per Program POU

The approximate size of sampling data per program POU is checked on the **Memory Usage** tab page.
When you select the **Details** in the **Memory Usage** tab page, information on variables included in the program POU assigned to each task is displayed. The **Memory of Variables with External Variables** for the program POU in the **Task Details** section is the guideline of the sampling data size per program POU[*1].

*1. Some **Memory of Variables with External Variables** may not match completely because they include sizes of variables that are not included in the sampling target.



Refer to *Procedure for Checking the Number of Variables to Use in Program POUs and the Memory Usage* on page 7-18 for information on how to display the **Memory Usage** tab page.

7-3 Checking Information on Sampling for Automation Playback

You can check information on sampling for automation playback.

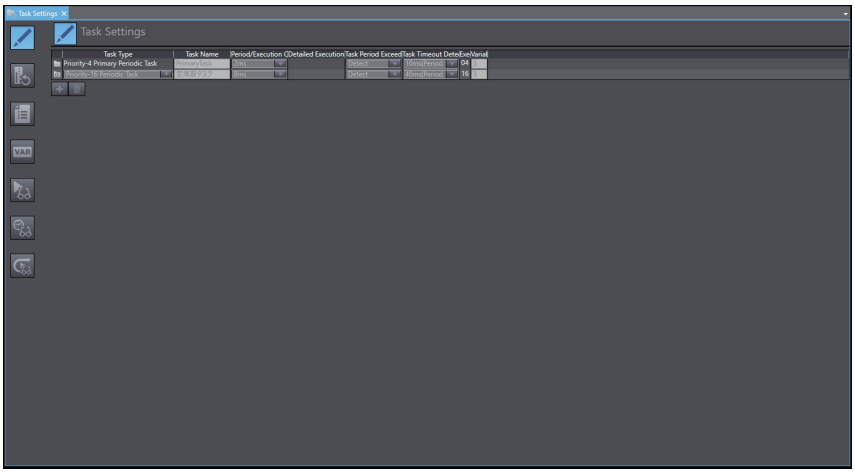
7-3-1 Checking the Operation Status of Automation Playback

Check the operation status using the Automation Playback Operation Monitor.

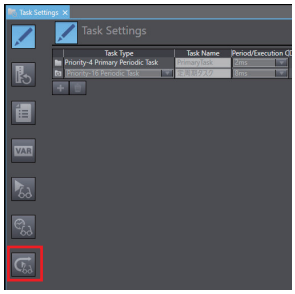
Procedure for Checking the Operation Status of Automation Playback

Use the Automation Playback Operation Monitor in the Sysmac Studio to check the sampling time margin, sampling status, etc.
To use the Automation Playback Operation Monitor, it is required that the CPU Unit is in RUN Mode and that the Sysmac Studio and the Controller are online.

1 Double-click **Task Settings** under **Configurations and Setup** or right-click it and select **Edit** from the menu in the Multiview Explorer of the Sysmac Studio.
The Edit pane is displayed.

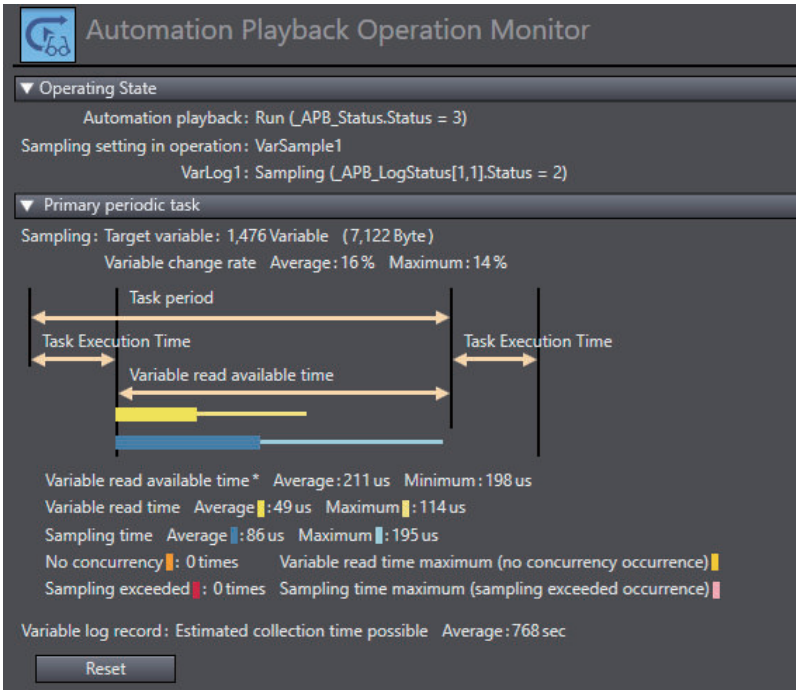


2 In the **Task Settings** display shown in the Edit pane, click the **Automation Playback Operation Monitor** button.

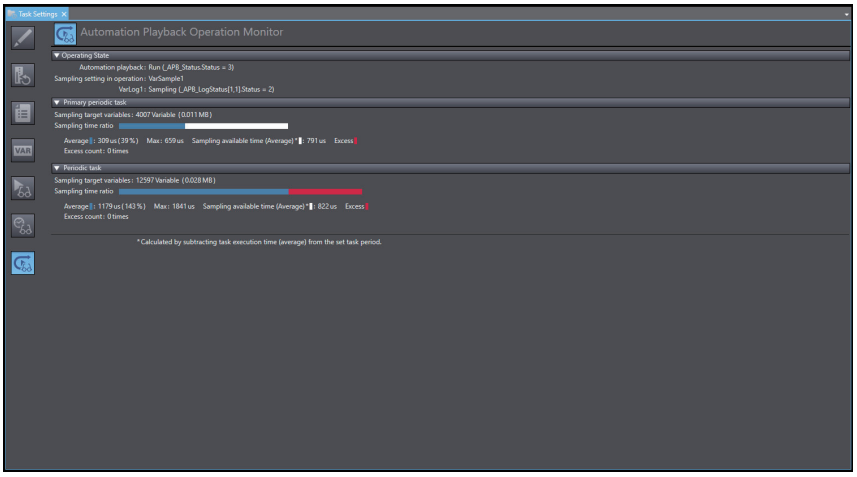


The **Automation Playback Operation Monitor** dialog box is displayed.

- Project unit version 1.68 or later



- Project unit version earlier than 1.68



Additional Information

The **Automation Playback Operation Monitor** dialog box is displayed in a separate window from the **Automation Playback Settings** display, so you can arrange the windows side by side to check playback operation.

