OMRON

Machine Automation Controller NJ-series

General-purpose Seriarl Connection Guide (RS-232C)

OMRON Corporation

G9SP Safety Controller

Network Connection Guide

SYSMAC always in control

P545-E1-01

About Intellectual Property Rights and Trademarks

Table of Contents

1. Related Manuals

The table below lists the manuals related to this document.
To ensure system safety, make sure to always read and heed the information provided in all Safety Precautions, Precautions for Safe Use, and Precaution for Correct Use of manuals for each device which is used in the system.

Cat. No.	Model	Manual name
W500	NJ501-[][][][]	NJ-series CPU Unit Hardware User's Manual
W501	NJ501-[][][][]	NJ-series CPU Unit Software User's Manual
W494	CJ1W-SCU[]2	CJ-series Serial Communications Units Operation Manual for NJ-series CPU Unit
W502	NJ501-[][][][]	NJ-series Instructions Reference Manual
W504	SYSMAC-SE2[][][]	Sysmac Studio Version 1 Operation Manual
Z922	G9SP-[][][][]	G9SP Series Safety Controller Operation Manual
Z923	G9SP-[][][][]	G9SP Series Safety Controller Instructions Reference Manual

2. Terms and Definitions

Terms	Explanation and Definition
No-protocol	No-protocol Mode enables you to receive or send data by using SCU Send Serial (SerialSend) or SCU Receive Serial (SerialRcv) instructions. In this mode, messages are sent/received to/from a destination device.
Send message	A send message is a communications frame (command) sent from the Serial Communications Unit to the destination device. This is executed by the SerialSend instruction and sent to the destination device.
Receive message	A receive message is a communications frame (response) sent from the destination device to the Serial Communications Unit. The SerialRcv instruction is used to read data received from the destination device.

3. Remarks

(1) Understand the specifications of devices which are used in the system. Allow some margin for ratings and performance. Provide safety measures, such as installing safety circuit in order to ensure safety and minimize risks of abnormal occurrence.
(2) To ensure system safety, always read and heed the information provided in all Safety Precautions, Precautions for Safe Use, and Precaution for Correct Use of manuals for each device used in the system.
(3) The user is encouraged to confirm the standards and regulations that the system must conform to.
(4) It is prohibited to copy, to reproduce, and to distribute a part of or whole part of this document without the permission of OMRON Corporation.
(5) The information contained in this document is current as of August 2013. It is subject to change without notice for improvement.

The following notation is used in this document.

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

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.

Symbols

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

4. Overview

This document describes the procedure for connecting a Safety Controller (G9SP series) of OMRON Corporation (hereinafter referred to as OMRON) with an NJ-series Machine Automation Controller (hereinafter referred to as the Controller) via serial communications, and the procedure for checking their connection.
Refer to the serial communications settings of the project file you prepared to understand the setting method and key points to connect the devices via serial communications.
This project file is used to check a serial connection by sending the monitor I/O command to the destination device.

Obtain the latest "Sysmac Studio project file" from OMRON beforehand.

Name	File name	Version
Sysmac Studio project file (extension: SMC)	OMRON_G9SP_SERI232_LD_EV100.SMC	Ver.1.00

⚠ Caution

This document aims to explain the wiring method and communications settings necessary to connect the corresponding devices and provide the setting procedure. The program used in this document is designed to check if the connection was properly established, and is not designed to be constantly used at a site. Therefore, functionality and performances are not sufficiently taken into consideration. When you construct an actual system, please use the wiring method, communications settings and setting procedure described in this document as a reference and design a new program according to your application needs.

5. Applicable Products and Support Software

5.1. Applicable Products

The applicable devices are as follows:

Manufacturer	Name	Model
OMRON	NJ series CPU Unit	NJ501-[][][][] NJ301-[][][][]
OMRON	Serial Communications Unit	CJ1W-SCU[]2
OMRON	Safety Controller	G9SP-[][][][]
OMRON	Expansion I/O Unit	CP1W-20EDT[] CP1W-32ET[]
OMRON	RS-232C Option Board	CP1W-CIF01
OMRON	G9SP Configurator Support Software	WS02-G9SP[][]-V1

Precautions for Correct Use

As applicable devices above, the devices with the models and versions listed in Section 5.2. are actually used in this document to describe the procedure for connecting devices and checking the connection.

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

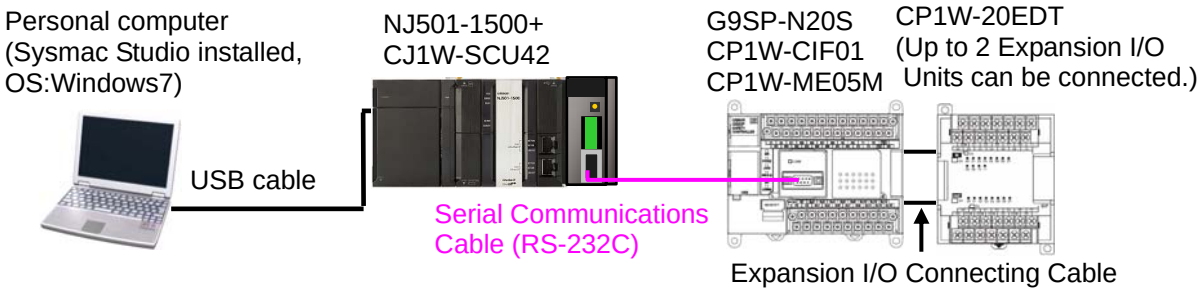
To use the above devices with versions not listed in Section 5.2 or versions higher than those listed in Section 5.2, check the differences in the specifications by referring to the manuals before operating the devices.

Additional Information

This document describes the procedure to establish the network connection. Except for the connection procedure, it does not provide information on operation, installation or wiring method. It also does not describe the function or operation of the devices. Refer to the manuals or contact your OMRON representative.

5.2. Device Configuration

The hardware components to reproduce the connection procedure of this document are as follows:



Manufacturer	Name	Model	Version
OMRON	Serial Communications Unit	CJ1W-SCU42	Ver.2.0
OMRON	NJ-series CPU Unit	NJ501-1500	Ver.1.01
OMRON	Power Supply Unit	NJ-PA3001	
OMRON	Sysmac Studio	SYSMAC-SE2[][][]	Ver.1.02
OMRON	Sysmac Studio project file	OMRON_G9SP_SERI232_LD_EV100.SMC	Ver.1.00
-	Personal computer (OS: Windows 7)	-	
-	USB cable (USB 2.0 type B connector)	-	
-	Serial Communications Cable	-	
OMRON	Safety Controller	G9SP-N20S	Ver.1.00
OMRON	RS-232C Option Board	CP1W-CIF01	
OMRON	Memory Cassette	CP1W-ME05M	
OMRON	Expansion I/O Unit	CP1W-20EDT	
OMRON	Expansion I/O Connecting Cable	CP1W-CN811	

Precautions for Correct Use

Obtain the latest Sysmac Studio project file from OMRON in advance.
(To obtain the files, contact your OMRON representative.)

Additional Information

It may not be possible to reproduce the same operation with different devices or versions. Check the configuration, model and version. If they are different from your configuration. Contact your OMRON representative.

Additional Information

For information on the serial cable (RS-232C), refer to *3-3 RS-232C and RS-422A/485 Wiring* in the *CJ-series Serial Communications Units Operation Manual for NJ-series CPU Unit* (Cat.No. W494).

Additional Information

In this document, a USB is used to connect with the Controller. For information on how to install a USB driver, refer to *A-1 Driver Installation for Direct USB Cable Connection* of the *Sysmac Studio Version 1 Operation Manual* (Cat.No. W504).

6. Serial Communications Settings

This section describes the specifications such as cable wiring and communication parameters that are set in this document.

Additional Information

This document and project file can be used to perform operations using the settings and command described in this section. Modifications are necessary to perform communications using different settings.

6.1. Serial Communications Settings

The table below lists the settings for serial communications.

	CJ1W-SCU42	G9SP-N20S
Unit number	0	-
Communications (connection) port	Port 2 (RS-232C)	-
Serial communications mode	No-protocol	-
Data length	8 bits	8 bits (fixed)
Stop bit	1 bit	1 bit (fixed)
Parity	Even (default value)	Even (fixed)
Baud rate	9,600 bps (default value)	9,600 bps (fixed)
No-protocol Start Code	Yes (#40)	#40 (fixed)
No-protocol End Code	No	(#2A0D (fixed))

*One byte data can only be set as the no-protocol End Code. Thus, in this document, #2A0D is treated as data.

Precautions for Correct Use

This document explains the setting procedure with Serial Communication Unit CJ1W-SCU42 whose Unit No. is 0, communication port is port 2 and device name is SCU. To connect devices under different conditions, refer to *9. Project File* and create a ladder program by changing the variable names and setting values.

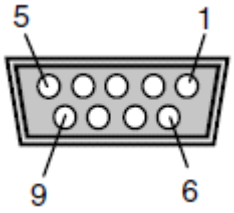
6.2. Cable Wiring Diagram

For details on the cable wiring, refer to *Section 3 Installation and Wiring* in the *CJ-series Serial Communications Units Operation Manual for NJ-series CPU Unit* (Cat.No. W494).
Check the connector configuration and pin assignment before wiring.

■Connector configuration and pin assignment

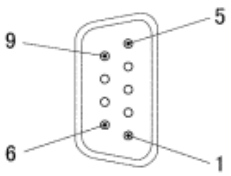
< OMRON G9SP-N20S + CP1W-CIF01 > Applicable Connectors: D-sub 9 pin

Pin	Abbr.	Signal	Signal direction
1	FG	Frame ground	---
2	SD (TXD)	Send data	Outputs
3	RD (RXD)	Receive data	Inputs
4	RS (RTS)	Request to send	Outputs
5	CS (CTS)	Clear to send	Inputs
6	5 V	Power	---
7	DR (DSR)	Data set ready	Inputs
8	ER (DTR)	Data terminal ready	Outputs
9	SG (0 V)	Signal ground	---
Connector hood	FG	Frame ground	---



<OMRON CJ1W-SCU42> Applicable connector: D-sub 9 pin

Pin No.	Abbreviation	Signal name	I/O
1 (see note 1)	FG	Shield	---
2	SD	Send data	Output
3	RD	Receive data	Input
4 (see note 2)	RTS (RS)	Request to send	Output
5 (see note 2)	CTS (CS)	Clear to send	Input
6 (see note 3)	5V	Power supply	---
7 (see note 2)	DSR (DR)	Data set ready	Input
8 (see note 2)	DTR (ER)	Data terminal ready (see note 4)	Output
9	SG	Signal ground	---
Shell (see note 1)	FG	Shield	---



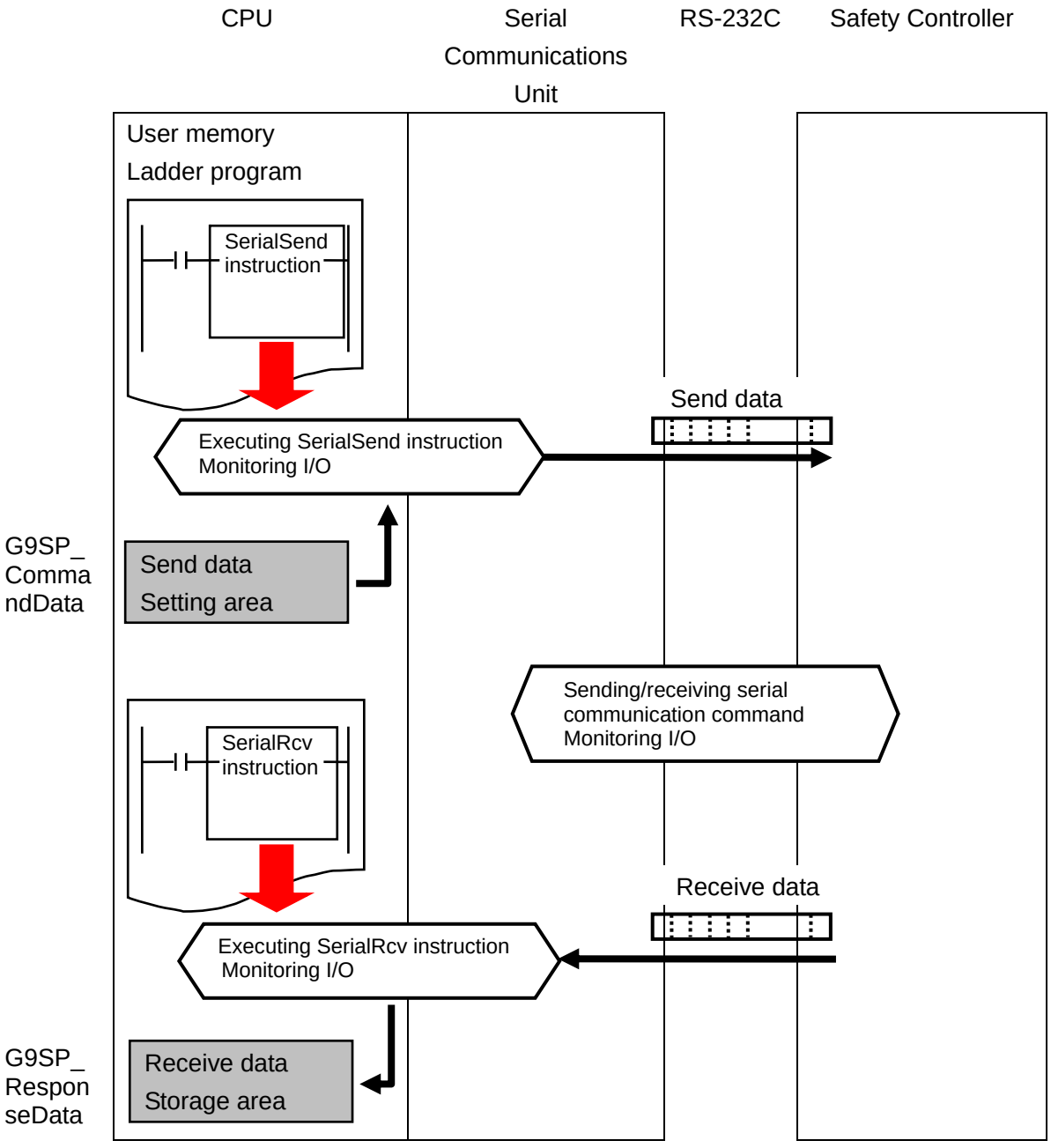
■Cable/pin assignment

CJ1W-SCU42 Serial Communications Unit				Safety Controller (G9SP-N20S)		
RS-232C Interface	Signal name	Pin No.		Pin No.	Signal name	RS-232C Interface
	FG	1		1	FG	
	SD	2		2	SD	
	RD	3		3	RD	
	RS	4		4	RS	
	CS	5		5	CS	
	5V	6		6	5V	
	DR	7		7	DR	
	ER	8		8	ER	
	SG	9		9	SG	
	FG	Shell		Shell	FG	
D-sub 9-pin Cable connector type: Male				D-sub 9-pin Cable connector type: Male		

6.3. Example of Checking Connection

This connection example uses the ladder program for network connection. For details on the ladder program, refer to *9. Project File*.

The Controller and Safety Controller send and receive a message of Monitor I/O. The following figure shows the outline of the operation.



7. Connection Procedure

This section describes the procedure for connecting the Controller via serial communications. This document explains the procedures for setting up the Controller from the factory default setting. For the initialization, refer to *Section 8 Initialization Method*.

7.1. Work Flow

Take the following steps to connect the Controller via serial communications.

7.2 Setting Up the Safety Controller	Set up the Safety Controller.
↓	
7.2.1 Installing the Option Board	Install the Option Board of the Safety Controller.
↓	
7.3 Setting Up the Controller	Set up the Controller.
↓	
7.3.1 Hardware Settings of the Serial Communications Unit	Set the hardware switches on the Serial Communications Unit and connect to the Controller.
↓	
7.3.2 Starting the Sysmac Studio and Importing the Project File	Start the Sysmac Studio, and import the Sysmac Studio project file.
↓	
7.3.3 Going Online and Transferring the Project Data	Connect online with the Sysmac Studio and transfer the project data to the Controller.
↓	
7.4 Connection Status Check	Check the serial network connection status.
↓	
7.4.1 Checking the Connection Status	Confirm that serial communications are performed normally.
↓	
7.4.2 Checking Data that are Sent and Received	Confirm that the correct data are sent and received.

Precautions for Correct Use

Obtain the latest Sysmac Studio project file from OMRON in advance.
(To obtain the files, contact your OMRON representative.)

7.2. Setting Up the Safety Controller

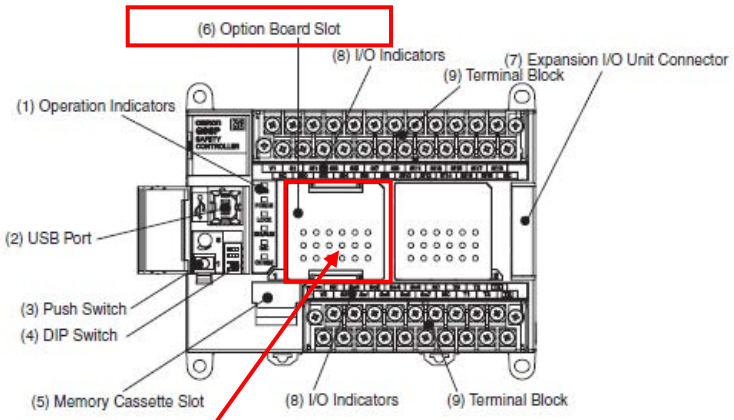
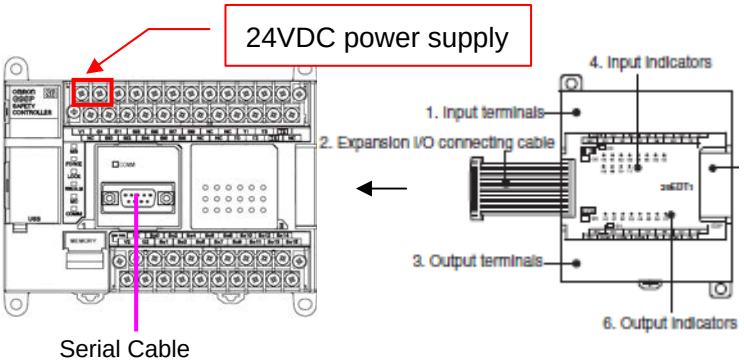
Set up the Safety Controller.

