Programmable Controller CJ-series

General-purpose Serial Connection Guide (RS-485 CompoWay/F)

OMRON Corporation

Digital Temperature Controller
(E5□D/E5□C/E5□C-T)

Network Connection Guide

P704-E1-01

Table of Contents

1. Related Manuals

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

Cat. No.	Model	Manual name
W472	CJ2M-CPU□□ CJ2H-CPU6□ CJ2H-CPU6□-EIP	CJ Series CJ2 CPU Unit Hardware USER'S MANUAL
W473	CJ2M-CPU□□ CJ2H-CPU6□ CJ2H-CPU6□-EIP	CJ Series CJ2 CPU Unit Software USER'S MANUAL
W336	CJ1W-SCU□1-V1 CJ1W-SCU□2	CJ Series Serial Communications Units OPERATION MANUAL
W474	CJ2□-CPU□□	CJ Series Programmable Controllers INSTRUCTIONS REFERENCE MANUAL
W446	CXONE-AL□□C-V4 / AL□□D-V4	CX-Programmer OPERATION MANUAL
W344	CXONE-AL□□C-V4 / AL□□D-V4	CX-Protocol OPERATION MANUAL
H225	E5□D	Digital Temperature Controllers Communications Manual
H224	E5□D	Digital Temperature Controllers User’s Manual
H175	E5□C	Digital Temperature Controllers Communications Manual
H174	E5□C	Digital Temperature Controllers User’s Manual
H186	E5□C-T	Digital Temperature Controllers Programmable Type Communications Manual
H185	E5□C-T	Digital Temperature Controllers Programmable Type User’s Manual

2. Terms and Definitions

Term	Explanation and Definition
protocol macro	A data transfer procedure (protocol) with a general-purpose external device is created and stored in a Serial Communications Board or a Serial Communications Unit. This functional protocol enables data to be exchanged with general-purpose external devices by executing the protocol macro instruction (hereinafter referred to as "PMCR instruction") in a CPU Unit.
protocol	A set of rules governing the data transfer procedures that gather independent communication processing with a specific general-purpose device. A protocol consists of more than one sequence.
sequence	A unit of action to perform the independent communication processing that can be started by executing the PMCR instruction in a program. A sequence that is started by the instruction executes steps registered in its own sequence.
step	A unit to execute any one of the followings: message send processing, message receive processing, message send/receive processing, receive buffer clear, or step wait. Up to 15 steps can be set for per sequence.
send message	A communications frame (command) sent to a general-purpose external device. A send message is invoked by steps in a sequence and is sent to a general-purpose external device.
receive message	A communications frame (response) sent from a general-purpose external device. A receive message is invoked by steps in the sequence and is compared with data received from general-purpose external devices.
matrix	A function to register and use some communications frames (responses) when more than one communications frame is expected to be received from a general-purpose external device. The receive processing can be executed according to registered communications frames by using this function.
case	A unit to register multiple communications frames (response) to a matrix. One communications frame is registered as one case. Up to 15 types of cases can be registered per matrix.

3. Precautions

(1) Understand the specifications of devices which are used in the system. Allow some margin for ratings and performance. Provide safety measures, such as installing a safety circuit, in order to ensure safety and minimize the risk of abnormal occurrence.

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

(3) The user is encouraged to confirm the standards and regulations that the system must conform to.

(4) It is prohibited to copy, to reproduce, and to distribute a part or the whole of this guide without the permission of OMRON Corporation.

(5) The information contained in this guide is current as of March 2018. It is subject to change for improvement without notice.

The following notations are used in this guide.

⚠ Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or 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.

Symbol

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

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

4. Overview

This guide describes procedures for connecting a Digital Temperature Controller (E5□D, E5□C or E5□C-T) to a CJ-series Programmable Controller + Serial Communications Unit (hereinafter referred to as the "PLC") via serial communications, both produced by OMRON Corporation (hereinafter referred to as "OMRON"), and for checking their communication status.

Refer to *Section 6. Serial Communications Settings* and *Section 7. Serial Communications Connection Procedure* to understand setting methods and key points to send or receive a message via serial communications.