3 Check the information.

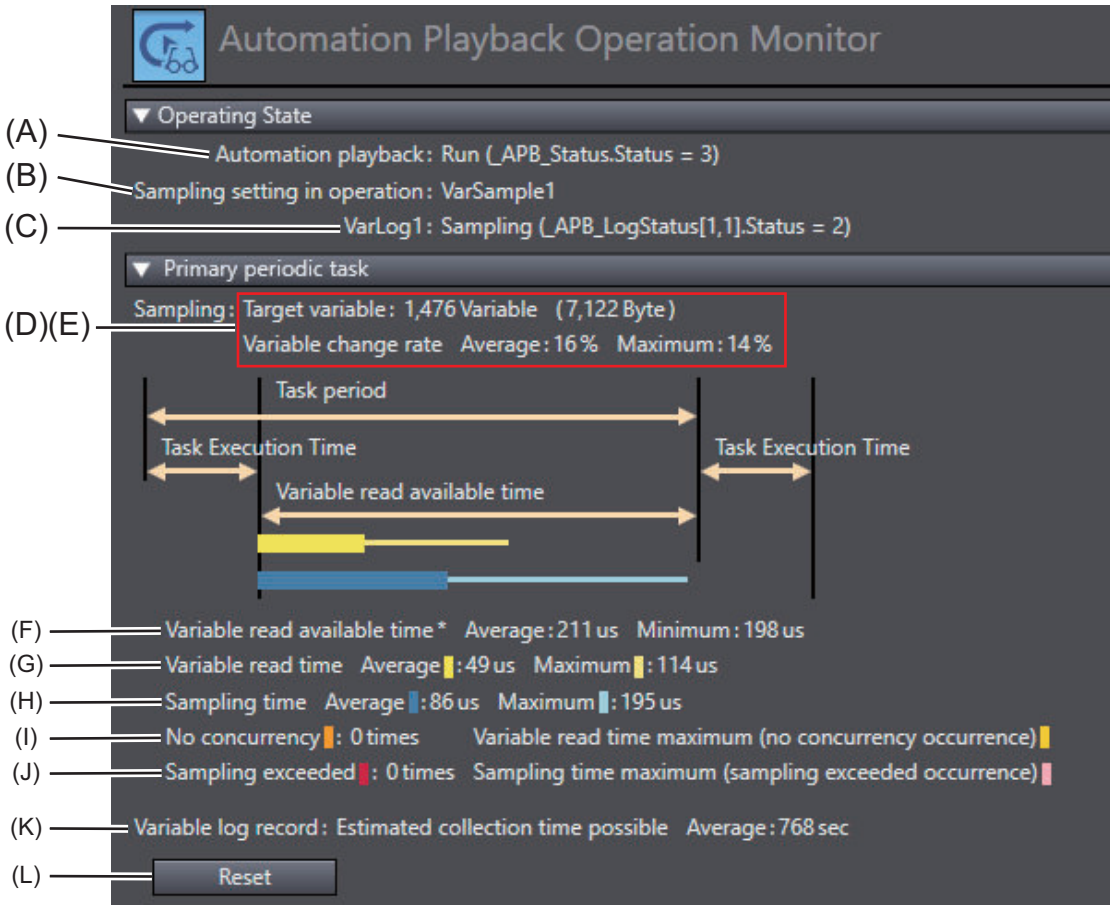
If the sampling time exceeds the task period, data concurrency cannot be ensured. To ensure data concurrency, reduce the number of sampling target variables.

Refer to *7-2-2 What to Do If Data Concurrency Cannot be Ensured in Variable Logs* on page 7-5 for how to ensure data concurrency.

Items That You Can Check in the Automation Playback Operation Monitor

You can check information on sampling for automation playback.

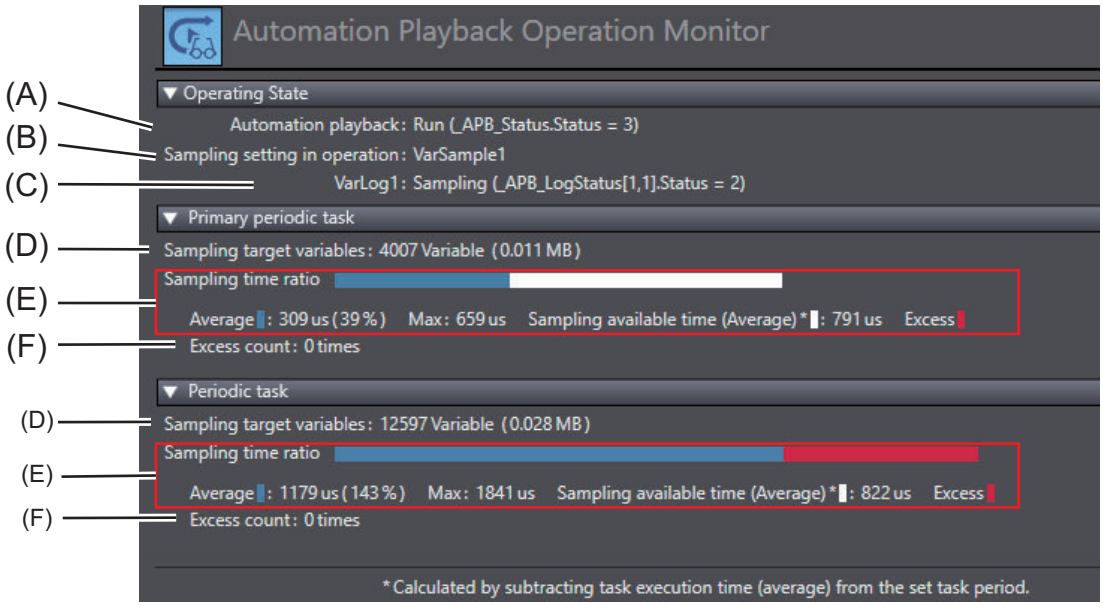
● Automation Playback Operation Monitor (Project unit version 1.68 or later)



Symbol	Item	Description
A	Automation playback	Displays the status of automation playback. When it is disabled, (B) and subsequent monitor values will not be displayed. Refer to *A-1-1 State Transitions for Automation Playback Function* on page A-2 for details on the status of automation playback.
B	Sampling setting in operation	Displays the setting name of the active sampling setting.
C	Variable log output setting during operation	Displays the setting name and sampling state of the variable log output setting during operation.
D	Target variable	Displays the number and the total data size of sampling target variables.
E	Variable change rate	Displays the percentage of the data size of variables whose values changed to the total data size of the sampling target variables.
F	Variable read available time	Displays the time available for reading variables while ensuring data concurrency, which is calculated as (task period - task execution time).

Symbol	Item	Description
G	Variable read time	Displays the time required for reading sampling target variables in sampling processing (from reading to storing the variables in memory).
H	Sampling time	Displays the time required for sampling processing.
I	No concurrency	Indicates the number of times of sampling in which data concurrency cannot be ensured because the *Variable read time* exceeds the *Variable read available time*.
J	Sampling exceeded	Displays the number of times variable sampling was omitted because sampling processing was not completed before the start of the next sampling processing.
K	Estimated collection time possible	Displays the maximum estimated time for recording in a variable log. The time available for recording varies depending on the percentage of variables whose values change.
L	Reset button	Resets the following values. *Variable change rate*, *Variable read available time*, *Variable read time*, *Sampling time*, *No concurrency* count, *Sampling exceeded* count, and *Estimated collection time possible*

● Automation Playback Operation Monitor (Project Unit Version Earlier Than 1.68)



Symbol	Item	Description
A	Automation playback	Displays the status of automation playback. When it is disabled, (B) and subsequent monitor values will not be displayed. Refer to *A-1-1 State Transitions for Automation Playback Function* on page A-2 for details on the status of automation playback.
B	Sampling setting in operation	Displays the setting name of the active sampling setting.
C	Variable log output setting during operation	Displays the setting name and sampling state of the variable log output setting during operation.
D	Sampling target variables	Displays the number and size of sampling target variables for the primary periodic task or periodic task.

Symbol	Item	Description
E	Sampling time ratio	Displays a stacked bar chart showing the average and exceeded sampling times for the primary periodic task or periodic task, where each bar has a length corresponding to its time percentage with the Sampling available time (Average) as 100%. The maximum value is displayed at the bottom of the bar. • Average Displays the average value of sampling time for the primary periodic task or periodic task in units of μs and as a percentage [%] of the Sampling available time (Average). • Max Displays the maximum value of sampling time for the primary periodic task or periodic task in units of μs. • Sampling available time (Average) Displays the value calculated from set period of primary periodic task or periodic task minus task execution time (average) in units of μs. • Excess This is the sampling time for the portion where the average value of sampling time for the primary periodic task or periodic task exceeds the Sampling available time (Average). A bar with a length corresponding to its time percentage is shown. The value is not shown.
F	Excess count	Displays the number of times the sampling processing for the variable was not executed due to the following factors. a. The sampling processing for the primary periodic task or periodic task did not complete before the next sampling process began. b. The number and size of the sampled variables exceeded the upper limit of the collection processing capacity.

7-3-2 Checking Variables and Memory Usage

You can check the number of sampling target variables and memory usage.

Checking the Number of Variables and Memory Usage of Each Variable (Ver. 1.65 or Later)

You can see the number of variables used and memory usage on the variable list in the **Select Sampling Target Variables** dialog box.

Version Information

The functions used in this procedure are available in project unit version 1.65 or later.