7.2.1. Installing the Option Board

Install the Option Board.

Precautions for Correct Use

Make sure that the power supply is OFF when you install.

1	Confirm that the power supply to the Safety Controller is OFF.	
2	Remove the cover of the option board slot, and install the RS-232C option board (CP1W-CIF01). RS-232C communications settings of the Safety Controller are as follows and cannot be changed. •RS-232C communications setting (fixed) Baud rate: 9,600 bps Data length: 8 bits Stop bits: 1 bit Parity: E (Even parity)	 (Front of Safety Controller)  (RS-232C Option Board)
3	Connect the serial cable (RS-232C) to the Safety Controller as shown on the right. Connect the expansion I/O connecting cable to the Safety Controller. Connect the 24VDC(+) line to terminal V1 of the Safety Controller, and the GND line to terminal G1.	
4	Turn ON the power supply to the Safety Controller.	

7.3. Setting Up the Controller

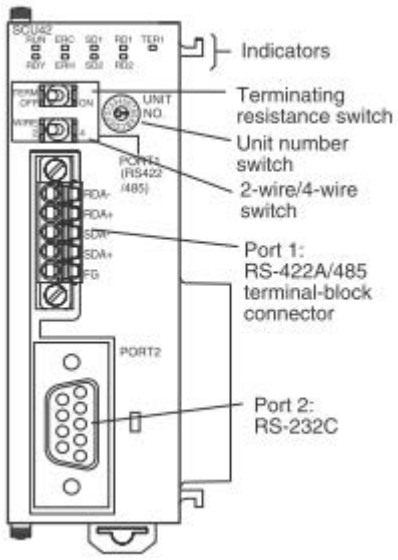
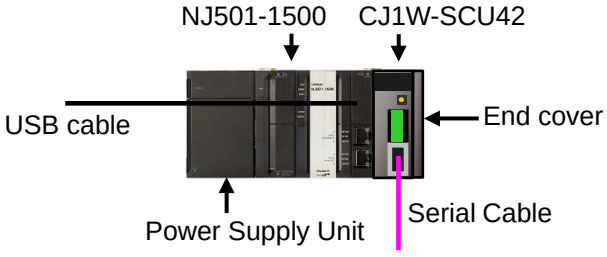
Set up the Controller.

7.3.1. Hardware Settings of the Serial Communications Unit

Set the hardware switches on the Serial Communications Unit.

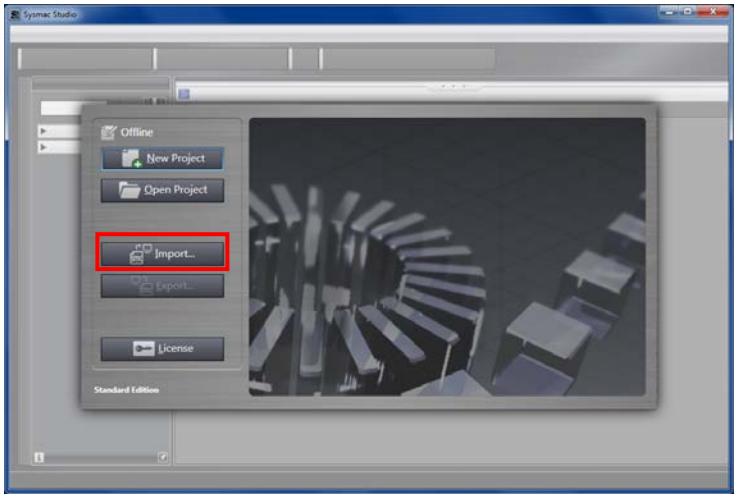
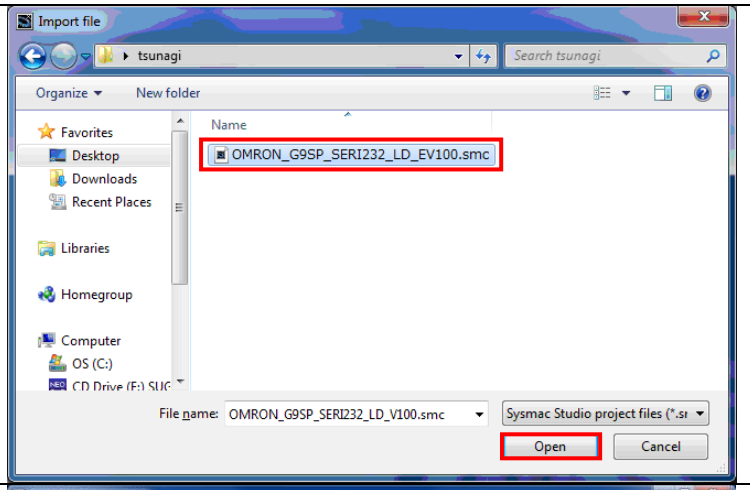
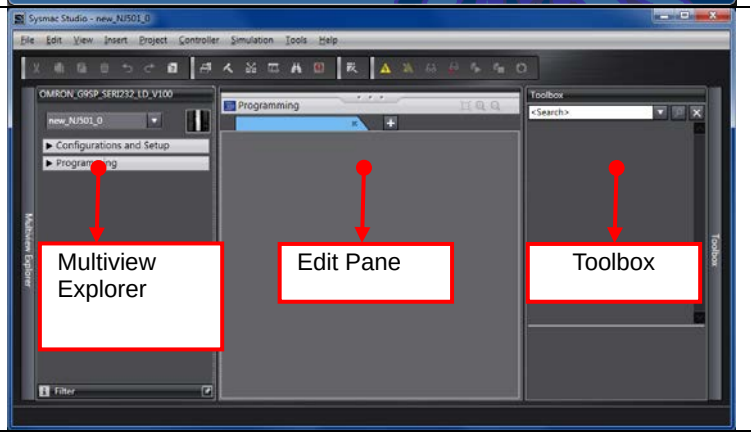
Precautions for Correct Use

Make sure that the power supply is OFF when you perform the setting up.

1	Confirm that the power supply to the Controller is OFF. *If the power supply is turned ON, settings may not be applicable as described in the following procedure.	
2	Connect the serial cable (RS-232C) to Port 2 connector. *This setting is required to use Port 2 of Serial Communications Unit.	
3	Set the Unit No. Switch to 0. (The unit number is factory-set to 0.)	
4	Connect the Serial Communications Unit to the Controller. Connect the personal computer, Safety Controller and Controller using the Serial cable and USB cable as shown in 5.2 Device Configuration. Turn ON the power supply to the Controller.	

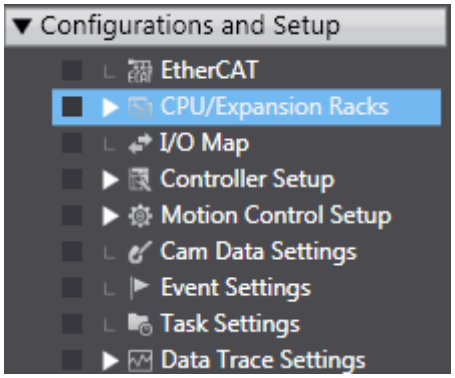
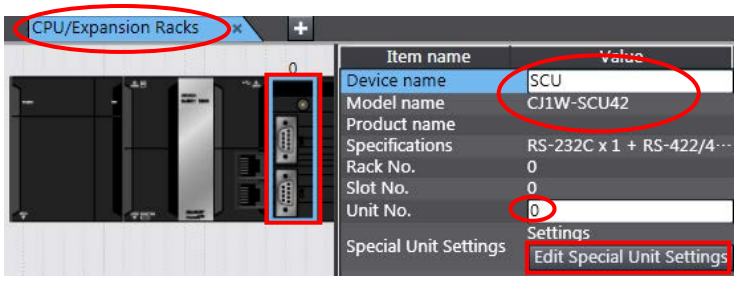
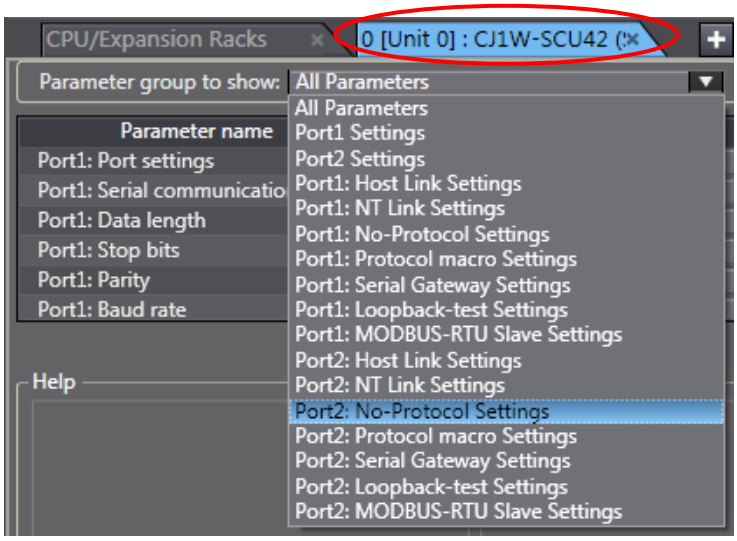
7.3.2. Starting the Sysmac Studio and Importing the Project File

Start the Sysmac Studio, and import the Sysmac Studio project file.
Install the programming software and USB driver in the personal computer beforehand.

1	Start the Sysmac Studio. Click the **Import** Button. *If a confirmation dialog for an access right is displayed at start, select to start.	
2	The Import File Dialog Box is displayed. Select OMRON_G9SP_SERI232_LD_EV100.smc (Sysmac Studio project file) and click the **Open** Button. *Obtain the Sysmac Studio project file from OMRON.	
3	OMRON_G9SP_SERI232_LD_EV100 project is displayed. The left pane is called Multiview Explorer, the right pane is called Toolbox and the middle pane is called Edit Pane.	

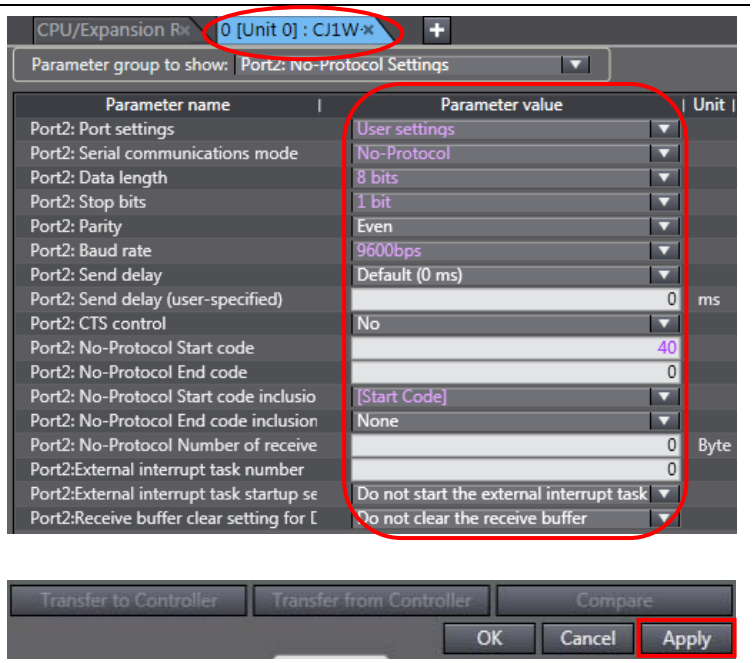
7.3.3. Checking the Parameters and Building

Check the set parameters, execute the program check on the project data and build the Controller.

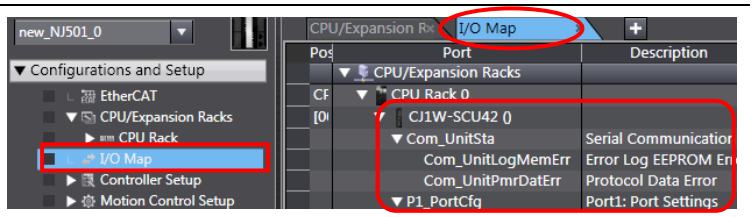
1	Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer.	
2	The CPU/Expansion Racks Tab is displayed on the Edit Pane. Select the Serial Communications Unit icon as shown on the right. Confirm that CJ1W-SCU42 is displayed, the device name is SCU, and the unit number is 0. *If the settings are different, change the values. Click **Edit Special Unit Settings**.	
3	The 0 [Unit 0]: Tab is displayed. Open the pull-down menu of Parameter group to show and select ***Port2: No-Protocol Settings***.	

4 Parameter group to show is set to Port 2: No-Protocol Settings. The items of the Port 2: No-Protocol Settings are displayed.
Confirm that the Port2: Port settings is set to User settings and other items are the same as Section 6.1.

*If the settings are different from the above, change the values from the pull-down menu. Click the **Apply** Button after changing values.

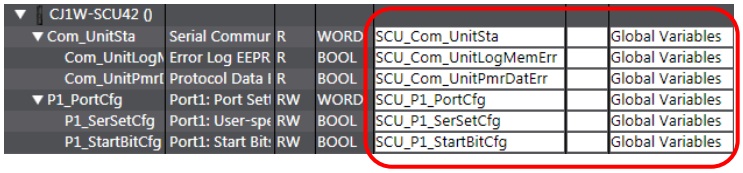


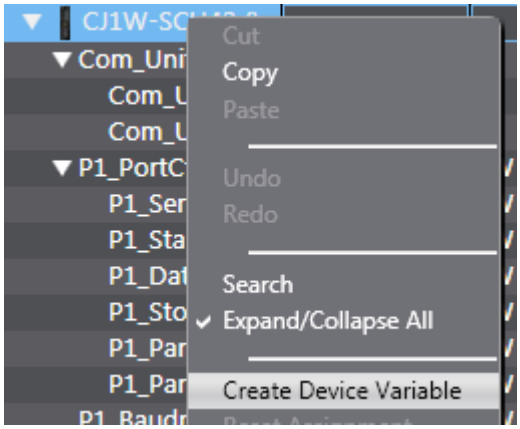
5 Double-click **I/O Map** under **Configurations and Setup** on the Multiview Explorer.
The I/O Map Tab Page is displayed and the parameters of the Unit are displayed.



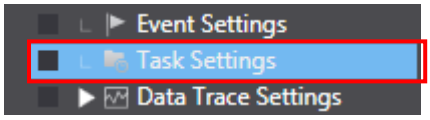
6 Confirm that the data in the Variable Columns on the I/O Map Tab Page start with SCU and that the Global Variables are set in the Variable Type Columns.

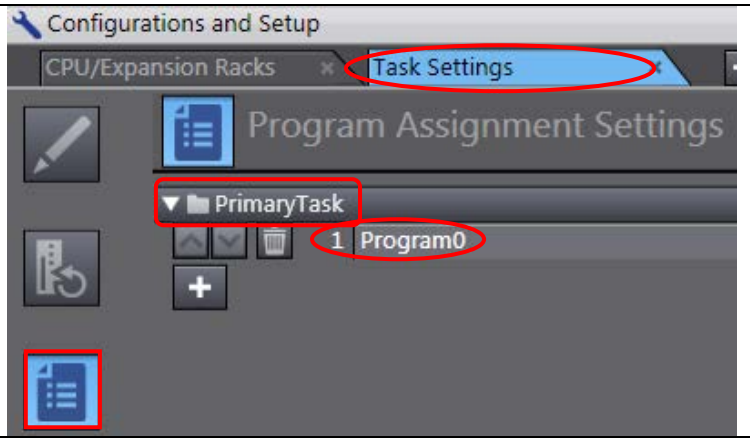
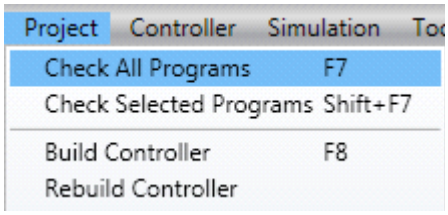
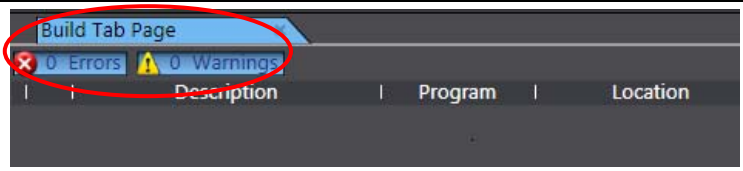
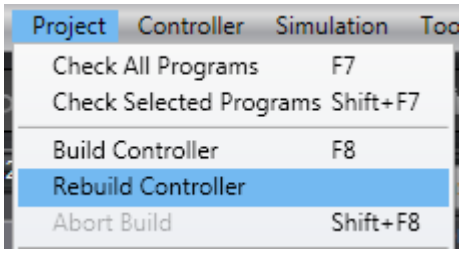
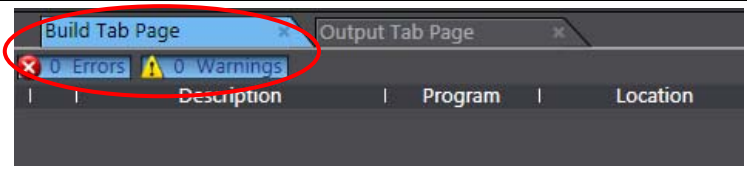
*If the settings are different from the above, right-click on CJ1W-SCU42 and select ***Create Device Variable***.