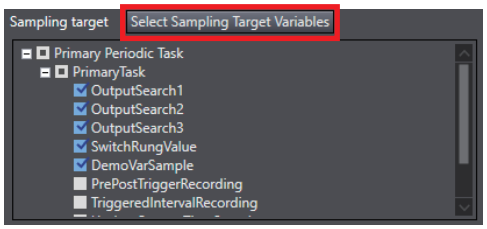
1 Double-click **Operation Settings** under **Configurations and Setup** – **Controller Setup** from the Multiview Explorer of the Sysmac Studio. Or right-click Operation Settings and select **Edit** from the menu.

2 In the **Operation Settings** tab page displayed in the Edit pane, click the **Automation Playback Settings** button.

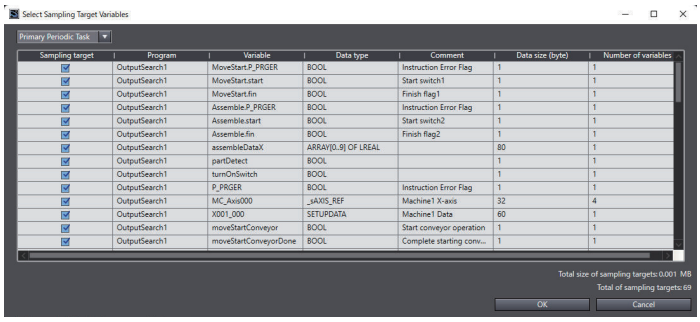
The **Automation Playback Settings** display opens.

3 Click **Sampling Setting 1** or **Sampling Setting 2**.
The sampling settings are displayed.

4 Click the **Select Sampling Target Variables** button.



The **Select Sampling Target Variables** dialog box is displayed.

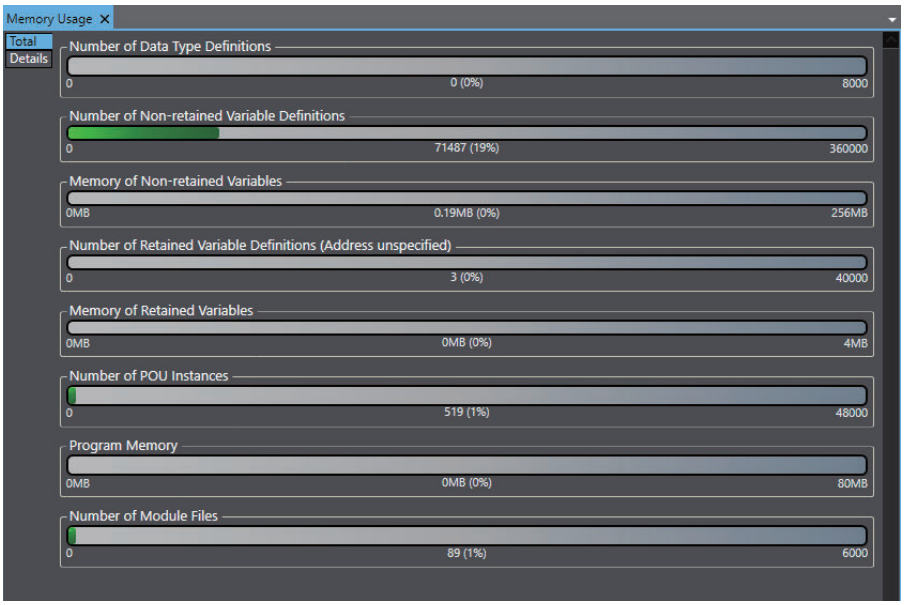


5 Check the information displayed in the dialog box.
Sort by the **Data size (byte)** column to see which variables have larger data sizes. You can also filter by program POU to see which variables are included in the program POU.
For more information on the **Select Sampling Target Variables** dialog box, refer to *Items on the Select Sampling Target Variables Dialog Box* on page 2-19.

Procedure for Checking the Number of Variables to Use in Program POUs and the Memory Usage

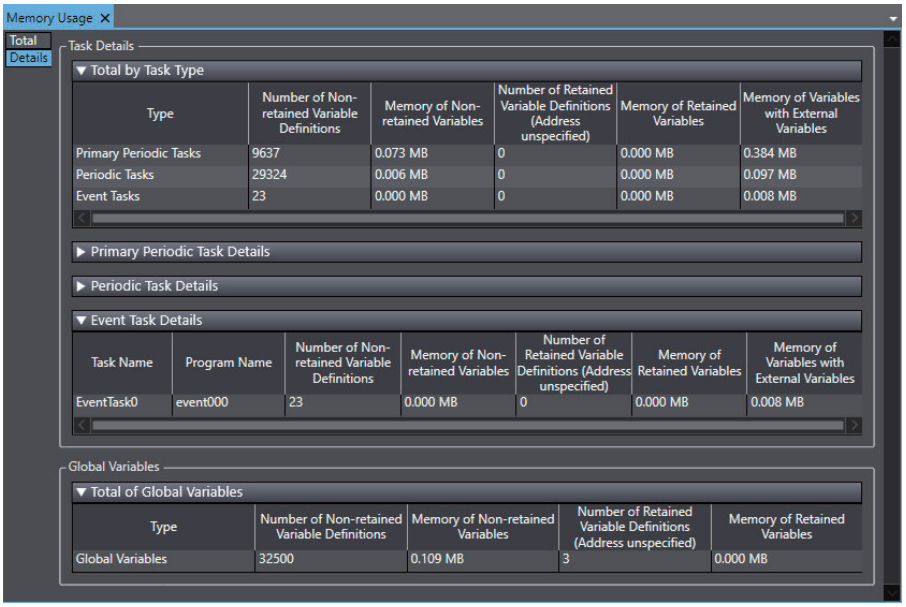
In the **Memory Usage** tab page in the Sysmac Studio, check the number of variables to use in program POUs assigned to tasks and the memory usage.

1 Select **Memory Usage** from the **Project** menu of the Sysmac Studio.
The **Memory Usage** tab page is displayed.



2 Click **Details**.

Detailed information is displayed.



3 Check each information.

Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for information on each item in the Details view.

7-4 Errors Related to the Playback Data Save Destination

The table below shows errors related to the playback data save destination.

Item	Error cause	Behavior	Correction
Network storage connection	Data cannot be saved because there is an error in the settings to use network storage.	The variable log output changes to the Error state and the Network Storage Connection Failed event (95A50000 hex) occurs.	Correct the network storage settings using the Sysmac Studio.
	The network storage has not been started, or connection to the network storage is not possible due to a network failure.	The variable log output changes to the Error state and the Network Storage Connection Failed event (95A50000 hex) occurs. The attached information for the event is either *2: Failed to access.* or *3: Timeout*.	Start the network storage or resolve the network failure. Execute a **communications test** using the Sysmac Studio to confirm that a connection can be established.
File saving	The playback data file cannot be saved because its output destination is not available.	The variable log output changes to the Error state and the Variable Log Save Failed event (152C0000 hex) occurs. When saving a video or backup file, the Video File Output Failed event (957F0000 hex) and the Backup Failed event (10360000 hex) also occur.	Make the output destination for playback data available.

7-5 Errors Related to the Camera Control Function

The table below shows errors that occur with the camera control function and their corrections.

Item	Error cause	Behavior	Correction
Camera settings	An attempt was made to register camera settings with more than 10 cameras enabled.	The camera control function changes to the Error state and the Number of Active Cameras Exceeded event (95A60000 hex) occurs.	Reduce the number of enabled cameras to 10 or less using the Web UI or the system-defined variable (_APB_CamActivate).
Camera connection	There is an error in the settings to use the camera control function, preventing connection to the cameras.	The camera control function changes to the Error state and the Camera Connection Failed event (95A40000 hex) occurs.	Correct the camera settings using the Web UI.
	The cameras have not been started, or connection to the cameras is not possible due to a network failure.	The camera control function changes to the Error state and the Camera Connection Failed event (95A40000 hex) occurs. The attached information for the event is either *2: Failed to access.* or *3: Timeout*.	Start the cameras and resolve the network failure. Execute a **communications test** in the Web UI to confirm that a connection can be established.
Video file saving	The camera cannot save video files because the output destination for playback data is not available.	The camera control function changes to the Error state and the Video File Output Failed event (957F0000 hex) occurs.	Make the output destination for playback data available.

Precautions for Correct Use

When the save destination is set to the SD Memory Card and video data is selected for the collection, the SD Memory Card will not be unmounted even if the SD Memory Card power supply switch is pressed while the controller is in RUN mode. To remove the SD Memory Card, switch the controller to PROGRAM mode, press the SD Memory Card power supply switch, and then remove the SD Memory Card after the SD PWR indicator turned off.

7-5-1 Error Messages and Corrective Actions in Camera Communications Tests

The table below shows corrective actions to take if an error message is displayed in camera communications tests.

Error message	Description	Correction
0203 Connection unreachable Connection unreachable: <IP address>	• Connection failed due to a mismatch in the user name or password. • Communications cannot be established due to a network failure, etc. • Connection timed out.	Make sure that the camera connection settings are correct, power is supplied to the camera, and there are no network failures.

Error message	Description	Correction
0204 Authentication failed Authentication failed: <IP address>	Camera authentication failed.	Make sure that HTTPS communications settings are enabled for the camera and the camera certification settings have not been changed from the defaults.
0203 Execution Error Connection test failed: <IP address>	An error other than those listed above occurred.	---

A

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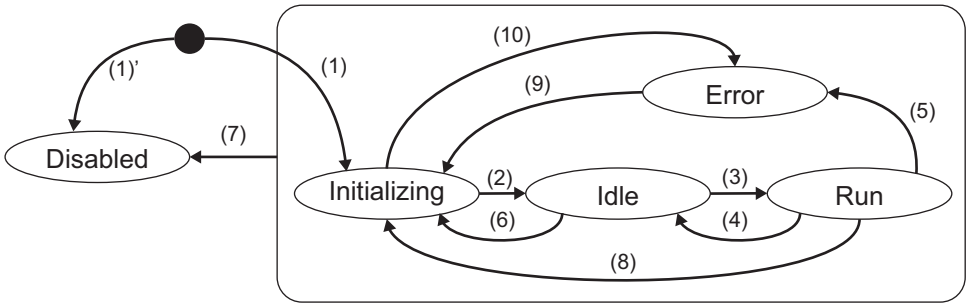
A-1 State Transitions

A-1-1 State Transitions for Automation Playback Function

For the automation playback function, state transitions occur in the Controller as shown in the following state transition diagram.
You can check each transition state by the values of system-defined variables related to the automation playback function.



State	Value in _APB_Status.Status	Description
Disabled	0	Automation playback is set to **Do not use**[*1], or the simulator is started.
Initializing	1	Automation playback function is performing its initial processing.
Idle	2	• Automation playback function completed the initial processing, but has not started sampling of variables. • Camera connection settings can be performed. (Unit version 1.71 or later)
Run	3	• Automation playback function is running. • Camera connection settings and camera control can be performed. (Unit version 1.71 or later)
Error	4	An error in sampling of variables with the automation playback function occurs, or an unexpected error occurs in the automation playback function.

*1. This includes the state of the Controller that is set to **Do not use** for automation playback, until the Controller restarts after the setting configured to **Use** is transferred.

The conditions for transition to each state are as follows.

No.	Main transition conditions	Event to occur
1	A Controller that is set to **Use** for the automation playback is started.	
1'	A Controller that is set to **Do not use** for the automation playback function is started.	
2	Automation playback function completes its initial processing.	
3	The conditions for starting variable sampling (all of the following) are met. • Valid sampling settings are transferred to the Controller. • The Controller changes from PROGRAM Mode to RUN Mode. Or one of the following conditions is met. • Online editing is completed. • Change of the Controller's time information is completed with the Sysmac Studio.	• Variable Sampling Started (95730000 hex)

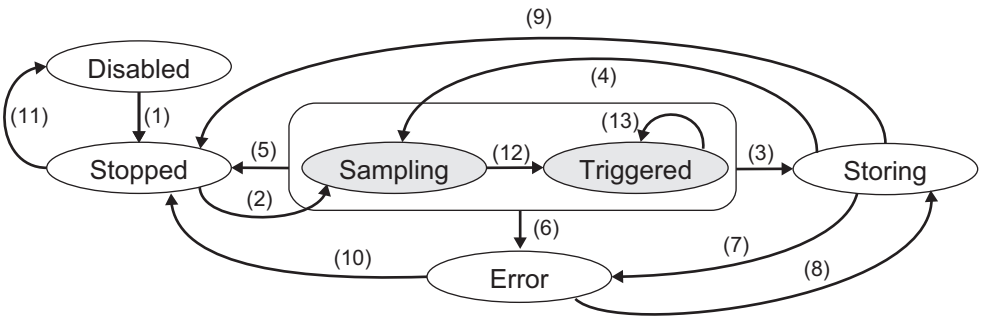
No.	Main transition conditions	Event to occur
4	One of the following conditions is met. *1 • The Controller changes to a state other than RUN Mode. • The user program or variable settings that were changed by online editing are reflected in the Controller. • A major fault level event occurred in the Controller. (Unit version earlier than 1.71) • Change of the Controller's time information is started with the Sysmac Studio.*2	
5	The following occurred with **Behavior after task period is exceeded** set to **Stop** in the variable log sampling setting. • Concurrency cannot be ensured in variable logs. • The system determines that there are periods in which sampling is not performed. • An unexpected error occurred in the automation playback function.	• No Variable Log Concurrency (64060000 hex) • Cycle with No Variable Sampling (64070000 hex)
6	The changed settings for the automation playback are transferred.	
7	**Do not use** setting for automation playback is transferred. Clear All Memory was performed.	
8	The APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed. Or, **Setting Change during RUN Mode** is performed.	
9	The changed settings for the automation playback are transferred (including the transfer through **Setting Change during RUN Mode**), or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed.	
10	An unexpected error occurred in the automation playback function. Or, a setting that exceeds the upper limit of variable sampling was applied to the Controller.	

*1. The data for the variables that have been sampled is discarded. Do not perform any operations that meet these conditions during the period of obtaining variable log.

*2. This does not include changes of time information by referencing an NTP server or with the SetTime instruction. In addition, when time information is changed with the NTP or instruction, variable logs that cannot be read in the Sysmac Studio may be output depending on the output timing of the variable log.

A-1-2 State Transitions in Variable Log Output Based on the Pre/Post Trigger Method

For variable log output based on the pre/post trigger method, state transitions occur in the Controller as shown in the following state transition diagram. Note that sampling of variables is performed in states shown in gray in the diagram.



State	Value in _APB_LogStatus.Status	Description
Disabled	0	There is no variable log output setting based on the pre/post trigger method, or the sampling setting related to the variable log output setting based on the pre/post trigger method is disabled.
Stopped	1	Sampling of variables has stopped, so it is impossible to output variable logs.
Sampling	2	Sampling of variables is in progress.
Triggered	3	One of the conditions specified for **File save trigger** is met.
Storing	5	The variable log is being stored. Sampling of variables is stopped when the state changes to this state.
Error	6	Storing of the variable log has failed.

The conditions for transition to each state are as follows.