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



8	The Task Settings Tab Page is displayed in the Edit Pane. Click the **Program Assignment Settings** Button and confirm that Program0 is set under PrimaryTask.	
9	Select ***Check All Programs*** from the Project Menu.	
10	The Build Tab Page is displayed in the Edit Pane. Confirm that "0 Errors" and "0 Warnings" are displayed.	
11	Select ***Rebuild Controller*** from the Project Menu. A screen is displayed indicating the conversion is being performed.	 
12	Confirm that "0 Errors" and "0 Warnings" are displayed in the Build Tab Page.	

7.3.4. Going Online and Transferring the Project Data

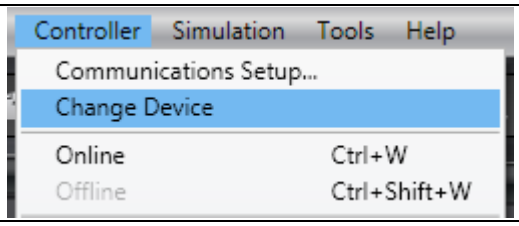
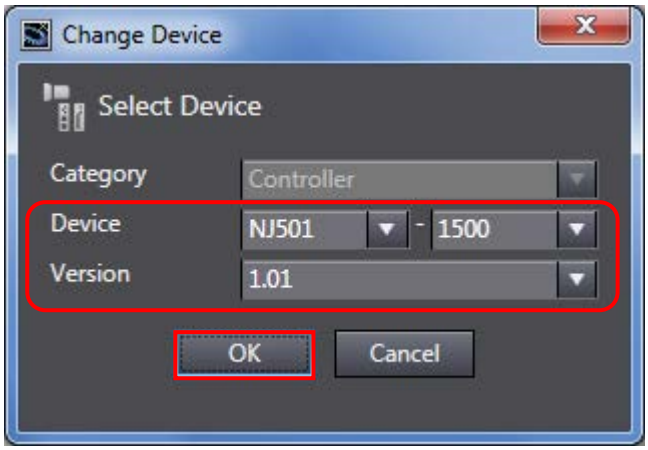
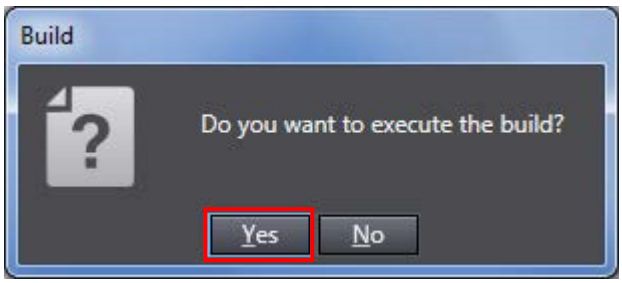
Connect online with the Sysmac Studio and transfer the project data to the Controller.

⚠ WARNING

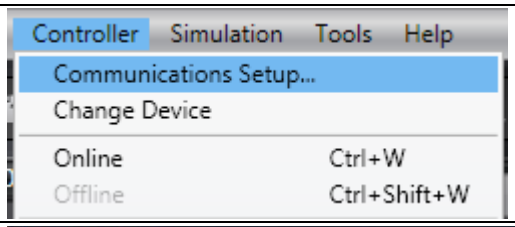
Always confirm safety at the destination node before you transfer a user program, configuration data, setup data, device variables, or values in memory used for CJ-series Units from the Sysmac Studio.
The devices or machines may perform unexpected operation regardless of the operating mode of the CPU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

⚠ Caution

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

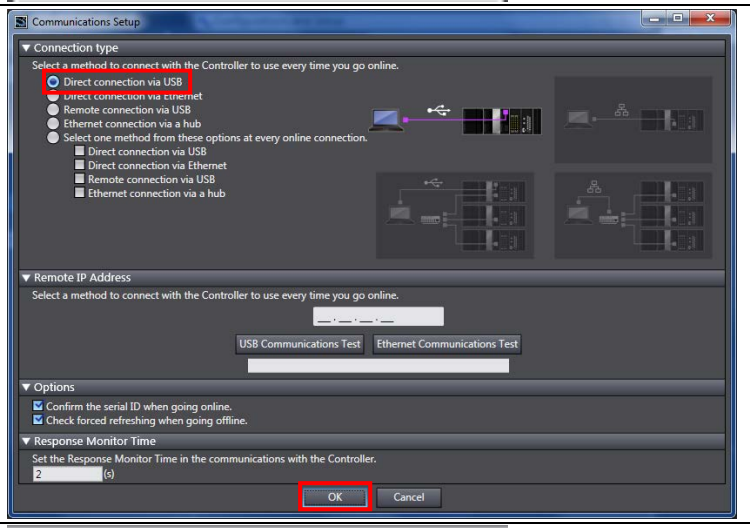
1	Select ***Change Device*** from the Controller Menu.	
2	The Change Device Dialog Box is displayed. Confirm that the Device and Version are set as shown on the right. *If the settings are different, change the value from the pull-down list. Click the **OK** Button.	
3	If the settings were changed in Step 2, the Build Dialog Box is displayed. Click the **Yes** Button.	

4 Select the ***Communications Setup*** from the Controller Menu.



5 The Communications Setup Dialog Box is displayed.
Select the *Direct Connection via USB* Option in the Connection Type Field.

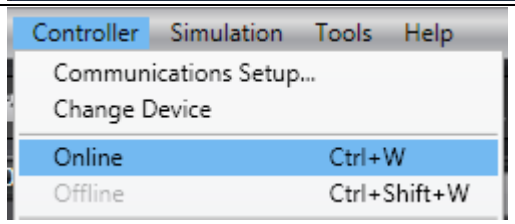
Click the **OK** Button.

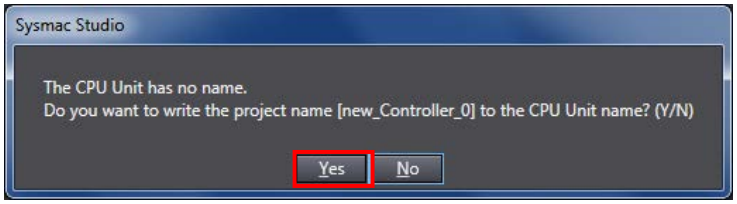


6 Select ***Online*** from the Controller Menu.

A confirmation dialog box is displayed. Click the **Yes** Button.

*The displayed dialog depends on the status of the Controller used. Select the **Yes** Button to proceed with the processing.



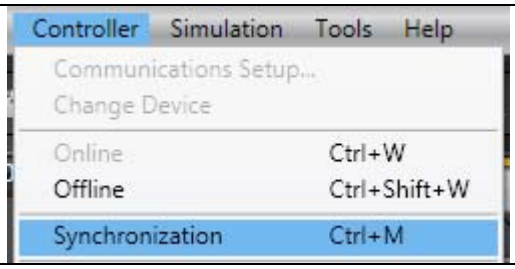


Additional Information

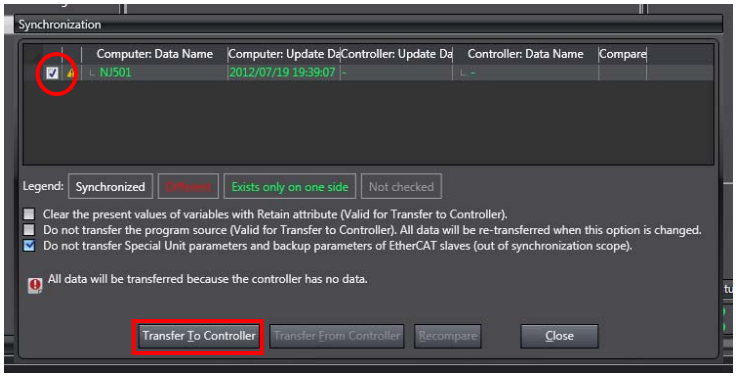
For details on online connections to a Controller, refer to *Section 5 Going Online with a Controller* in the *Sysmac Studio Version 1.0 Operation Manual* (Cat. No. W504).

7 When an online connection is established, a yellow bar is displayed on the top of the Edit Pane.

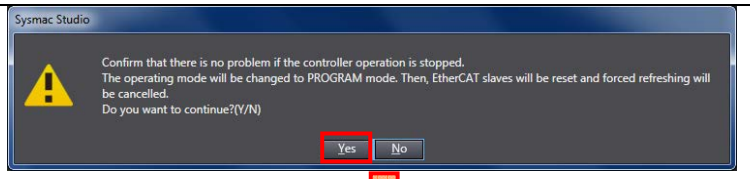
8 Select ***Synchronization*** from the Controller Menu.



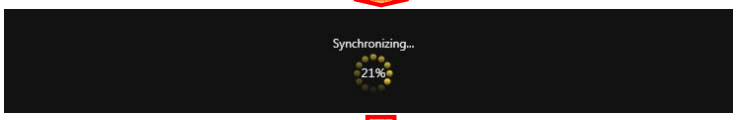
9 The Synchronization Dialog Box is displayed.
Confirm that the data to transfer (NJ501 in the right figure) is selected. Then, click the **Transfer to Controller** Button.



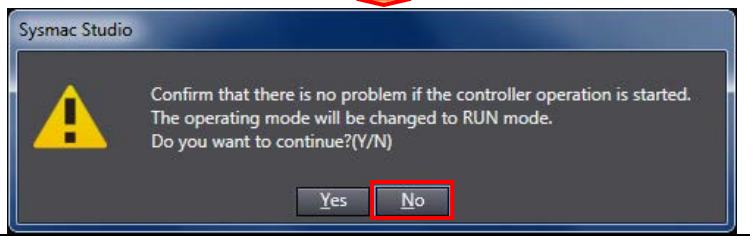
10 A confirmation dialog is displayed. Click the **Yes** Button.



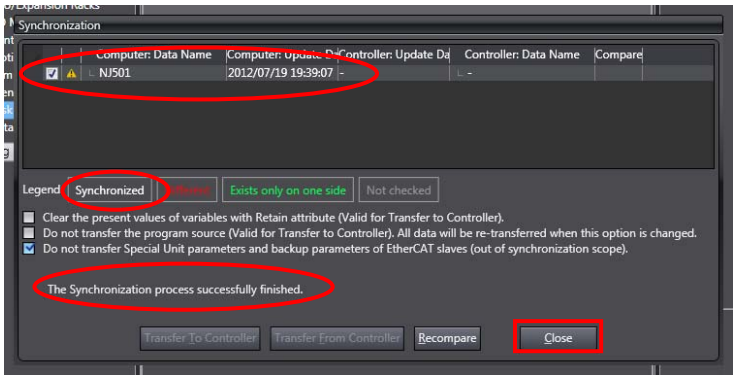
A screen stating "Synchronizing" is displayed.

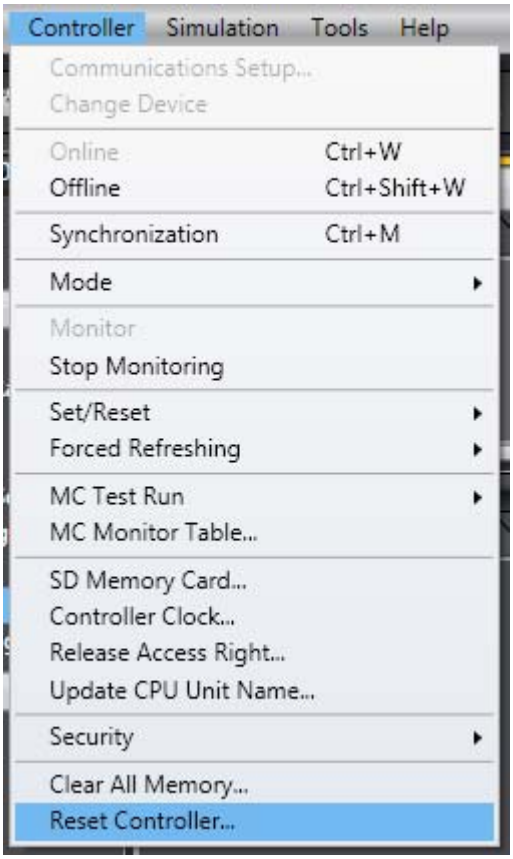
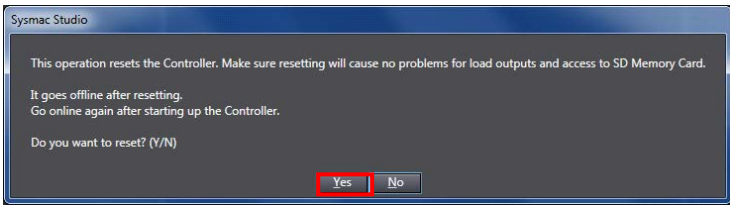
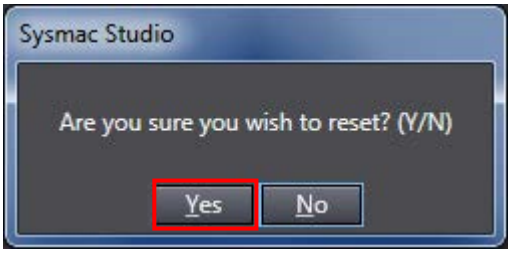
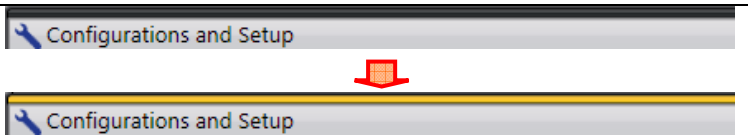


A confirmation dialog box is displayed. Click the **No** Button.



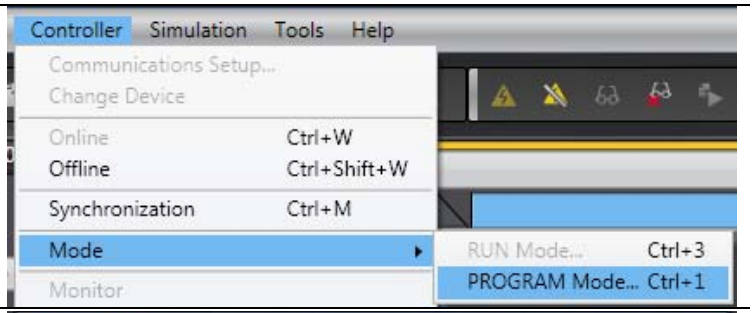
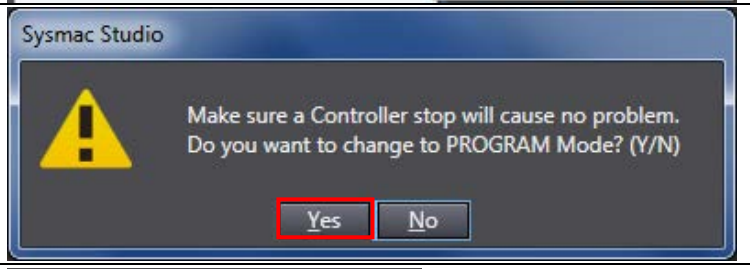
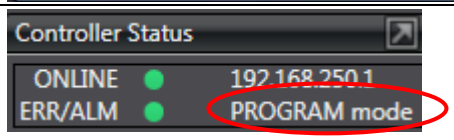
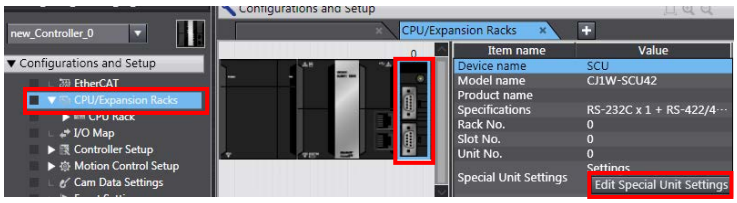
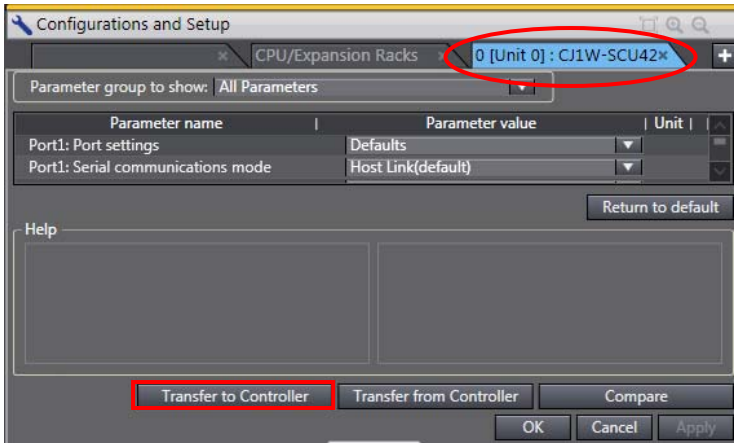
11 Confirm that the synchronized data is displayed with the color specified by “Synchronized” and that a message is displayed stating "The synchronization process successfully finished". If there is no problem, click the **Close** Button.
*If the synchronization fails, check the wiring and repeat the procedure described in this section.