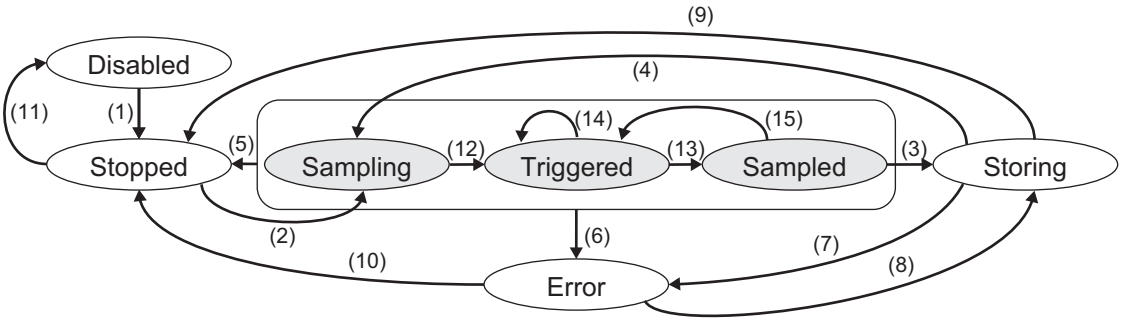
No.	Main transition conditions	Event to occur
1	Automation playback function enters an Idle state, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed.	
2	Automation playback function enters a Run state.	
3	The time specified for **Post-trigger sampling time** has elapsed. Or, the system determined that the time that target data can be saved in the memory of the CPU Unit is shorter than the sum of the **Pre-trigger sampling time** and **Post-trigger sampling time**.	
4	• Unit version 1.70 or later Output of the variable log file is completed.*1 Output of the backup file is completed. (Applicable when project backup is enabled) • Unit version earlier than 1.70 Output of the variable log file is completed.*1	• Unit version 1.70 or later Variable Log Output Completed (95750000 hex) Backup Completed (901B0000 hex) (Applicable when project backup is enabled) • Unit version earlier than 1.70 Variable Log Output Completed (95750000 hex)
5	Automation playback function enters an Idle state, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed. Or, **Setting Change during RUN Mode** is performed.	
6	Automation playback function enters an Error state. The following occurred with **Behavior after task period is exceeded** set to **Stop** in the variable log sampling setting. • Concurrency cannot be ensured in variable logs.	
7	Output of the variable log has failed.	
8	All of the following were satisfied. • Error reset operation is performed. • The state of the automation playback function is not Error.	

No.	Main transition conditions	Event to occur
9	The Controller changes to a state other than RUN Mode while the variable log file is being output, and output of the variable log is completed. *2 Or, **Setting Change during RUN Mode** is performed while the variable log file is being output, and output of the variable log is completed. *3	
10	Automation playback function enters an Idle state, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed. Or, **Setting Change during RUN Mode** is performed.	
11	The setting for automation playback is changed to **Do not use**, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed.	
12	One of the conditions specified for **File save trigger** is met.*4	
13	One of the conditions specified for **File save trigger** is met. • Unit version 1.70 or later Measurement of the post-trigger sampling time continues with the previous **file save trigger** as the starting point. The **file save trigger** that was input later is discarded. • Unit version earlier than 1.70 Measurement of the post-trigger sampling time starts with the input **file save trigger** as the starting point. The **file save trigger** that was input earlier is discarded.	• Unit version 1.70 or later: Variable Log Save Not Possible (957A0000 hex)

*1. This includes cases where the sampling time is less than the set sampling time.
*2. If the Controller changes to a state other than RUN Mode during Storing, output of the variable log is not aborted and the state transition occurs after the variable log file is output.
*3. If variable log settings are changed and transferred during Storing, output of variable log is not aborted and the state transition occurs after the variable log file is output.
*4. This condition is valid even when the period of Sampling (execution period of sampling actual variables) is less than **Pre-trigger sampling time**. In this case, the variable log whose Sampling period is less than **Pre-trigger sampling time** will be output. No events will be generated.

A-1-3 State Transitions in Variable Log Output Based on the Start/Save Trigger Method

For variable log output based on the start/save trigger method, state transitions occur in the Controller as shown in the following state transition diagram. Note that sampling of variables is performed in states shown in gray in the diagram.



State	Value in _APB_LogStatus.Status	Description
Disabled	0	There is no variable log output setting based on the start/save trigger method, or the sampling setting related to the variable log output setting based on the start/save trigger method is disabled.
Stopped	1	Sampling of variables has stopped, so it is impossible to output variable logs.
Sampling	2	Sampling of variables is in progress.
Triggered	3	The condition specified for **Start trigger** is met.
Sampled	4	The time set for **Sampling time** has elapsed.
Storing	5	The variable log is being stored.
Error	6	Storing of the variable log has failed.

The conditions for transition to each state are as follows.

No.	Main transition conditions	Event to occur
1	Automation playback function enters an Idle state, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed.	
2	Automation playback function enters a Run state.	
3	One of the conditions set for **File save trigger** is met.	
4	• Unit version 1.70 or later Output of the variable log file is completed.*1 Output of the backup file is completed. (Applicable when project backup is enabled) • Unit version earlier than 1.70 Output of the variable log file is completed.*1	• Unit version 1.70 or later Variable Log Output Completed (95750000 hex) Backup Completed (901B0000 hex) (Applicable when project backup is enabled) • Unit version earlier than 1.70 Variable Log Output Completed (95750000 hex)
5	Automation playback function enters an Idle state, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed. Or, **Setting Change during RUN Mode** is performed.	
6	Automation playback function enters an Error state. The following occurred with **Behavior after task period is exceeded** set to **Stop** in the variable log sampling setting. • Concurrency cannot be ensured in variable logs.	
7	Output of the variable log has failed.	
8	All of the following were satisfied. • Error reset operation is performed. • The state of the automation playback function is not Error.	
9	The Controller changes to a state other than RUN Mode while the variable log file is being output, and output of the variable log is completed. *2 Or, **Setting Change during RUN Mode** is performed while the variable log file is being output, and output of the variable log is completed. *3	

No.	Main transition conditions	Event to occur
10	Automation playback function enters an Idle state, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed. Or, **Setting Change during RUN Mode** is performed.	
11	The setting for automation playback function is changed to **Do not use**, or the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is executed.	
12	The condition specified for **Start trigger** is met.	
13	The time set for **Sampling time** has elapsed.	
14	The condition specified for **Start trigger** is met.*4 Measurement of the sampling time starts with the input **start trigger** as the starting point. The **start trigger** that was input earlier is discarded.	
15	The condition specified for **Start trigger** is met.*4	

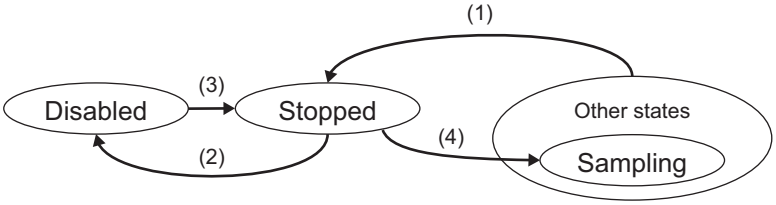
*1. This includes cases where the sampling time is less than the set sampling time.
*2. If the Controller changes to a state other than RUN Mode during Storing, output of the variable log is not aborted and the state transition occurs after the variable log file is output.
*3. If variable log settings are changed and transferred during Storing, output of variable log is not aborted and the state transition occurs after the variable log file is output.
*4. The variable log start time that can be output is updated.

Precautions for Correct Use

Automation playback function continues sampling the variables even after the state is changed to “Sampled.” Therefore, if you continue the operation in a Sampled state without the save trigger condition met, the old sampling data will be continuously overwritten, and depending on the timing at which the save trigger condition is met, the start time of the variable log may be shifted to a later time than when the start trigger condition is met. In such a case, make sure to promptly establish the save trigger condition.

A-1-4 Special Notes on State Transition of Variable Log Output

When the APB_ChangeSamplingSettings (Change Sampling Settings) instruction is used to switch the enabled sampling setting, the variable log output setting associated with that sampling setting is also switched accordingly, with the enabled setting being disabled and the disabled setting being enabled. Focusing on the state transition of variable log output, this is as shown in the diagram below.



State Transition of Variable Log Output Setting Associated with Enabled Sampling Setting

No.	State transition
1	Changes to Stopped with execution of the APB_ChangeSamplingSettings (Change Sampling Settings) instruction.
2	Changes to Disabled in the course of switch processing.

State Transition of Variable Log Output Setting Associated with Disabled Sampling Setting

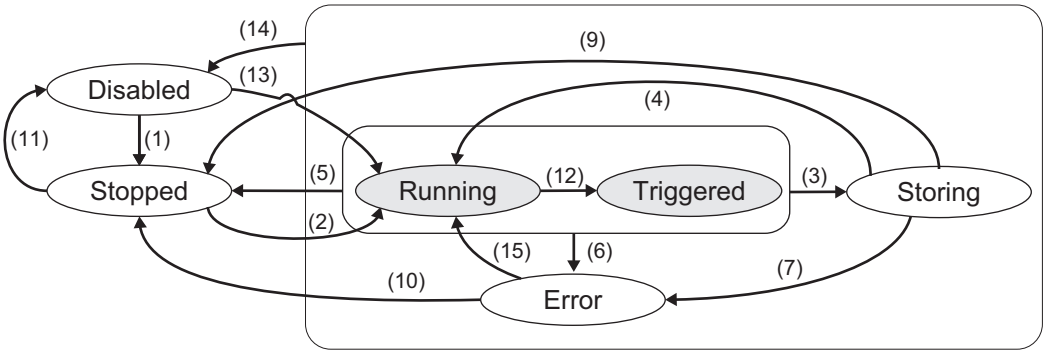
No.	State transition
3	Changes from Disabled to Stopped in the course of switch processing.
4	Changes to Sampling thereafter.