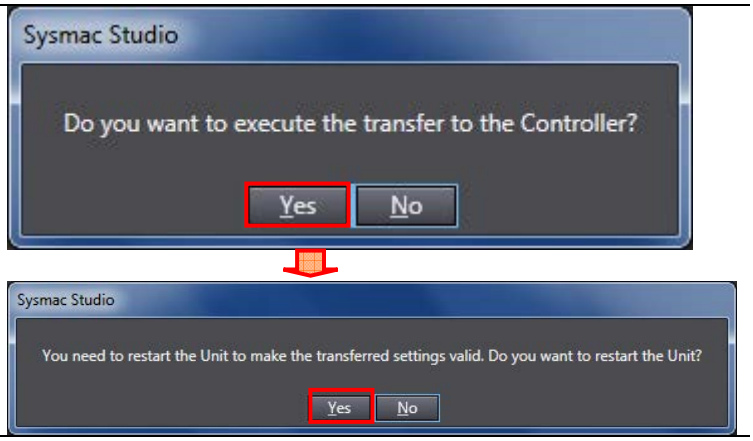
12	Select ***Reset Controller*** from the Controller Menu. *When Mode is set to RUN Mode, Reset Controller cannot be selected. In this case, select ***Mode*** - ***PROGRAM Mode*** from the Controller Menu to change to PROGRAM mode and perform the procedure in this step.	
13	A confirmation dialog box is displayed several times. Click the **Yes** Button.	 
14	The Controller is reset, and Sysmac Studio goes offline. The yellow bar on the top of the Edit Pane disappears. Use steps 6 and 7 to go online.	

7.3.5. Transferring the Unit Settings

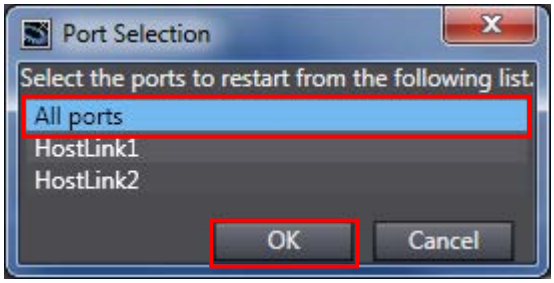
Transfer the setting data of the Serial Communication Unit.

1	Select ***Mode*** - ***PROGRAM Mode*** from the Controller Menu.	
2	A confirmation dialog box is displayed. Click the **Yes** Button.	
3	PROGRAM mode is displayed on the Controller Status Pane.	
4	Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. Select the Serial Communications Unit figure. Click **Edit Special Unit Settings**.	
5	The 0 [Unit 0]: Tab is displayed. Click the **Transfer to Controller** Button.	

6 A confirmation dialog box is displayed.
Click the **Yes** Button.
A dialog box is displayed indicating transferring is being performed.
A confirmation dialog box is displayed.
Click the **Yes** Button.

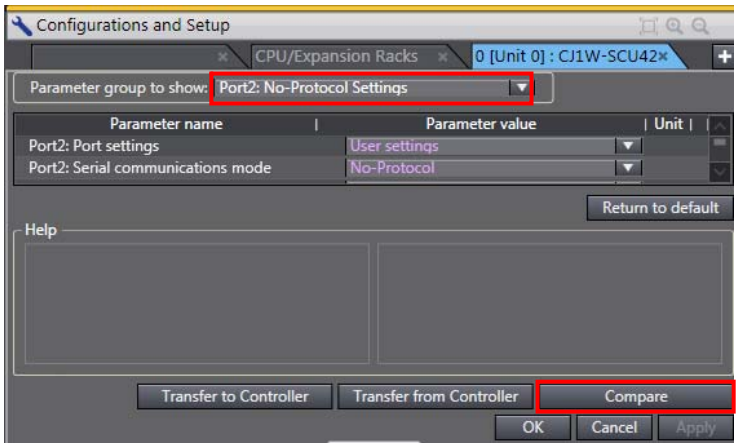


7 The Port Selection Dialog Box is displayed.
Select **All ports** and click the **OK** Button.
*You can select **HostLink2** instead of All ports.

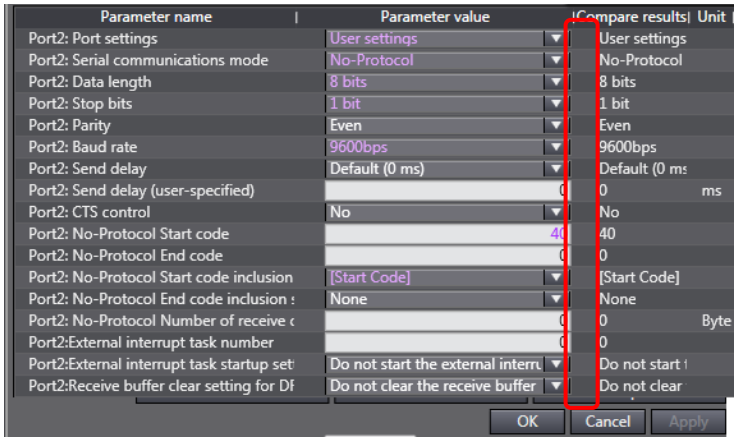


8 A confirmation dialog box is displayed.
Click the **OK** Button.

9 Select *Port2: No-Protocol Settings* from the pull-down list of Parameter group to show.
Click the **Compare** Button.



10 Confirm that "≠" (mismatch) is not shown in the red frame on the right.



7.4. Connection Status Check

Execute the project file that was transferred and confirm that serial communications are performed normally.

⚠ Caution

Sufficiently confirm safety before you change the values of variables on a Watch Tab Page when the Sysmac Studio is online with the CPU Unit. Incorrect operation may cause the devices that are connected to Output Units to operate regardless of the operating mode of the Controller.

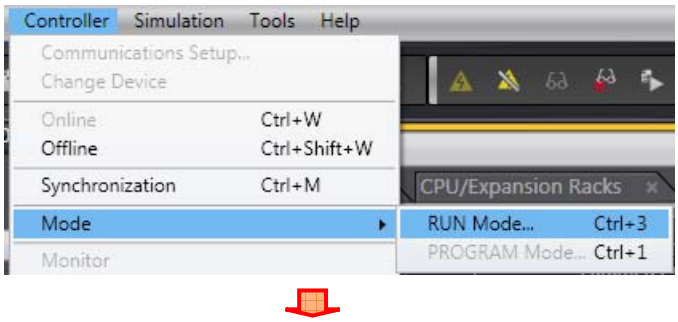
Precautions for Correct Use

Please confirm that the serial cable is connected before proceeding to the following steps.
If it is not connected, turn OFF the power of the devices, and then connect the serial cable.

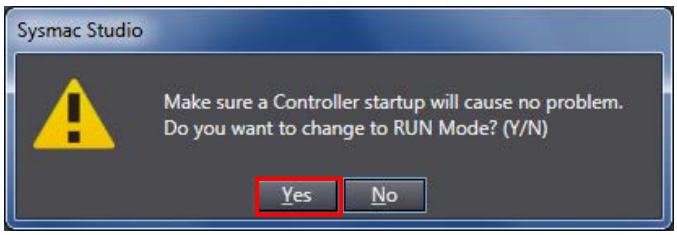
7.4.1. Executing the Ladder Program and Checking the Receive Data

Execute the ladder program and confirm that the correct data are written to the variables of the Controller.

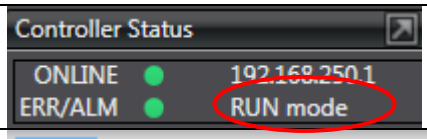
1 Select ***Mode*** - ***RUN Mode*** from the Controller Menu.



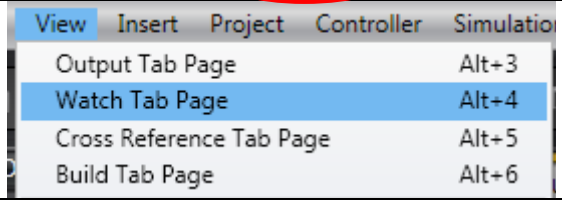
A confirmation dialog box is displayed. Click the **Yes** Button.



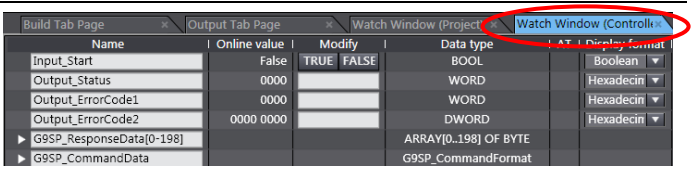
2 RUN mode is displayed on the Controller Status Pane.



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

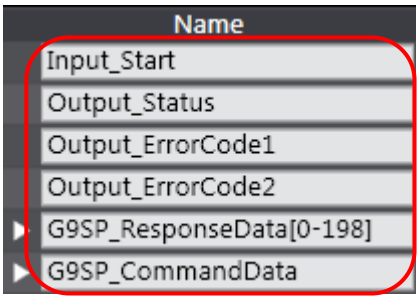


4 The Watch Tab Page is displayed in the lower section of the Edit Pane.

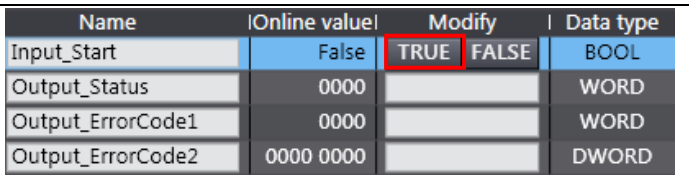


5 Confirm that the following values are displayed in the Name Columns.
- Input_Start
- Output_Status
- Output_ErrorCode1
- Output_ErrorCode2
- G9SP_ResponseData[0-198]
- G9SP_CommandData

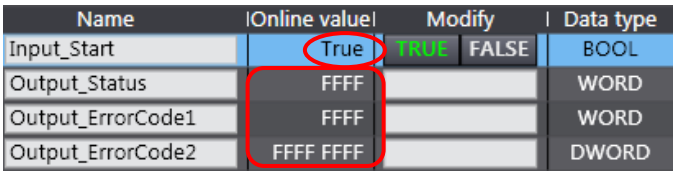
*If the necessary variables are not displayed, click **Input Name** to add.



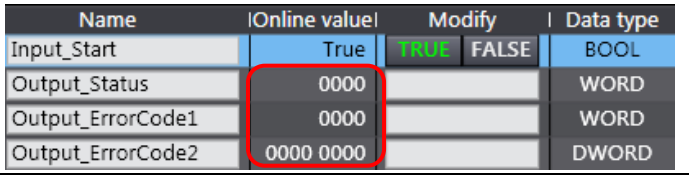
6 Click **TRUE** on the Modify Column of Input_Start.



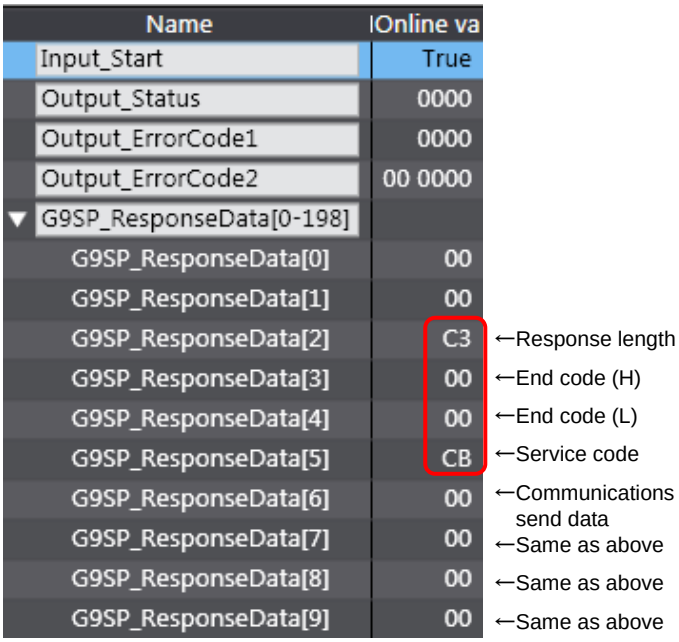
The Online value of Input_Start changes to True.
The Online Values of Output Status and etc. are initialized to FFFF.



When serial communications are completed normally, the Online Values of Output Status and etc. change to 0000.



7 The response data that was received are stored in *G9SP_ResponseData[0]* to *[198]*. Specify variables you want to see in the Watch Tab Page as shown in the right figure and check them.
If values are stored in *G9SP_ResponseData[2]* to *[5]* as shown on the right, the operation is completed normally.
- G9SP_ResponseData[2]:C3
- G9SP_ResponseData[3]:00
- G9SP_ResponseData[4]:00
- G9SP_ResponseData[5]:CB



8. Initialization Method

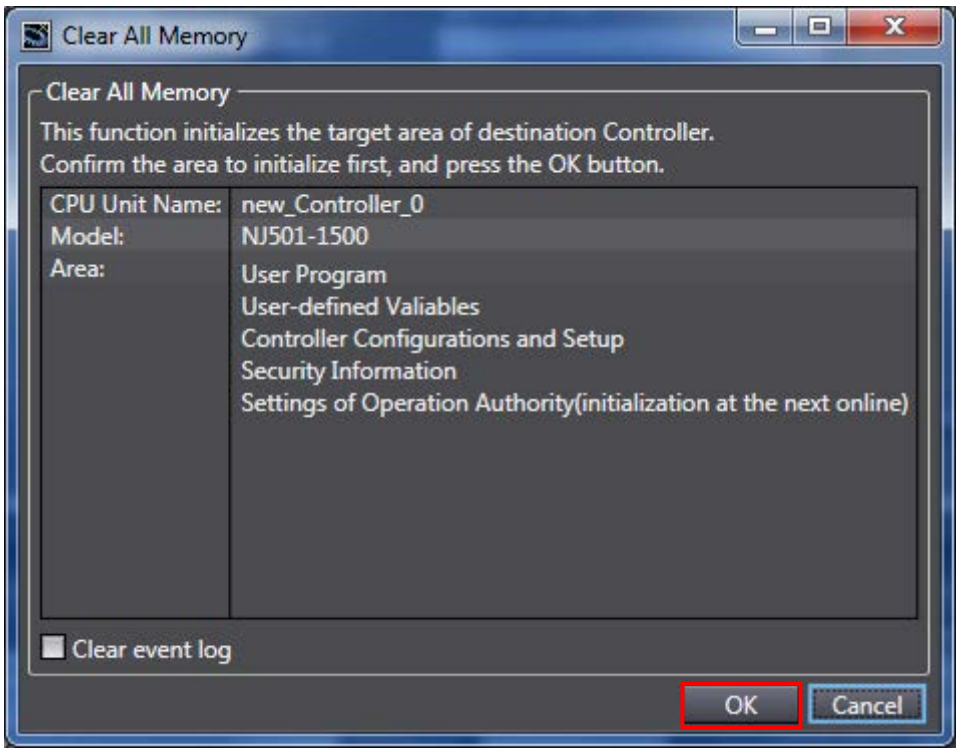
This document explains the setting procedure from the factory default setting.
Some settings may not be applicable as described in this document unless you use the devices with the factory default setting.

8.1. Initializing the Controller

To initialize the Controller, it is necessary to initialize the CPU Unit and Serial Communications Unit.

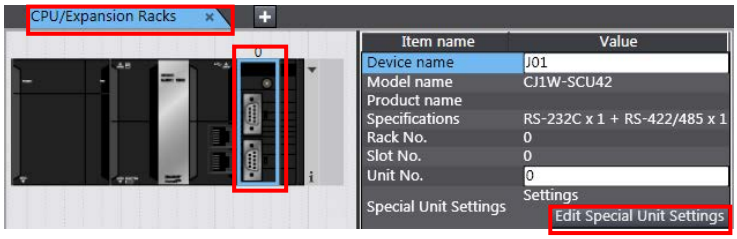
8.1.1. CPU Unit

To initialize the settings of the Controller, select ***Clear All Memory*** from the Controller Menu of the Sysmac Studio.

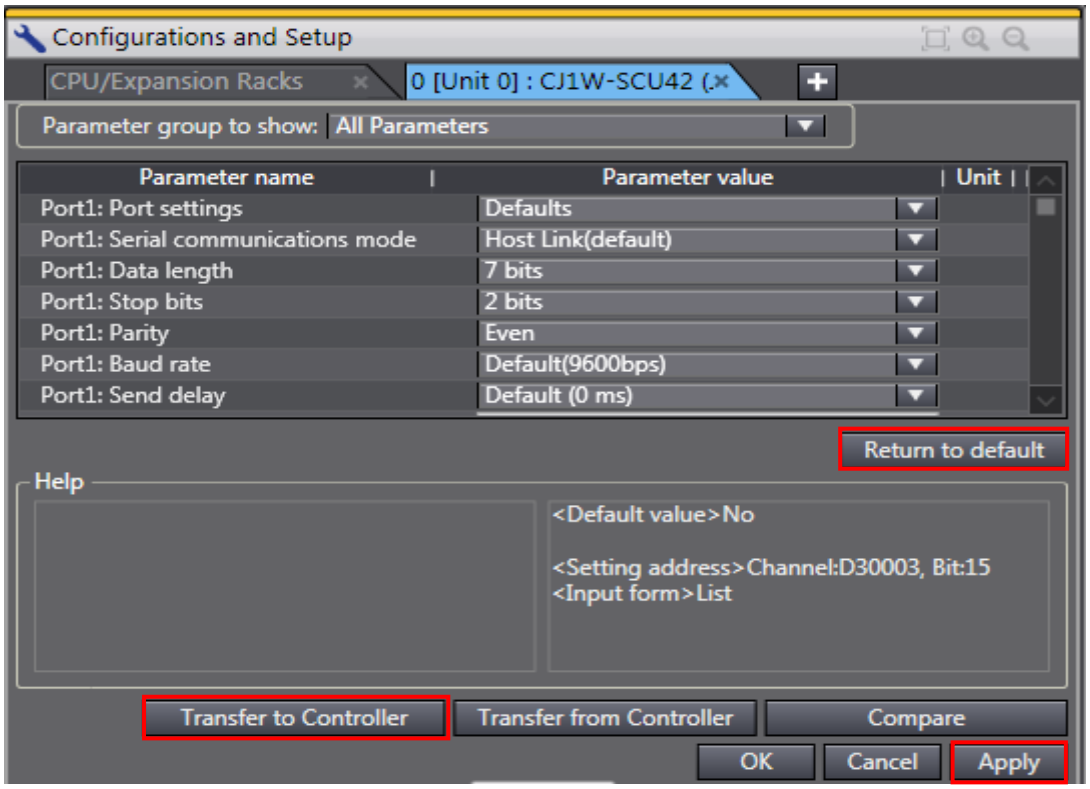


8.1.2. Serial Communications Unit

To initialize the settings of the Serial Communications Unit, select **Edit Special Unit Settings** of CJ1W-SCU42 in CPU/Expansion Racks from the Sysmac Studio.



Click the **Return to default** Button and click the **Apply** Button. Then, click the **Transfer to Controller** Button.



9. Project File

This section describes the details on the project file used in this document.

9.1. Overview

This section explains the specifications and functions of the project file used to connect the Safety Controller (hereinafter referred to as the destination device or G9SP) to the Controller (Serial Communications Unit) (hereinafter referred to as an SCU Unit).

The project file means a Sysmac Studio project file.
The following data has already been set in this project file.
·SCU Unit communications settings and program task settings
·Ladder program for serial communications
·Variable tables and data type definitions of the variables used in ladder programs

This project file uses the serial communications of the SCU Unit to execute “read the I/O monitor results” on the destination device and to detect whether the operation ends normally or abnormally.
A normal end of this project file means a normal end of that the serial communications.
An error end means an error end of the serial communications and a destination device error (Detected with the response data from the destination device).

Additional Information

OMRON has confirmed that normal communications can be performed using this project file under the OMRON evaluation conditions including the test system configuration, version of each product, and product Lot, No. of each device which was used for evaluation.
OMRON does not guarantee the normal operation under the disturbance such as electrical noise or the performance variation of the device.

Additional Information

With Sysmac Studio, the “data type + #” prefix is added to decimal data and “data type + # + 16 + #" prefix is added to hexadecimal data when it is necessary to distinguish between decimal and hexadecimal data. (e.g., INT#1000 decimal -> INT#16#03E8 hexadecimal. For DINT, a data type + "#" are unnecessary.)

9.1.1. Communications Data Flow

The following figure shows the data flow from when the Controller (SCU Unit) issues a communications command (hereinafter referred to as command) to the destination device until when the SCU receives the response data from the destination device.

1.	Sending a command	The SCU Unit sends the send message set with the ladder program to the destination device.
	↓	
2.	Receiving a response	The response data, which was received by the SCU Unit from the destination device, is stored in the specified internal variable of the CPU Unit.

9.1.2. Serial Communications Instruction and Send/Receive Message

This section outlines the function blocks for Serial Communications Unit (hereinafter referred to as serial communications instructions) and the general operation of the send/receive messages.

Additional Information

For details, refer to *Communications Instructions* under *Section 2 Instruction Descriptions of NJ-series Instructions Reference Manual* (Cat. No. W502).

●Serial communications instructions

In this project file, serial communications are performed by using the following 2 types of standard instructions.

Name	Function blocks	Description
SCU Send Serial	SerialSend	Sends data in No-protocol Mode from a serial port. (Send instruction)
SCU Receive Serial	SerialRcv	Reads the receive data from the serial port in No-protocol Mode. (Receive instruction)

●Serial communications instructions argument data

·SCU Send Serial

Instruction	Name	FB/ FUN	Graphic expression	ST expression
SerialSend	SCU Send Serial	FB	SerialSend_instance SerialSend Execute Done Port Busy SrcDat Error SendSize ErrorID ErrorIDEx	SerialSend_instance(Execute, Port, SrcDat, SendSize, Done, Busy, Error, ErrorID, ErrorIDEx);

Variables

Name	Meaning	I/O	Description	Valid range	Unit	Default
Port	Destination port	Input	Destination port	---	---	---
SrcDat[] (array)	Send data array		Send data array	Depends on data type.		*
SendSize	Number of send data elements		Number of elements to send from *SrcDat[]*	0 to 256	Bytes	1

* If you omit an input parameter, the default value is not applied. A building error will occur.

·SCU Receive Serial

Instruction	Name	FB/ FUN	Graphic expression	ST expression
SerialRcv	SCU Receive Serial	FB	SerialRcv_instance SerialRcv Execute Done Port Busy Size Error DstDat ErrorID ErrorIDEx RcvSize	SerialRcv_instance(Execute, Port, Size, DstDat, Done, Busy, Error, ErrorID, ErrorIDEx, RcvSize);

Variables

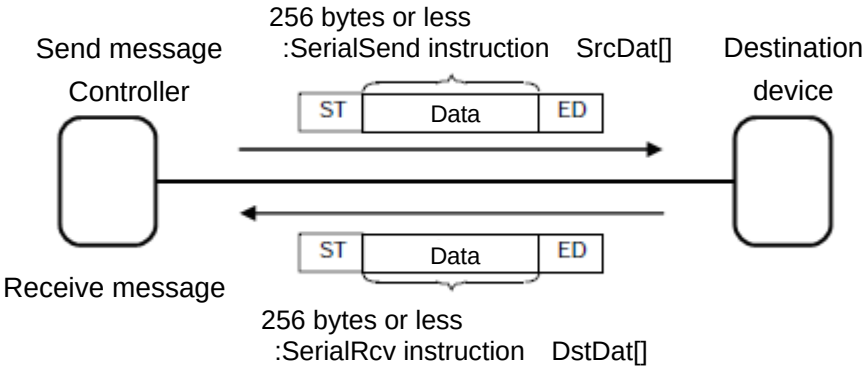
Name	Meaning	I/O	Description	Valid range	Unit	Default
Port	Destination port	Input	Destination port	---	---	---
Size	Receive data size		Size of receive data stored in *DstDat[]*	0 to 256	Bytes	1
DstDat[] (array)	Receive data array	In-out	Receive data array	Depends on data type.	---	---
RcvSize	Number of receive data array elements	Output	Number of receive data array elements actually stored in *DstDat[]*	0 to 256	Bytes	---

·The data type (_sPORT) of destination port (Port)

Name	Meaning	Description	Data type	Valid range	Unit	Default
Port	Destination port	Destination port	_sPORT	---	---	---
UnitNo	Unit number	Unit number of Serial Communications Unit	_eUnitNo	_CBU_No00 to _CBU_No15	---	_CBU_No00
PhysicPortNo	Serial port number	Serial port number on Serial Communications Unit	USINT	1 or 2		1

●Send/receive messages

[Overview of send/receive message]



*The set values shown below for the SCU Unit are stored in ST (Start Code) and ED (End Code).

9.2. Destination Device Command

This section explains the destination device command used in this project file.

9.2.1. Command Format

The command format of the destination device is as follows:

Variable	Type	Data	Code	Remarks
	ST	Start code	#16#40	Fixed
G9SP_Send Command_	Data			
BYTE[0]		Fixed data	#16#00	Fixed
BYTE[1]			#16#00	Fixed
BYTE[2]			#16#0F	Fixed
BYTE[3]			#16#4B	Fixed
BYTE[4]			#16#03	Fixed
BYTE[5]			#16#4D	Fixed
BYTE[6]			#16#00	Fixed
BYTE[7]			#16#01	Fixed
BYTE[8]		Communications receive data	#16#aa	Bits 00 to 07
BYTE[9]			#16#bb	Bits 08 to 15
BYTE[10]			#16#cc	Bits 16 to 23
BYTE[11]			#16#dd	Bits 24 to 31
BYTE[12]		Echo back	#16#e0	Bit 7: Echo back
BYTE[13]			#16#00	Fixed
BYTE[14]		Checksum	#16#ff	Checksum (Leftmost)
BYTE[15]			#16#gg	Checksum (Rightmost)
BYTE[16]		End code	#16#2A	Fixed
BYTE[17]			#16#0D	Fixed

*The checksum is calculated based on ST and G9SP_SendCommand_BYTE[0] to [13].

9.2.2. Response Format

The response format of the destination device is as follows:

<Normal response>

Variable	Type	Data	Value	Remarks	
	ST	Start code	#16#40	Fixed	
G9SP_Response	Data				
Data[0]		Response length	#16#00	Fixed (Response length (HL))	
Data[1]			#16#00	Fixed (Response length (LH))	
Data[2]			#16#C3	Fixed (Response length (LL))	
Data[3]		End code	#16#00	Fixed (End code (H))	
Data[4]			#16#00	Fixed (End code (L))	
Data[5]		Service code	#16#CB	Fixed	
Data[6]		Communications send data	#16#aa	Bits 00 to 07	
Data[7]			#16#bb	Bits 08 to 15	
Data[8]			#16#cc	Bits 16 to 23	
Data[9]			#16#dd	Bits 24 to 31	
Data[10]		Safety input terminal data	#16#ee	Bits 00 to 07	
Data[11]			#16#ff	Bits 08 to 15	
Data[12]			#16#0g	Bits 16 to 19	
Data[13] to [15]			#16#00	Not used	
Data[16]		Safety input terminal data	#16#hh	Bits 00 to 07	
Data[17]			#16#ii	Bits 08 to 15	
Data[18] to [19]			#16#00	Not used	
Data[20]		Safety input terminal status	#16#jj	Bits 00 to 07	
Data[21]			#16#kk	Bits 08 to 15	
Data[22]			#16#0l	Bits 16 to 19	
Data[23] to [25]			#16#00	Not used	
Data[26]		Safety output terminal status	#16#mm	Bits 00 to 07	
Data[27]			#16#nn	Bits 08 to 15	
Data[28] to [29]			#16#00	Not used	
Data[30] to [39]		Safety input terminal error cause	#16#oo	Safety input terminal 01	Safety input terminal 00
			#16#pp	Safety input terminal 03	Safety input terminal 02
				:	
			#16#qq	Safety input terminal 17	Safety input terminal 16
			#16#rr	Safety input terminal 19	Safety input terminal 18
Data[40] to [53]			#16#00	Not used	
Data[54] to [63]		Safety output terminal error cause	#16#ss	Safety input terminal 01	Safety input terminal 00
			#16#tt	Safety input terminal 03	Safety input terminal 02
				:	
			#16#uu	Safety input terminal 17	Safety input terminal 16
			#16#vv	Safety input terminal 19	Safety input terminal 18
Data[64] to [69]			#16#00	Not used	
Data[70] to [71]		Reserved	#16#00	Not used	
Data[72]		Unit Status and echo-back	#16#ww	Bit 7: Echo-back Bit 0: Unit Normal Operating Flag	
Data[73]			#16#xx	Bit 5: Function Block Execution Error Flag Bit 2: Safety I/O Terminal Error Flag Bit 1: Output Power Supply Error Flag	

Variable	Type	Data	Value	Remarks
Data[74]		Configuration ID	#16#yy	Rightmost byte
Data[75]			#16#zz	Leftmost byte
Data[76]		Unit Conduction Time	#16#aa	First byte
Data[77]			#16#bb	Second byte
Data[78]			#16#cc	Third byte
Data[79]			#16#00	Not used
Data[80] to [99]		Reserved	#16#00	Not used
Data[100] to [111]		Present Error Information	#16#dd	Error Information Map 0
			#16#ee	Error Information Map 1
			:	
			#16#ff	Error Information Map 10
			#16#gg	Error Information Map 11
Data[112]		Error Log Count (Operation Log Count)	#16#hh	Error Log Count
Data[113]			#16#ii	Operation Log Count
Data[114] to [153]		Error Log (Error Code: Conduction Time)	#16#jj	Error code 1
			#16#kk	Conduction Time first byte at error
			#16#ll	Conduction Time second byte at error
			#16#mm	Conduction Time third byte at error
			:	:
			#16#nn	Error code 10
			#16#oo	Conduction Time first byte at error
			#16#pp	Conduction Time second byte at error
			#16#qq	Conduction Time third byte at error
Data[154] to [193]		Operation Log (Operation Code: Conduction Time)	#16#rr	Operation code 1
			#16#ss	Conduction Time first byte at error
			#16#tt	Conduction Time second byte at error
			#16#uu	Conduction Time third byte at error
			:	:
			#16#vv	Operation code 10
			#16#ww	Conduction Time first byte at error
			#16#xx	Conduction Time second byte at error
			#16#yy	Conduction Time third byte at error
Data[194]		Checksum	#16#zz	Checksum (Leftmost)
Data[195]			#16#aa	Checksum (Rightmost)
Data[196]		End code	#16#2A	Fixed
Data[197]			#16#0D	Fixed

*The checksum is calculated based on ST and G9SP_ResponseData[0] to [193].

*The response length is calculated based on G9SP_ResponseData[3] to [197].

<Error response>

Variable	Type	Data	Code	Remarks
	ST	Start code	#16#40	Fixed
G9SP_Response	Data			
Data[0]		Response length	#16#00	Fixed (Response length (HL))
Data[1]			#16#00	Fixed (Response length (LH))
Data[2]			#16#09	Fixed (Response length (LL))
Data[3]		End code	#16#00	Fixed (End code (H))
Data[4]			#16#00	Fixed (End code (L))
Data[5]		Service code	#16#CB	Fixed
Data[6] to [7]		Data	#16#aa	Reserved (Specified by user)
Data[8]		Checksum	#16#bb	Checksum (Leftmost)
Data[9]			#16#cc	Checksum (Rightmost)
Data[10]		End code	#16#2A	Fixed
Data[11]			#16#0D	Fixed

*The checksum is calculated based on ST and G9SP_ResponseData[0] to [7].

*The response length is calculated based on G9SP_ResponseData[3] to [11].

Additional Information

For details, refer to *Section 7 Communications with a Standard PLC Using an Option Board* in the *G9SP-series Safety Controller Operation Manual* (Z922).

9.2.3. Send/Receive Messages

Data are sent in sequence from ST of the command format.

Data are received in sequence from ST of the response format.

*Send message

40	00	00	0F	4B	03	4D	00	01	..(Total of 19 bytes)

*Receive message 1 (at normal processing)

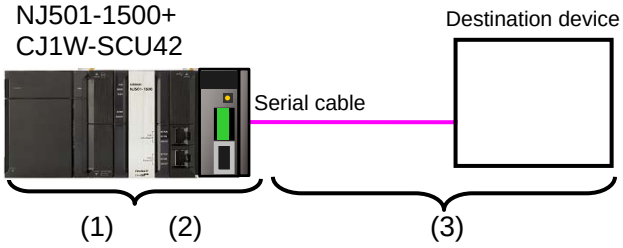
40	00	00	C3	00	00	CB	aa	..(Total of 199 bytes)

*Receive message 2 (at error processing)

40	00	00	09	00	00	CB	aa	..(Total of 13 bytes)

9.3. Error Detection Processing

This project file detects and handles errors (1) to (3). For information on error codes, refer to *9.7 Error Status List*.



(1) Errors during execution of SerialSend/SerialRcv instructions (communications instruction errors)

An error end of SerialSend/SerialRcv instruction due to an incorrect SCU Unit setting or incorrect variable setting, etc is detected as a communications instruction error. The error is detected with the error flag (Error) at the execution of an instruction.

(2) SCU Unit errors (Unit errors)

An error that prevents the SCU Unit from being ready for communications is detected as a Unit error. This error is detected when a timeout occurs.

(3) Errors in the destination device (Destination device errors)

An error that occurs during communications with a destination device is detected as a destination device error. Destination device errors include a transmission error caused by a destination device's command error, parameter error, data error and an error that prevents execution, character corruption or unmatched baud rate setting. The error is detected with the response data which is sent from the destination device.

With this project file, the destination device error is detected when there is a difference between a normal receive message (hereinafter referred to as a normal message) and an error receive message (hereinafter referred to as an error message). (Refer to *9.2.3. Send/Receive Message* for details.)

Normal message (Normal response)	#40	#0000C3	#0000	#CB	188Byte	#****	#2A0D
	Start code	Response length	End code	Service code	Data	Checksum	Delimiter

Error message (Error response)	#40	#000009	#0000	#CB	#****	#****	#2A0D
	Start code	Response length	End code	Service code	Reserve data	Checksum	Delimiter

9.4. Variables

The table below lists the variables used in this project file.

9.4.1. External variables

These external variables are necessary to execute this program.

To use global variables, they must be declared in each program.

Additional Information

With the Sysmac Studio, the data type is expressed as ARRAY[0..2] OF WORD when an array is specified for a data type. However, a data type of an array is simplified in this document (e.g. WORD[3]).
It is possible to set either of the following to specify an array for a data type with the Sysmac Studio.
·ARRAY[0..2] OF WORD
·WORD [3]
In the example above, 3 WORD array elements are secured.