A-1-5 State Transitions of the Camera Control Function

For camera control, state transitions occur in the Controller as shown in the following state transition diagram. Note that video capturing is performed in states shown in gray in the diagram. The camera control function supports only the Pre/Post trigger method.
State transitions occur for individual camera control settings.

Version Information

The camera control function is available with unit version 1.71 or later.



State	Value in _APB_CamStaus[].Status	Description
Disabled	0	The camera is disabled.
Stopped	1	The camera control function is stopped.
Running	2	The camera control function is running.
Triggered	3	The **file save trigger** for the output setting number assigned to the camera is established.
Storing	5	The camera control function is saving a video file. Sampling of variables is stopped when the state changes to this state.
Error	6	The camera control function has an error.

The conditions for transition to each state are as follows.

No.	Main transition conditions	Event to occur
1	With the camera settings enabled, the automation playback function enters an Idle state. When the automation playback function is in an Idle state or Error state, the camera settings are enabled.	• Camera Control Stopped (957C0000 hex) (Only for the first transition condition on the left.)
2	With the camera settings enabled, the automation playback function enters a Run state and video capturing starts.	• Camera Control Started (957B0000 hex)

No.	Main transition conditions	Event to occur
3	With the camera settings enabled, the time specified for the **post-trigger sampling time** for the assigned trigger has elapsed.	
4	With the camera settings enabled, saving of the video file is completed.	• Video File Output Completed (957D0000 hex)
5	With the camera settings enabled, the automation playback function enters an Idle state.	• Camera Control Stopped (957C0000 hex)
6	With the camera settings enabled, the connection with the camera failed, or the automation playback function enters an error state.	• Camera Control Stopped (957C0000 hex)
7	With the camera settings enabled, saving of the video file failed or the automation playback function enters an error state.	• Camera Control Stopped (957C0000 hex)
9	With the camera settings enabled, the automation playback function enters an Idle state after completion of saving the video file.	• Camera Control Stopped (957C0000 hex)
10	With the camera settings enabled, the automation playback function enters an Idle state.	• Camera Control Stopped (957C0000 hex)
11	The camera settings are disabled.	
12	With the camera settings enabled, the conditions specified for the **file save trigger** for an assigned trigger are met.	
13	When the automation playback function is in a Run state, the camera settings are enabled.	
14	When the automation playback function is in a Run state, the camera settings are disabled.	
15	The connection with the camera has been restored.	

A-2 Precautions for Online Editing

The following are precautions for automation playback when you perform online editing.

- If you perform online editing and have the changed user program and variable settings reflected in the Controller when sampling of the variables has started, the sampling of the variables stops. The sampling of variables will be resumed when the online editing is completed.
- The variables added during online editing are not included in the sampling target. To include the variables added during online editing in the sampling target, use the synchronization function of the Sysmac Studio to transfer the settings that contain those for automation playback to the Controller. For a CPU Unit with unit version 1.65 or later, when you add a variable in online editing and then execute setting change during RUN Mode, the variable added in online editing is also included in the sampling target.
- Before you perform online editing, such as during system startup, select the **Do not back up** option for **Project backup** by automation playback. If you do not disable project backups, a project backup is generated each time you perform online editing and online editing will not be possible until the backup is complete. (Unit version earlier than 1.70)
  If you want to continue operating the system with the **Project backup** by automation playback set to **Do not back up**, make sure that the project file used to play the playback data is the same as the program running on the system.
  Refer to *2-8 Configuring the Setting to Back Up the Project for Playback* on page 2-49 for information on the setting to back up the project.

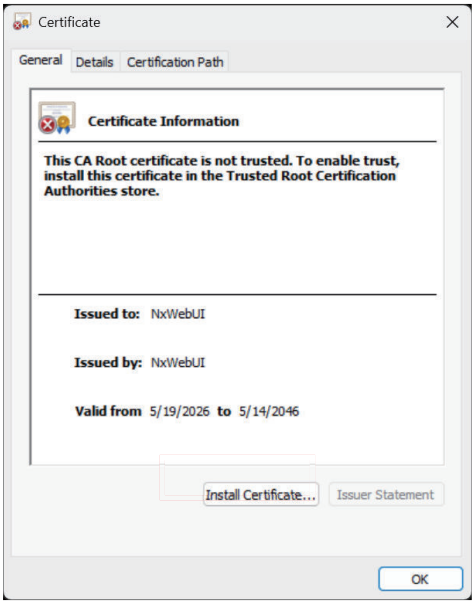
A-3 Notes on Connecting to the Web UI

When connecting your browser, you may see a warning such as *No security protection*.
Even though the warning appears, the communications are encrypted. You can prevent the warning from appearing by registering a certificate.
Follow the steps below to register a certificate.

1 Obtain the certificate file from the Controller.
Place the Sysmac Studio online with the Controller and, using the SD Memory Card function, copy the certificate file nx-webui-cacert.der, which is located under the /APB folder on the SD Memory Card, and paste it to your computer.

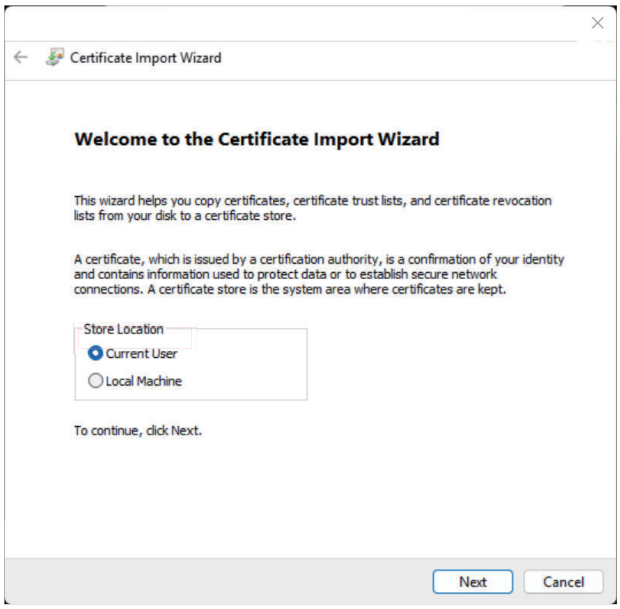
2 In File Explorer, double-click the copy of the certificate file on the computer.
The **Certificate** dialog box is displayed.

3 Click the **Install Certificate** button.



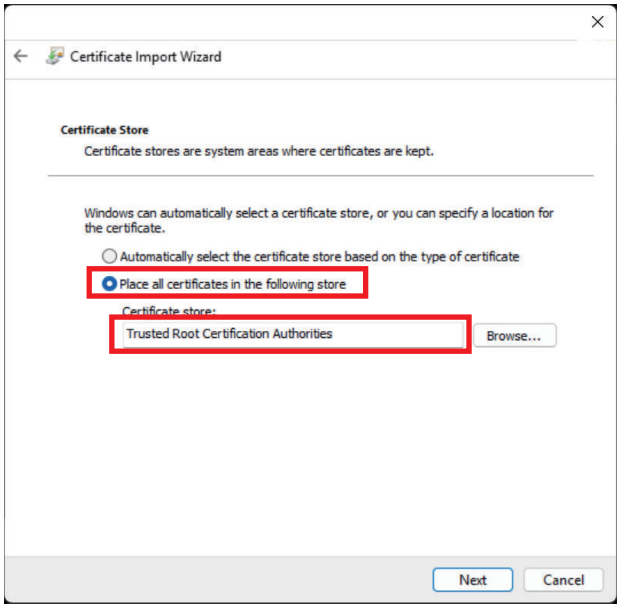
The **Certificate Import Wizard** is displayed.