●Variables that are used

(1)These variables are used to operate and check this program.

Name	Data type	Description
Input_Start	BOOL	This project file is started by changing from FALSE (OFF) to TRUE (ON).
Output_Status	WORD	Stores the execution results of this project file. #16#FFFF: Default #16#0000: Normal end #16#FF01: SerialSend instruction error #16#FF02: SerialRcv instruction error #16#FF03: Destination device error (receive data value error) #16#FF04: Communications error (timeout detection)
Output_ErrorCode1	WORD	Stores the value of *ErrorID* and destination device error code for each instruction when an instruction error occurs. (Default: #16#FFFF)
Output_ErrorCode2	DWORD	Stores the value of *ErrorIDEx* and destination device error code for each instruction when an instruction error occurs. (Default: #16#FFFF FFFF)
SCU_Inport	_sPORT	Sets the unit number and port number of the SCU Unit.
G9SP_CommandData	G9SP_CommandFormat	Sets the command sent to G9SP.
G9SP_SendCommand_BYTE	BYTE[18]	Data obtained by converting *G9SP_CommandData* into a BYTE array to be used in the SerialSend instruction.
G9SP_SendCommand_Checksum_WORD	WORD	Checksum value (WORD) of the send data
G9SP_SendCommand_Checksum_HighByte	BYTE	The leftmost byte data of the checksum value (WORD)
G9SP_SendCommand_Checksum_LowByte	BYTE	The rightmost byte data of the checksum value (WORD)
G9SP_ResponseData	BYTE[199]	BYTE array data received by the SerialRcv instruction

(2)These variables of the SCU Unit are used in this program.

Name	Data type	Description
SCU_P2_NopSerialSendExecSta	BOOL	SerialSend instruction executing flag: ON during data send operation and OFF when the send operation is completed.
SCU_P2_NopRcvCompleteSta	BOOL	Receive completion flag: ON when reception of data is completed and OFF when storing the receive data in a variable specified with the SerialRcv is completed.
SCU_P2_NopRcvCntSta	UINT	Receive counter: Stores the size of the received data.

Additional Information

For information on variables of the Serial Communications Unit, refer to *5-2 Device Variables for CJ-series Unit and System-defined Variables (During Serial Gateway Mode)* in the *CJ-series Serial Communications Units Operation Manual for NJ-series CPU Unit* (Cat.No. W494).

(3)This system variable is used in this program.

Name	Data type	Description
_Port_isAvailable	BOOL	Communications Port Enabled Flag

Additional Information

For information on system variables when using the serial communications instructions, refer to *SerialSend* and *SerialRecv* in *Section 2 Instruction Descriptions* of the *NJ-series Instructions Reference Manual* (Cat. No. W502).

●Structure

The structures used in the external variables are shown below.

(1)_sPORT

Variable		Meaning	Description	Data type	Valid range	Default
SCU_Inport		Destination port	Destination port	_sPORT	―	
	UnitNo	Unit number	Unit number of SCU Unit	_eUnitNo	_CBU_No00 to _CBU_No15	_CBU_No00
	PhysicPortNo	Serial port number	Serial port number of SCU Unit	USINT	1 or 2	1

(2)G9SP_CommandFormat

Variable		Meaning	Description	Data type	Valid range	Default
G9SP_CommandFormat		G9SP command setting	Specifies command data sent to G9SP.	G9SP_CommandFormat	-	
	FixationArea1	Fixed area 1	Sets the fixed data that cannot be changed by the user.	USINT[8]	Fixed	-
	SendData	User specification area	Sets communications receive data and echo back data that can be changed by the user.	USINT[6]	#16#00 to 16#FF	-
	CheckSum	Checksum area	Sets a checksum value.	UINT	#16#00 to #16#FF	-
	FixationArea2	End code area	Sets the end code (#16#2A0D).	USINT[2]	Fixed	-

9.4.2. Internal Variables

These internal variables are necessary to execute this project file.

They can be used only in this program.

●Variables for internal processing

These function blocks are used in this program.

Name	Data type	Description
G9SP_SerialSend_Instance	SerialSend	The instance of the SerialSend instruction
G9SP_SerialRcv_Instance	SerialRcv	The instance of the SerialRcv instruction
G9SP_RcvWait_Timer	TON	Data receive waiting timer. Normally, the SerialRcv instruction is executed after the reception of data is completed (after SCU_P2_NopRcvCompleteSta is turned ON). This timer is used to execute the SerialRcv instruction after a certain period of time after completion of the send processing even if completion of the receive operation cannot be detected. (Setting value: 200 ms)
G9SP_Check_Timer	TON	G9SP send/receive completion check timer. This timer operates after *Input_Start* is turned ON until send/receive operations are completed. A timeout error occurs when this timer is turned ON. (Setting value 20 seconds)

●Variables that are used

These variables are used in this program.

Name	Data type	Description
G9SP_ResponseData_OK	BOOL	Turns ON when this program receives a normal response.
G9SP_Error_End	BOOL	Turns ON an error occurs after executing this program.
G9SP_Excuting	BOOL	Serial communications executing flag. Turns ON from when *Input_Start* is turned ON until when the normal end (G9SP_ResponseData_OK) or the error end (G9SP_Error_End) is turned ON.
G9SP_SerialSend_Excute	BOOL	SerialSend instruction execution flag. Turns ON during execution of the SerialSend instruction (until *Done* is turned ON).
G9SP_SerialSend_Wait	BOOL	Data sending flag. Turns ON after the SerialSend instruction is completed until the data send processing is completed (until *SCU_P2_NopSerialSendExecSta* is turned OFF).
G9SP_SerialSend_End	BOOL	Data send completion flag. Turns ON when the data send processing is completed.
G9SP_SerialSend_Error	BOOL	SerialSend instruction error flag. Turns ON when the SerialSend instruction ends in an error.
G9SP_SerialRcv_Excute	BOOL	SerialRcv instruction execution flag. Turns ON during execution of the SerialRcv instruction (until *Done* is turned ON).
G9SP_SerialRcv_End	BOOL	Data receive completion flag. Turns ON when the data receive processing is completed.
G9SP_SerialRcv_Error	BOOL	SerialRcv instruction error flag. Turns ON when the SerialRcv instruction ends in an error.
G9SP_TimeOUT	BOOL	G9SP send/receive timeout flag. Turns ON when the *G9SP_Check_Timer* times out.

Name	Data type	Description
G9SP_ReceiveData_error	BOOL	Receive data error flag. Turns ON when the receive data is not normal.

9.5. Ladder Program

9.5.1. Ladder Program Function Configuration

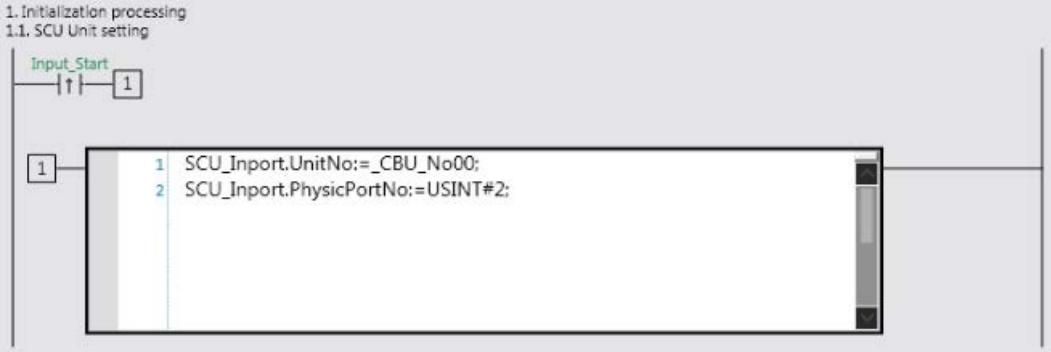
The functional configuration of this program is as follows

Major classification	Minor classification	Description
1. Initialization processing	1.1. SCU Unit setting 1.2. Setting the G9SP command data 1.3. Generating a checksum 1.4. Converting the send data (USINT→BYTE) 1.5. Initializing the response data area and status 1.6. Turning ON the serial communications executing flag and enabling the monitor timer (20 seconds)	Preparation for communications. Variables to be used are cleared and initialization settings are performed.
2. Managing the SerialSend instruction executing status	2.1. Generating a SerialSend instruction execution flag 2.2. Executing the SerialSend instruction 2.3. Checking for the SerialSend instruction error 2.4. Waiting for data send completion 2.5. Checking for data send completion 2.6. Saving the error status	The SerialSend instruction is executed and the program waits for the completion of data send operation. The error status is stored in the status area when the operation ends in an error.
3. Managing the SerialRcv instruction executing status	3.1. Generating a SerialRcv instruction execution flag 3.2. Executing the SerialRcv instruction 3.3. Checking for SerialRcv instruction error 3.4. Checking for data receive completion 3.5. Saving the error status	The SerialRcv instruction is executed and the program waits for the completion of data receive operation. The error status is stored in the status area when the operation ends in an error.
4.End processing	4.1. Checking the response data 4.2. Generating an error flag	The receive data is checked. The error flag is turned ON when an error occurs.

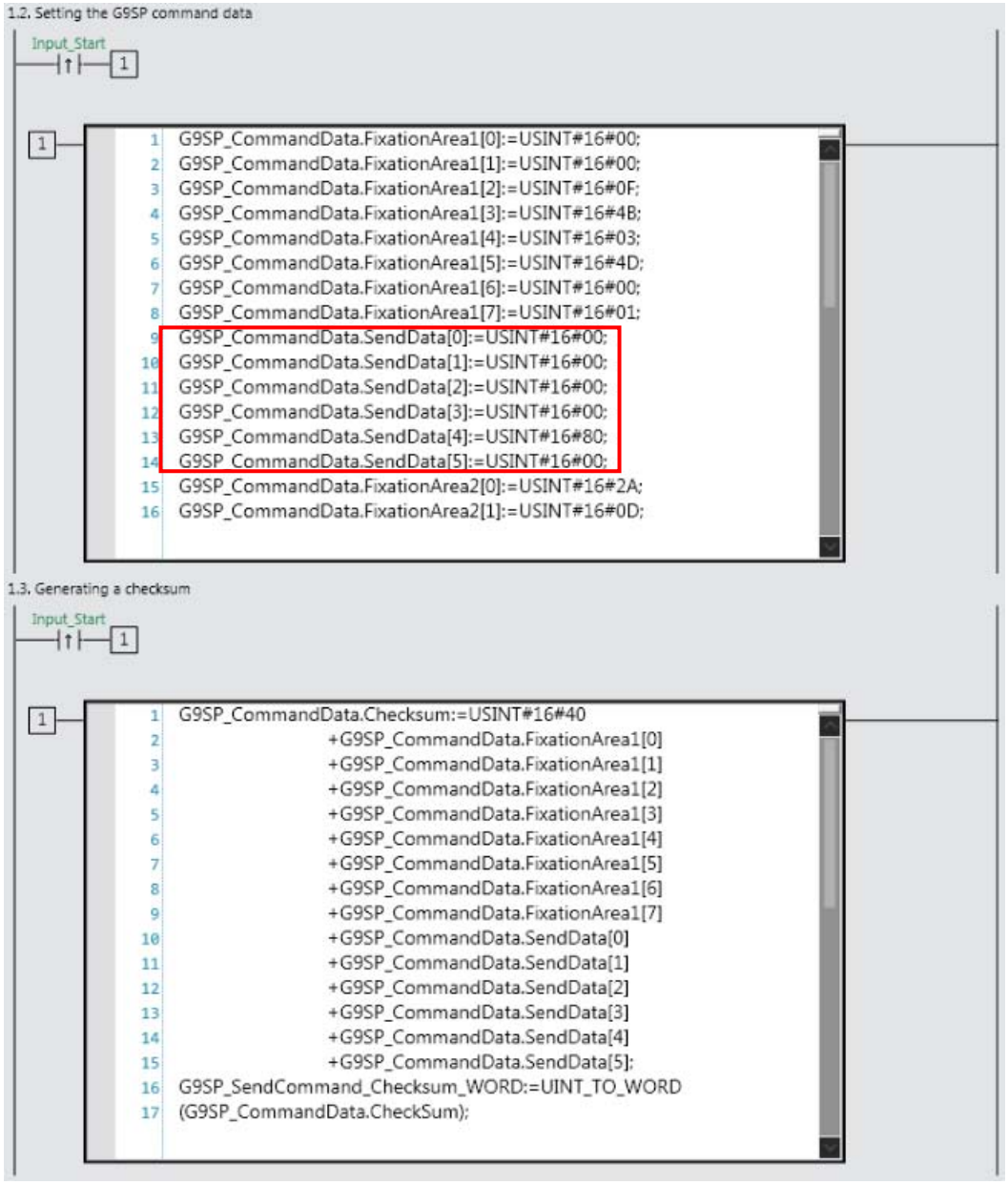
9.5.2. Explanation on Each Functional Component

This section shows the details on the functions of this program.

1. Initialization processing

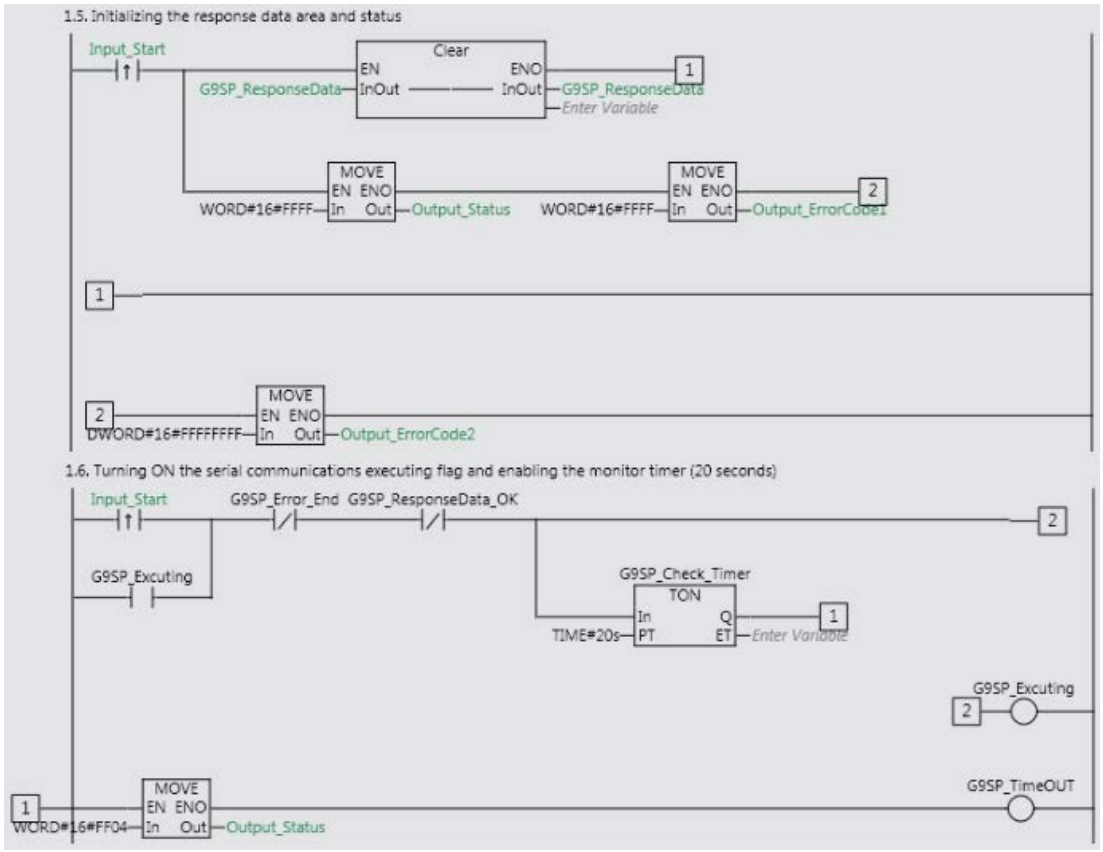


No.	Overview	Description
1.1.	SCU Unit setting	Sets the Unit number and serial port number of the SCU Unit in the *SCU_Inport* structure.



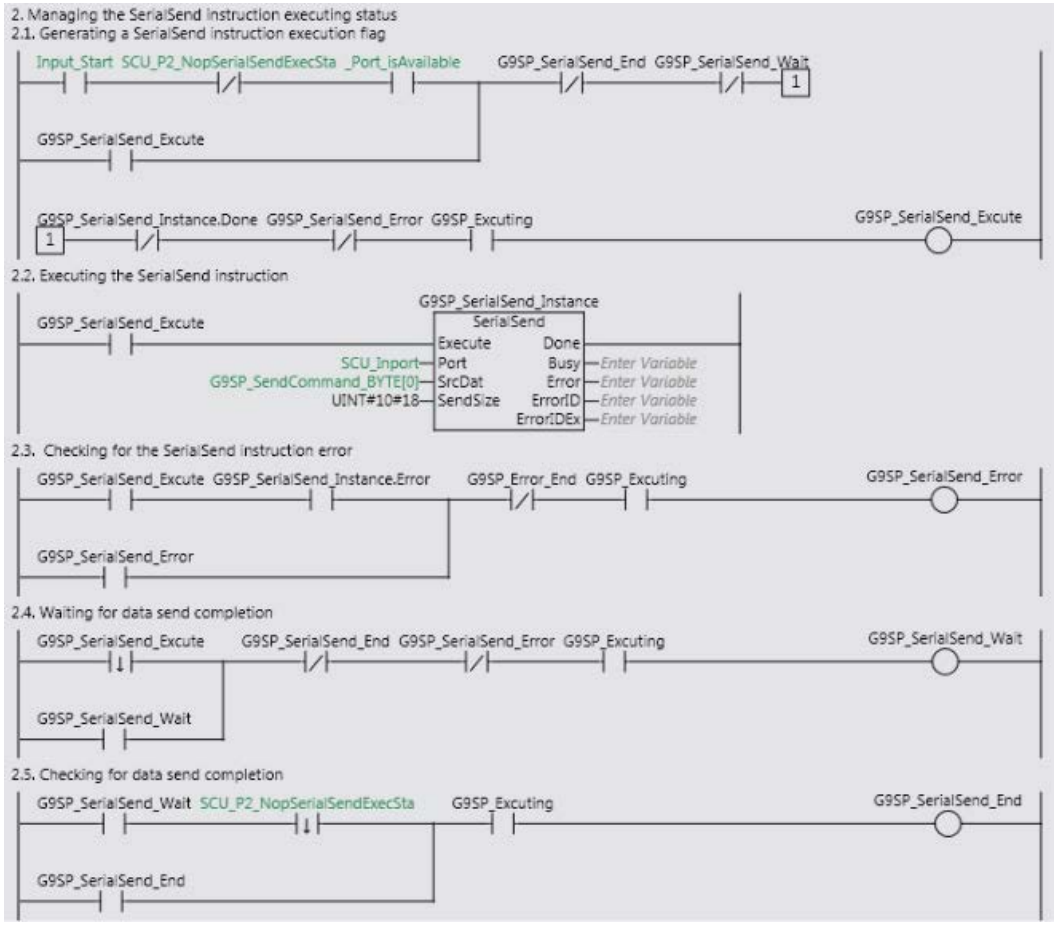
No.	Overview	Description
1.2.	Setting the G9SP command data	Sets a command sent to G9SP. Data in the red frame are communication receive data and echo back data that can be changed by the user. Any value can be set.
1.3.	Generating a checksum	Calculates the checksum value of the set command data.

No.	Overview	Meaning
1.4.	Converting the send data (USINT→BYTE)	Converts the set command data and calculated checksum value into a BYTE array to set them for the SerialSend instruction.

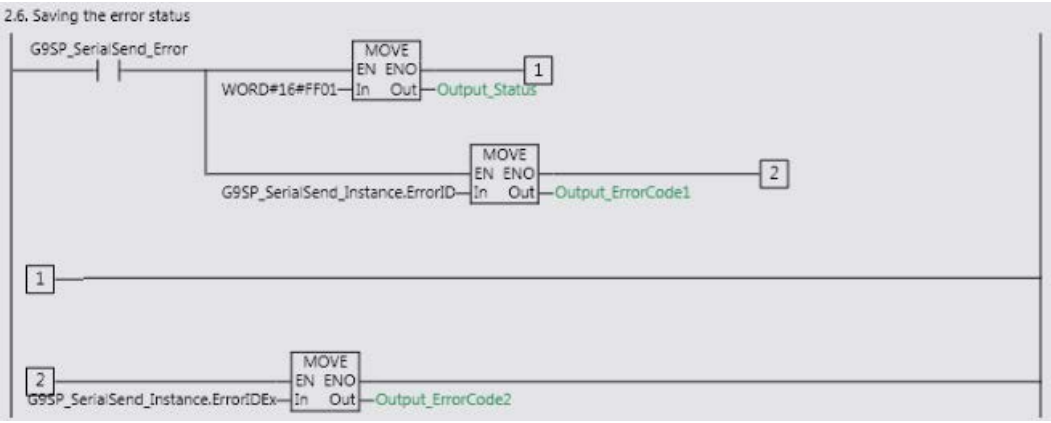


No.	Overview	Meaning
1.5.	Initializing the response data area and status	Initializes the response area and status area. The status area is initialized to #16#FFFF.
1.6.	Turning ON the serial communications executing flag and executing the monitor timer (20 seconds)	Turns ON *G9SP_Excuting* that indicates the serial communications are in progress. G9SP send/receive completion check timer (*G9SP_Check_Timer*) is operated to detect a timeout. When the G9SP send/receive completion check timer times out, G9SP_TimeOUT is turned ON and the error status is stored.

2. Managing the SerialSend instruction executing status



No.	Overview	Meaning
2.1.	Generating a SerialSend instruction execution flag	Turns ON *G9SP_SerialSend_Excute* and starts the SerialSend instruction execution processing if the SerialSend instruction executing flag is not turned ON. Turns OFF this flag when *Done* flag of the SerialSend instruction is turned ON.
2.2.	Executing the SerialSend instruction	Executes the SerialSend instruction.
2.3.	Checking for a SerialSend instruction error	Turns ON the *G9SP_SerialSend_Error* flag when Error flag of the SerialSend instruction is turned ON.
2.4.	Waiting for data send completion	Turns ON *G9SP_SerialSend_Wait* when *G9SP_SerialSend_Excute* is turned OFF. When the SerialSend instruction executing flag is turned ON, the send processing is completed, *G9SP_SerialSend_Wait* is turned OFF and *G9SP_SerialSend_End* is turned ON.
2.5.	Checking data send completion	

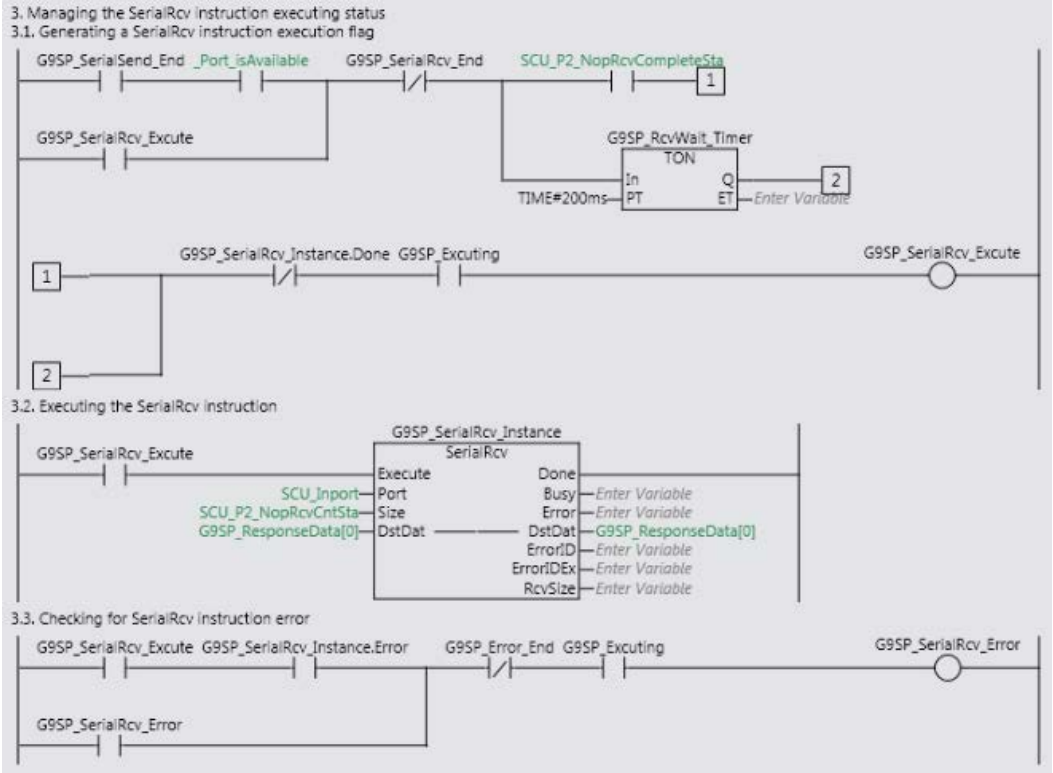


No.	Overview	Meaning
2.6.	Saving error status	Sets the following status when the SerialSend instruction ends in an error. ·Output_Status: #16#FF01 ·Output_ErrorCode1: *ErrorID* of SerialSend instruction ·Output_ErrorCode2: *ErrorIDEx* of SerialSend instruction

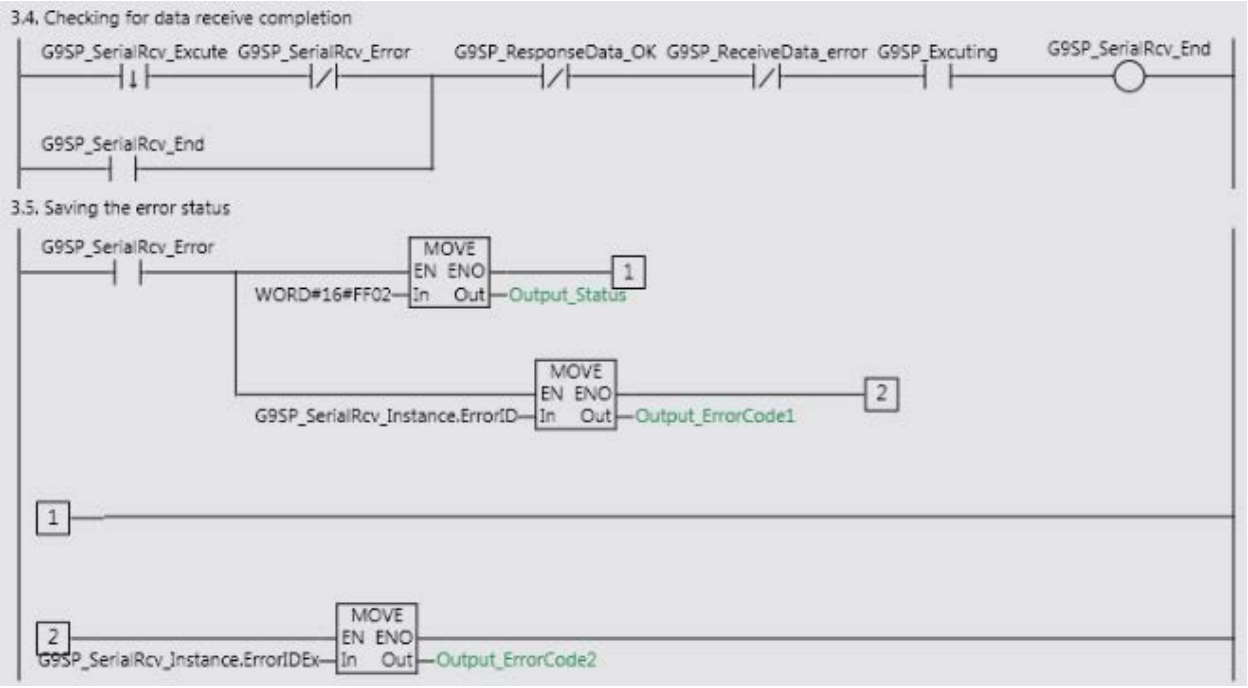
Additional Information

For information on the error status, refer to *9.7 Error Status List*.

3. SerialRcv instruction execution management



No.	Overview	Description
3.1.	Generating a SerialRcv instruction execution flag	If *G9SP_SerialSend_End* is turned ON and the receive completion flag is turned ON, Turns ON *G9SP_SerialRcv_Excute* and starts the SerialRcv instruction execution processing. This flag is turned OFF when Done flag of the SerialRcv instruction is turned ON. If the receive completion flag is not turned ON for a certain period of time (200 ms), *G9SP_SerialRcv_Excute* is turned ON and the SerialRcv instruction is executed.
3.2.	Executing the SerialRcv instruction	Executes the SerialRcv instruction
3.3.	Checking for SerialRcv instruction error	Turns ON the *G9SP_SerialRcv_Error* flag when the Error flag of the SerialRcv instruction is turned ON.
3.4.	Checking for data receive completion	Turns ON *G9SP_SerialSend_End* when *G9SP_SerialRcv_Excute* is turned OFF.

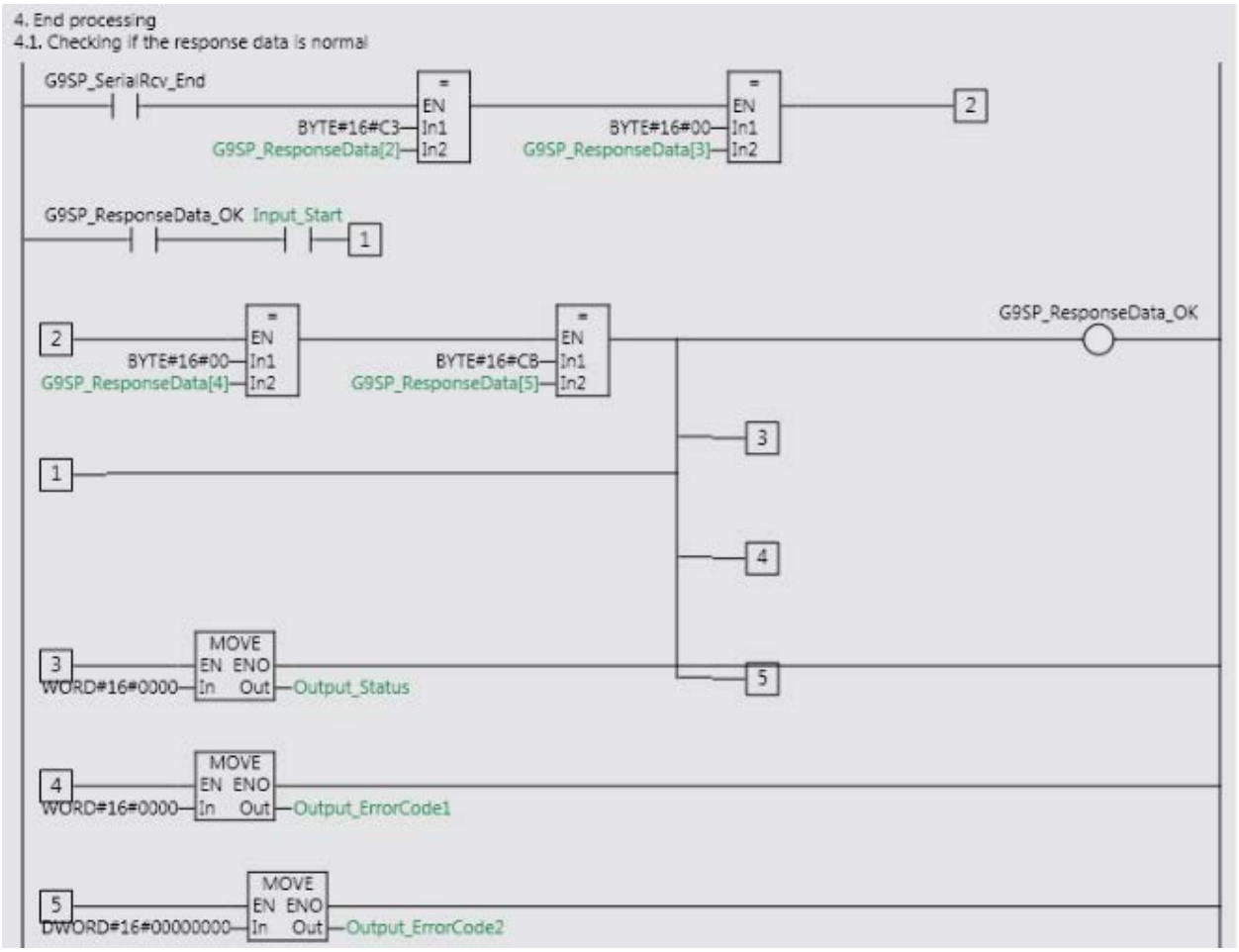


No.	Overview	Meaning
3.4.	Checking for data receive completion	Turns ON *G9SP_SerialSend_End* when *G9SP_SerialRcv_Excute* is turned OFF.
3.5.	Saving the error status	Sets the next status when the SerialRcv instruction ends in an error. ·Output_Status: #16#FF02 ·Output_ErrorCode1: *ErrorID* of SerialRcv instruction ·Output_ErrorCode2: *ErrorIDEx* of SerialRcv instruction