4 In the **Store Location** section, select **Current User**.



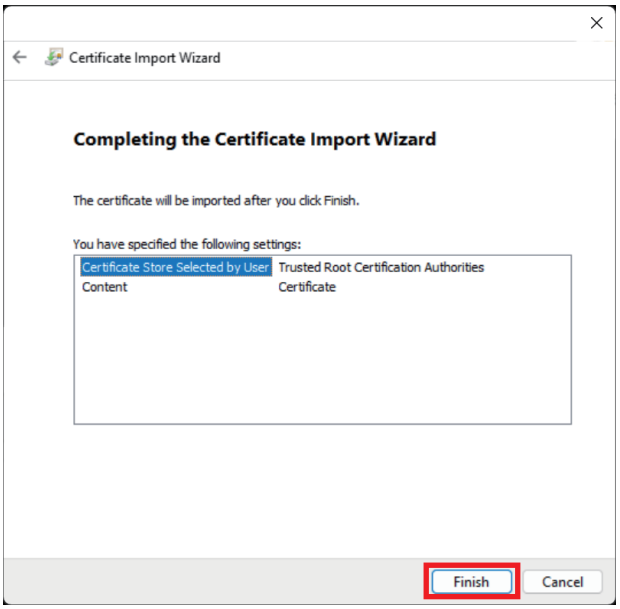
5 Click the **Next** button.

6 On the **Certificate Store** page, select **Place all certificates in the following store** and specify **Trusted Root Certification Authorities**.



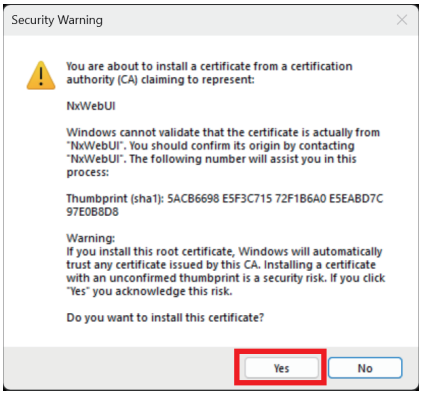
7 Click the **Next** button.

8 Click the **Finish** button.

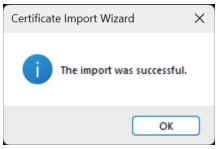


The Security Warning dialog box appears.

9 In the Security Warning dialog box, click **Yes** .



An import completed dialog box appears.



10 Click the **OK** button.
The **Certificate Import Wizard** closes.

11 Restart the browser.
The warning no longer appears.

A-4 List of System-defined Variables for Automation Playback

The following is a list of system-defined variables for automation playback. Refer to the *NJ/NX-series CPU Unit Software User's Manual (Cat. No. W501)* for details on each system-defined variable.

Variable Name	Name	Description
_APB_Status	APB Service Status	Indicates the operating status of the automation playback service.
_APB_LogStatus	APB Log Output Status	Indicates the operating status of the variable log output for automation playback.
_APB_SysInfo (Unit version 1.68 or later)	APB System Information	Represents automation playback system information.
_APB_SmplInfo (Unit version 1.68 or later)	APB Sampling Information	Represents sampling statistics, variable log information, etc.
_APB_LogCfg (Unit version 1.68 or later)	APB Log Output Configuration	Represents automation playback variable log output configuration information.
_APB_CamStatus (Unit version 1.71 or later)	APB Camera Output Status	Represents the status of the camera.
_APB_CamActivate (Unit version 1.71 or later)	APB Camera Activate	Switches the active/inactive status of the camera.

A-5 Version Information for Automation Playback Functions

A-5-1 Relationship between Unit Versions of CPU Units and Sysmac Studio Versions

Supported models and unit versions for each function of the automation playback that can use in the Sysmac Studio are listed below.

Function	Model number	Unit version	Sysmac Studio version
Automation Playback Settings	NX502-1□00	Ver. 1.63 or later	Ver. 1.55 or higher
Automation Playback Operation Monitor			
Copying playback data			
Playing playback data			
Playback chart			
Output factor search			
Memory usage			
Camera control		Ver. 1.71 or later	Ver. 1.67 or higher
Centralized data management			
Event log collection and playback			
Playback of HMI screens			
Connection to the Web UI from the Sysmac Studio			Ver. 1.68 or higher
Automatic screen display at playback start			

A-5-2 Functions That Were Added or Changed Due to Version Updates

The main functions of the automation playback that were added and changed due to version updates are listed below.

Function		Addition/change	Unit version	Sysmac Studio version
Automation Playback Settings	Selection of individual variable to include in the sampling target	Addition	Ver. 1.65	Ver. 1.57
		Change	Ver. 1.68	Ver. 1.62
	Change of variable data collection settings in RUN Mode	Addition	Ver. 1.65	Ver. 1.57
	Display of estimated collection time possible	Addition	Ver. 1.68	Ver. 1.62
	Setting of playback data save destination	Addition	Ver. 1.71	Ver. 1.67
	Camera recording setting	Addition	Ver. 1.71	Ver. 1.67
	Event log recording setting	Addition	Ver. 1.71	Ver. 1.67

Function		Addition/change	Unit version	Sysmac Studio version
Connection to the Web UI from the Sysmac Studio		Addition	Ver. 1.71	Ver. 1.68
Camera control	• Camera settings • Camera control • Live view	Addition	Ver. 1.71	Ver. 1.67
Event log collection and playback		Addition	Ver. 1.71	Ver. 1.67
Playback of HMI screens		Addition	Ver. 1.71	Ver. 1.67
Centralized data management		Addition	Ver. 1.71	Ver. 1.67
Automation Playback Operation Monitor	Addition of displayed items	Change	Ver. 1.68	Ver. 1.62
Playing playback data	Rotate video button	Addition	Ver. 1.68	Ver. 1.62
	Save the loaded variable log file button	Deletion	Ver. 1.70	Ver. 1.66
	Save the loaded variable log file menu item	Addition	Ver. 1.70	Ver. 1.66
	Automatic screen display at playback start	Addition	Ver. 1.71	Ver. 1.68
Playback chart	**Save the loaded comparison target variable log file** menu item	Addition	Ver. 1.70	Ver. 1.66
	Two-point measurement cursors	Addition	Ver. 1.71	Ver. 1.67
	Playback jump to the time at the cursor position	Addition	Ver. 1.71	Ver. 1.67
Total data size of variables	Upper limit 5 MB	Change	Ver. 1.65	Ver. 1.57
	Upper limit 10 MB	Change	Ver. 1.68	Ver. 1.62
Variable log file	Extension .bin2	Change	Ver. 1.68	Ver. 1.62

Function		Addition/change	Unit version	Sysmac Studio version
Events	• Upper Limit of Sampling Processing Capacity (64040000 hex) • Variable Log Save Not Possible (957A0000 hex)	Addition	Ver. 1.68	Ver. 1.62
	• Video FileOutput Failed (957F0000 hex) • Connection Failed (95A40000 hex) • Network Storage Connection Failed (95A50000 hex) • Number of Active Cameras Exceeded (95A60000 hex) • Web UI Connection Started (90350000 hex) • Web UI Connection Ended (90360000 hex) • Web UI Authentication Failed (90370000 hex) • Camera Control Started (957B0000 hex) • Camera Control Stopped (957C0000 hex) • Video File Output Completed (957D0000 hex) • Camera Settings Changed (957E0000 hex) • Cameras Settings Imported/Exported (95A70000 hex) • Network Storage Connection Successful (95A80000 hex)	Addition	Ver. 1.71	Ver. 1.67
System-defined variables	• _APB_SysInfo • _APB_SmplInfo • _APB_LogCfg	Addition	Ver. 1.68	Ver. 1.62
	• _APB_CamStatus • _APB_CamActivate	Addition	Ver. 1.71	Ver. 1.67

Version Information

- About the combination of variable log files and Sysmac Studio versions
  Variable log files with the extension .bin2 recorded in the CPU Unit with unit version 1.68 or later cannot be played using Sysmac Studio version 1.61 or lower.
  To record variable log files that can be played using Sysmac Studio version 1.61 or lower, make sure that the project transferred to the CPU Unit is project unit version earlier than 1.68.

Project unit version of projects in the Controller	Variable log file	Sysmac Studio version	
		Ver. 1.62 or higher	Ver. 1.61 or lower
Version 1.68 or later	Extension .bin2	Can be played	(Extension .bin2 cannot be read)
Version earlier than 1.68	Extension .bin	Can be played	Can be played

A-5-3 Supplementary Information on Camera Control and Video Data Management for Unit Version Earlier Than 1.71

This section describes how to control cameras and centrally manage variable logs and video data with unit version earlier than 1.71.

You can also control a camera from the user program to create video data.
For information on a sample program of creating video data using a user program, visit the following URL. Or, contact your OMRON representative.
https://www.ia.omron.com/product/tool/nx5_apb/download.htm

For information on how to centrally manage variable logs and video data with scripts that work with the network storage, visit the following URL. Or, contact your OMRON representative.
https://www.ia.omron.com/product/tool/nx5_apb/download.htm

A-6 Cameras That Have Been Tested for Operation

Cameras that are supported by the camera control function in automation playback are AXIS network cameras meeting the following conditions:

- OS version
  a) When server validation is set to **Disable**, the OS version must be 12 or lower.
  b) When server validation is set to **Enable**, the OS version must be between 10 and 12.
- HTTPS settings must be enabled.
- The default certificate must be used.

Precautions for Correct Use

- To reduce security risks arising from vulnerabilities, update the firmware of your cameras to the latest version within the scope where conditions are met.
- Cameras with an OS version of 8 or lower may not be able to display the live view.

Version Information

The functions of camera connection settings and camera control from the CPU Unit are available with unit version 1.71 or later.

The following cameras have been tested for operation regarding connection and capturing instructions from the CPU Unit.

Type	Model	OS version	Maximum resolution	Maximum frame rate [fps]
Dome	AXIS M3125-LVE	11.11.198	1,920 × 1,080	50/60
	AXIS M4216-LV	11.11.198	2,304 × 1,728	25/30
	AXIS P3265-LVE	11.11.198	1,920 × 1,080	50/60
	AXIS Q3536-LVE	11.11.198	2,688 × 1,512	50/60
	AXIS M3085-V	11.11.198	1,920 × 1,080	25/30
	AXIS M3086-V	11.11.198	2,688 × 1,512	25/30
	AXIS M3088-V	11.11.198	3,840 × 2,160	12/15
	AXIS M3115-LVE	10.12.323	1,920 × 1,080	25/30
PTZ	AXIS M5000-G	11.11.198	1,920 × 1,080	25/30
	AXIS M5074	11.11.198	1,280 × 720	50/60
	AXIS M5526-E	11.11.198	2,688 × 1,512	50/60
	AXIS Q6135-LE	11.11.198	1,920 × 1,080	50/60
	AXIS V5925	11.11.198	1,920 × 1,080	50/60
	AXIS M5075-G	11.11.198	1,920 × 1,080	50/60
	AXIS M5525-E	8.40.93	1,920 × 1,080	25/30

Type	Model	OS version	Maximum resolution	Maximum frame rate [fps]
Sensor/Unit separated	AXIS P1245 MK II	11.11.198	1,920 × 1,080	25/30
	AXIS P1265 MK II	11.11.198	1,920 × 1,080	25/30
	AXIS P1275 MK II	11.11.198	1,920 × 1,080	25/30
	AXIS P1280-E	9.80.132	208 × 156	8.3
	AXIS P1290-E	9.80.132	208 × 156	8.3
	AXIS P1245	9.80.132	1,920 × 1,080	25/30
	AXIS P1275	9.80.132	1,920 × 1,080	25/30
	AXIS FA1105 + AXIS FA54	11.11.198	1,920 × 1,080	25/30
	AXIS F2105-RE + AXIS F9111	11.11.198	1,920 × 1,080	180
	AXIS F2115-R + AXIS F9111	11.11.198	1,920 × 1,080	180
Box	AXIS M1055-L	11.11.198	1,920 × 1,080	25/30
	AXIS M1075-L	11.11.198	1,920 × 1,080	25/30
	AXIS M1135 Mk II	11.11.198	1,920 × 1,080	25/30
	AXIS P1385	11.11.198	1,920 × 1,080	50/60
	AXIS P1387-B	11.11.198	2,592 × 1,944	50/60
	AXIS P1388	11.11.198	3,840 × 2,160	50/60
	AXIS P1375	11.11.198	1,920 × 1,080	50/60
	AXIS P1378	11.11.198	3,840 × 2,160	25/30
	AXIS Q1715	11.11.198	1,920 × 1,080	120
Panorama	AXIS M4308-PLE	11.11.198	2,880 × 2,880	25/30
	AXIS P3818-PVE	11.11.198	5,120 × 2,560	30
	AXIS Q3819-PVE	11.11.198	4,096 × 864	30
Bullet	AXIS M2035-LE	11.11.198	1,920 × 1,080	25/30
	AXIS M2036-LE	11.11.198	2,688 × 1,512	25/30
	AXIS P1455-LE	11.11.198	1,920 × 1,080	50/60
	AXIS Q1805-LE	11.11.198	1,920 × 1,080	90

A-7 Browsers That Have Been Tested for Operation

The following browsers have been tested to work with the Web UI.

Browser	Version tested for operation
Microsoft Edge	Microsoft Edge for Business version 145.0.3800.82
Google Chrome	Version 148.0.7778.179
Mozilla Firefox	Version 151.0
Safari	Version 26.5

A-8 Security Guidelines for Using the Web UI

A-8-1 Guidelines Related to Security When Using the Web UI

The following describes what you should do to use the Web UI securely.

- Restrict access to the computer in use to prevent unauthorized user access.
- Install antivirus software on the computer in use to reduce the risk of virus infection. Always keep your antivirus software up to date.
- Always keep the OS and browser on your computer up to date to avoid security risks arising from vulnerabilities in the OS or browser.
- Enable login authentication. Enabling login authentication prompts the user to enter a user name and password when connecting to the Web UI. You cannot log in unless the user name and password match the predefined settings.
  Disabling login authentication allows the user to log in without entering a user name and password. Use the Web UI in secure areas.
- The Web UI's login authentication uses the user account information registered in the Controller. User accounts are configured from the Sysmac Studio. Take appropriate measures to configure and manage user names and passwords to prevent unauthorized use by others.

A-8-2 Precautions for Correct Use Related to Security When Using the Web UI

The following are precautions for correct use related to the security of the Web UI.

- After downloading a project with **Camera recording** set to **Record** in **Common Setting** in the Automation Playback Settings display to the CPU Unit, cycle the power supply to the Controller. This automatically generates a server certificate using the IP address of the built-in EtherNet/IP port at that time. Then, change the IP address of the built-in EtherNet/IP port. This causes a mismatch between the IP address of the built-in EtherNet/IP port and the IP address in the server certificate. Under this condition, attempting to connect to the Web UI from a browser displays a warning that the connection destination is unsafe.
  To prevent this warning from appearing, revert to the original IP address of the built-in EtherNet/IP port. Or, after downloading a project with **Camera recording** set to **Do not record** to the CPU Unit and restarting it, download again a project with **Camera recording** set to **Record** to the CPU Unit and restart it to regenerate the server certificate.
- When using a self-signed server certificate, your browser may display a warning such as *No security protection*. In this case also, the communications are encrypted. To prevent the warning from appearing, register the certificate file located under the \APB folder on the SD Memory Card in your computer. Refer to *A-3 Notes on Connecting to the Web UI* on page A-11 for how to register a certificate.
  Performing the Clear All Memory operation with the *Erase the data completely* check box selected also clears the Web UI certificate. Then, restarting the Controller regenerates a certificate. To connect your browser using a new certificate, register the certificate file located under the \APB folder on the SD Memory Card in your computer. Refer to *A-3 Notes on Connecting to the Web UI* on page A-11 for how to register a certificate.

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