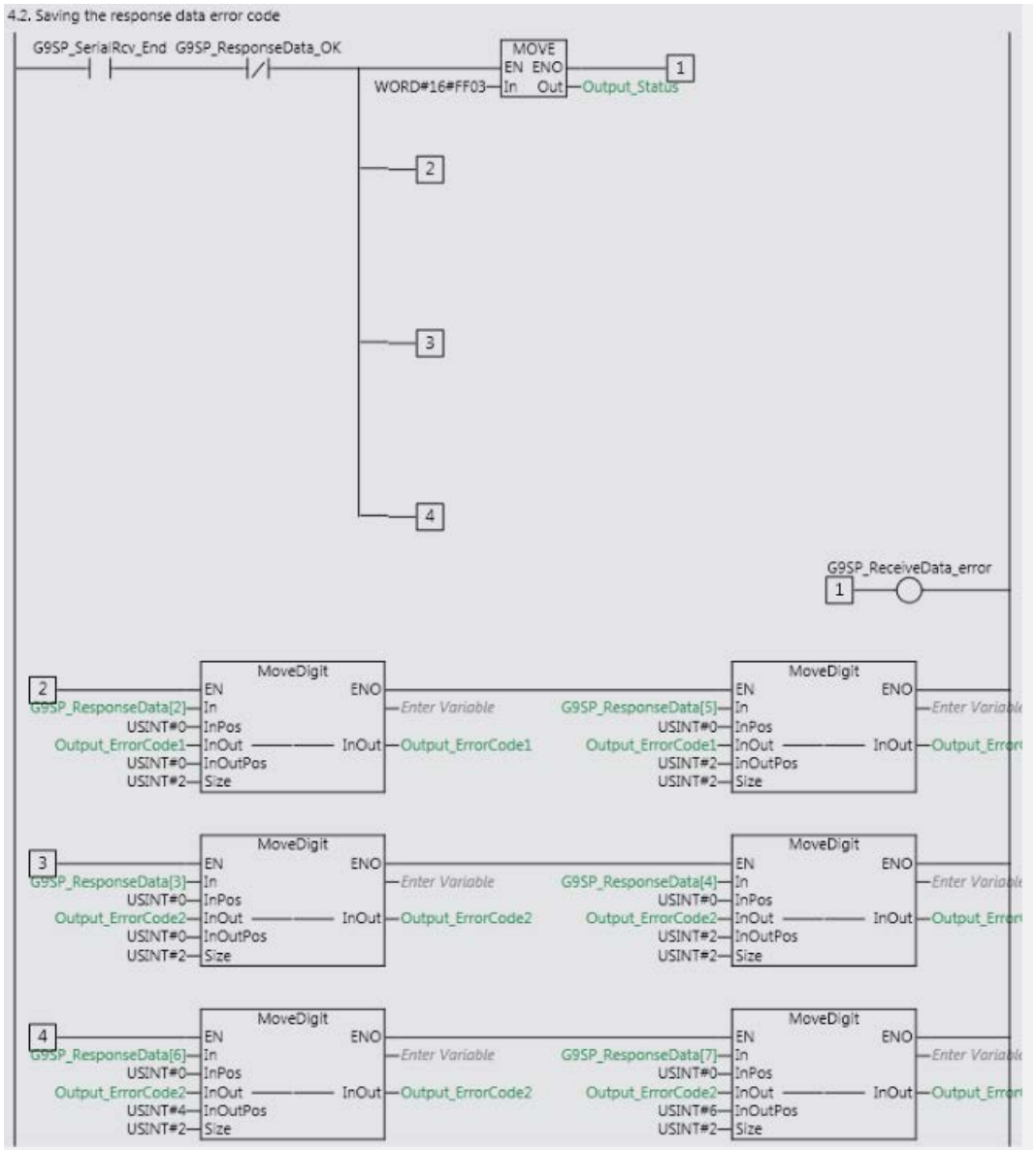
Additional Information

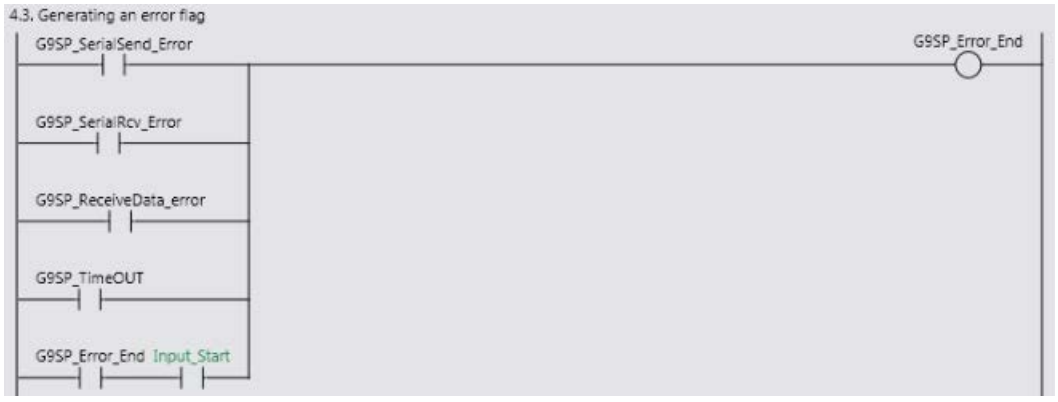
For derails on the error status, refer to *9.7 Error Status List*.

4. End processing



No.	Overview	Meaning
4.1.	Checking if the response data is normal	Checks if the receive response data (G9SP_ResponseData[2] to [5]) is the same as the fixed data. If they are the same, the following data are set. Output_Status: #16#0000 Output_ErrorCode1: #16#0000 Output_ErrorCode2: #16#00000000 G9SP_ResponseData_OK: ON


4.2. Saving the response data error code
G9SP_SerialRcv_End
G9SP_ResponseData_OK
MOVE
EN ENO
In Out
WORD#16#FF03
Output_Status
1
2
3
4
G9SP_ReceiveData_error
MoveDigit
EN ENO
In
InPos
InOut
InOutPos
Size
USINT#0
USINT#2
USINT#4
Enter Variable
G9SP_ResponseData[2]
Output_ErrorCode1
G9SP_ResponseData[5]
G9SP_ResponseData[3]
Output_ErrorCode2
G9SP_ResponseData[4]
G9SP_ResponseData[6]
G9SP_ResponseData[7]


4.3. Generating an error flag
G9SP_SerialSend_Error
G9SP_Error_End
G9SP_SerialRcv_Error
G9SP_ReceiveData_error
G9SP_TimeOUT
G9SP_Error_End
Input_Start

No.	Overview	Meaning
4.2.	Saving the response data error code	If the comparison results are different in No. 4.1, the following data are set. Output_Status: #16#FF03 G9SP_ResponseData_error: ON Output_ErrorCode: G9SP_ResponseData[5]+[2] (Service code+Response length) Output_ErrorCode: G9SP_ResponseData[7]+[6]+[4]+[3] (Reserve data at error response+End code)
4.3.	Generating an error flag	Turns ON *G9SP_Error_End* when an error occurs.

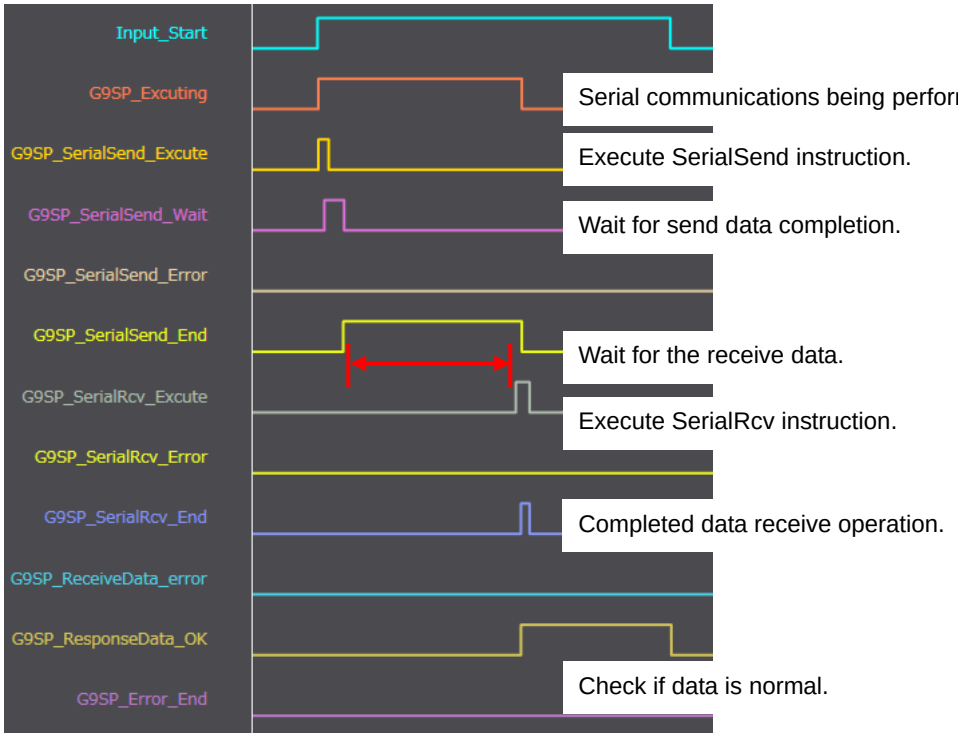
9.6. Timing Charts

This section explains the timing charts of the ladder program.

The definitions of the timing chart patterns are as follows:

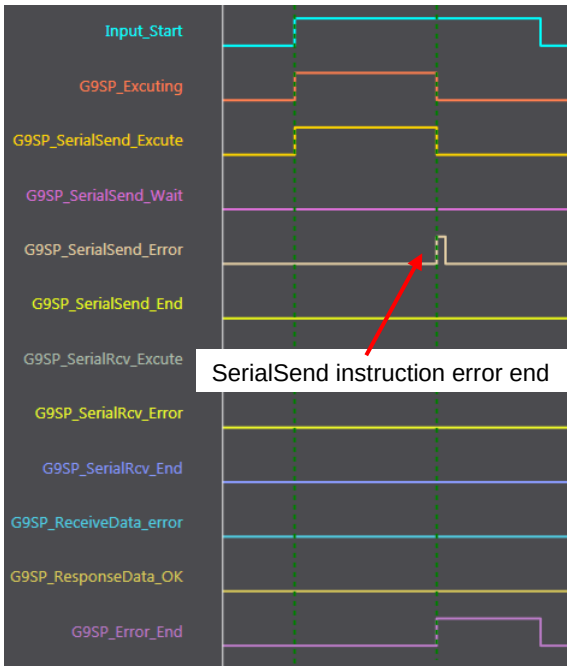
Pattern	Normal end	Error end (1) Communications instruction error	Error end (2) Unit error	Error end (3) Destination Device error
Command	Normal	Error	Normal or error	Normal
Destination device	Normal	Normal or error	Normal or error	Error
Response	Yes	No	No	Yes

(1) Normal end

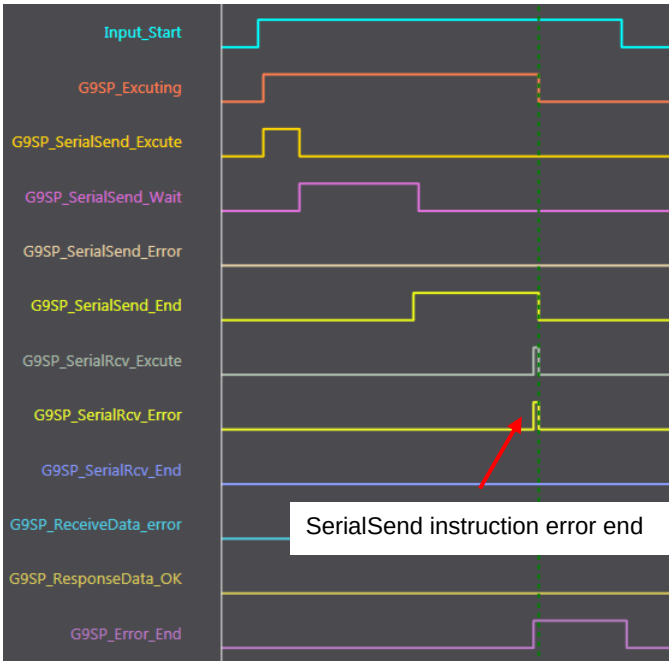


(2) Error end 1 (Communications instruction error)

SerialSend instruction error



SerialRcv instruction error



(3) Error end 2 (Unit error)

(4) Error end 3 (Destination device error)

9.7. Error Status List

9.7.1. SerialSend/SerialRcv instruction errors

This error occurs when the SerialSend/SerialRcv instruction ends in an error.

The status code (Output_Status) for each instruction error is shown below.

SerialSend instruction error: #16#FF01

SerialRcv instruction error: #16#FF02

Each error status is stored in the following.

ErrorID: Output_ErrorCode1, ErrorIDEx: Output_ErrorCode2

[Error status (error code) list]

*Output_ErrorCode1

Error code	Name	Meaning	Assumed cause
16#0400	Input Value Out of Range	An input parameter for an instruction exceeded the valid range for an input variable. Or, division by an integer of 0 occurred in division or remainder calculations.	• An input parameter for an instruction exceeded the valid range for an input variable. Or, division by an integer of 0 occurred in division or remainder calculations.
16#0406	Illegal Data Position Specified	The data position specified for an instruction exceeded the data area range.	• The data position or data size specified for an instruction exceeded the data area range.
16#0407	Data Range Exceeded	The results of instruction processing exceeded the data area range of the output parameter.	• The results of instruction processing, such as the number of array elements, exceeded the data area range of the output parameter.
16#040D	Illegal Unit Specified	The Unit specified for an instruction does not exist.	• A Unit that does not exist in the Unit configuration information was specified. • A Unit that is in the Unit configuration information was specified, but the Units does not actually exist in the Controller.
16#0800	FINS Error	An error occurred when a FINS command was sent or received.	• An error occurred when a FINS command was sent or received.
16#0801	FINS Port Already in Use	The FINS port is being used.	• The FINS port is being used.
16#0C00	Illegal Serial Communications Mode	The Serial Communications Unit is not in the serial communications mode required to execute an instruction.	• The serial communications port for the Serial Communications Unit is not set to the mode expected by the instruction.

*Output_ErrorCode2

Value	Meaning
16#00000401	The serial communications mode is set to Protocol Macro, NT Link, Echoback Test, or Serial Gateway Mode.
16#00000205	The serial communications mode is set to Host Link Mode.
16#00001001	The command is too long.
16#00001002	The command is too short.
16#00001004	The command format is incorrect.
16#0000110C	This is another parameter error.
16#00002201	The SerialSend or SerialRcv instruction is already in execution.
16#00002202	The protocol is being switched, so execution is not possible.

Additional Information

For details on the errors, refer to *A-3 Error Code Details* in the *NJ-series Instructions Reference Manual* (Cat. No. W502).
For troubleshooting the errors, refer to *9-3 Troubleshooting* in the *CJ-series Serial Communications Units Operation Manual for NJ-series CPU Unit* (Cat.No. W494).

9.7.2. Destination Device Error

The error codes for destination device errors are shown below.
The status code (Output_Status) of the destination device error is #16#FF03.

[Destination device error code list]

	Meaning	Destination device error code	Description
ErrorCode1 rightmost	Response length	#16#C3 #16#09 #16#00 #16#xx	Normal Error response No response data Other errors
ErrorCode1 leftmost	Service code	#16#CB #16#xx	Both normal/error response (#CB is received) Other errors
ErrorCode2 rightmost	End code	#16#0000 #16#xxxx	Normal Incorrect command
ErrorCOde2 leftmost	Reserve data at error response	#16#0000 #16#xxxx	Normal Error state

·Destination device error record function

The response data from the Safety Controller include Present Error Information, Error Log Count (Operation Log Count), Error Log (Error Code: Conduction Time), Operation Log (Operation Code: Conduction Time), which are stored in G9SP_ResponseData[100] and the subsequent variables.
Note that this project does not detect these errors.

Additional Information

For details and troubleshooting the destination device errors, refer to *Section 13 Troubleshooting* in the *G9SP Series Safety Controller Operation Manual* (Cat. No. Z922).

■ Error Codes

Error code (hex)	Error description	Bit map in present error information	
		Map No.	Bit No.
05	Force mode timeout	Error Information Map 0	4
07	Invalid configuration	Error Information Map 0	6
08	System failure	Error Information Map 0	7
11	External test signal failure at Safety Input	Error Information Map 2	0
12	Internal circuit error at Safety Input	Error Information Map 2	1
13	Discrepancy error at Safety Input	Error Information Map 2	2
15	Overload detected at Test Output	Error Information Map 2	4
17	Stuck-at-high detected at Test Output	Error Information Map 2	6
18	Under current detected using Muting Lamp	Error Information Map 2	7
19	Over current detected at Safety Output	Error Information Map 3	0
1A	Short circuit detected at Safety Output	Error Information Map 3	1
1B	Stuck-at-high detected at Safety Output	Error Information Map 3	2
1C	Dual channel violation at Safety Output	Error Information Map 3	3
1D	Internal circuit error at Safety Output	Error Information Map 3	4
22	Output PS voltage low	Error Information Map 4	1
25	Output PS OFF circuit error	Error Information Map 4	4
26	Internal circuit error at Test Output	Error Information Map 4	5
33	Function block status error	Error Information Map 6	2
39	Internal NVS access error	Error Information Map 7	0
3A	Unsupported expansion I/O unit	Error Information Map 7	1
3B	Expansion I/O unit maximum connection number exceeded	Error Information Map 7	2
3C	Expansion I/O unit configuration mismatch	Error Information Map 7	3
3D	Expansion I/O bus error	Error Information Map 7	4
3E	Unsupported option board	Error Information Map 7	5
3F	Option board communications error, communications timeout	Error Information Map 7	6
40	Option board communications error, not mounted	Error Information Map 7	7
42	Memory cassette not inserted or incorrect memory cassette	Error Information Map 8	1
43	Memory cassette removed or access error	Error Information Map 8	2
44	Internal NVS access error during execution of memory cassette functions	Error Information Map 8	3
45	Restore model information mismatch	Error Information Map 8	4
46	Device password mismatch between restore memory cassette and unit	Error Information Map 8	5
47	Restore prohibit error	Error Information Map 8	6
48	Incorrect configuration data at restore	Error Information Map 8	7
49	Unconfigured unit at backup	Error Information Map 9	0
4A	Unlocked unit at backup error	Error Information Map 9	1

■ Operation Codes

Operation code (hex)	Operation description
01	Power ON or emulating cycling power
02	Out of box reset
04	Download
05	Lock/Unlock
06	Change Mode
07	Start/stop of force mode
08	Change device password
09	Clear error log
0A	Backup to Memory Cassette
0B	Restore from Memory Cassette

10. Revision History

Revision code	Date of revision	Revision reason and revision page
01	Aug. 1, 2013	First edition

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