The ladder program in the prepared CX-Programmer project file is used to check the serial connection by sending or receiving a message of "Properties Read" to/from the Digital Temperature Controller.

■The send/receive messages of "Properties Read"

PLC	Serial communications (RS-485)	Digital Temperature Controller
Sending command data	Command data →	Executing the command
Receiving response data and storing in memory	← Response data	Returning response data

Prepare the CX-Programmer project file and the CX-Protocol project file with latest versions beforehand. To obtain the project files, contact your OMRON representative.

Name	File name	Version
CX-Programmer project file (extension: cxp)	P704_CJ_CWF485_OMRON_E5CD_V100.cxp	Ver.1.00
CX-Protocol project file (extension: psw)	P704_CJ_CWF_OMRON_E5CDV100.psw	Ver.1.00

⚠ Caution

This guide aims to explain wiring methods and communications settings necessary to connect corresponding devices and provides the setting procedures. The program used in this guide is not designed to be constantly used at a site but is designed to check if the connection is properly established. Both functionalities and performances are therefore not fully considered for the program.

When you actually construct a system, please use the wiring methods, communications settings and setting procedures described in this guide as a reference, and design a program according to your application needs.

5. Applicable Devices and Device Configuration

5.1. Applicable Devices

The applicable devices are as follows:

Manufacturer	Name	Model
OMRON	CJ2 CPU Unit	CJ2□-CPU□□
OMRON	Serial Communications Unit	CJ1W-SCU□1-V1 CJ1W-SCU□2
OMRON	Digital Temperature Controller	E5CD-□□2□□M-002 E5CD-□□2□□M-004 E5ED-□□4□□M-004 E5ED-□□4□□M-008 E5ED-□□4□□M-022 E5CC-□□□□□M-002 E5CC-□□□□□M-003 E5CC-□□□□□M-004 E5AC-□□□□SM-004 E5AC-□□□□SM-008 E5AC-□□□□SM-009 E5AC-□□□□SM-012 E5AC-□□□□SM-014 E5EC-□□□□□M-004 E5EC-□□□□□M-008 E5EC-□□□□□M-009 E5EC-□□□□□M-012 E5EC-□□□□□M-014 E5DC-□□□□□M-002 E5DC-□□□□□M-015 E5GC-□□□□□M-015 E5CC-T□□3□SM-002 E5CC-T□□3□SM-003 E5CC-T□□3□SM-004 E5AC-T□□4□SM-004 E5AC-T□□4□SM-008 E5AC-T□□4□SM-020 E5AC-T□□4□SM-022 E5EC-T□□4□SM-004 E5EC-T□□4□SM-008 E5EC-T□□4□SM-020 E5EC-T□□4□SM-022

Precautions for Correct Use

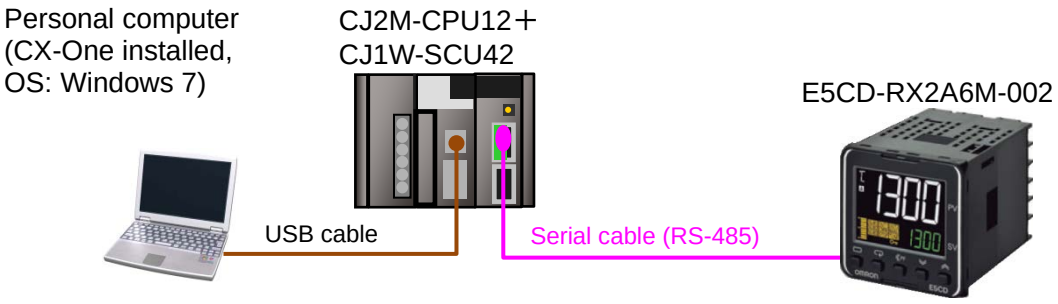
In this guide, the devices with models and versions listed in *5.2. Device Configuration* are used as examples of applicable devices to describe the procedures for connecting the devices and checking their connection.
You cannot use devices with versions lower than the versions listed in *5.2*.
To use the above devices with models not listed in *5.2.* or versions higher than those listed in *5.2.*, check the differences in the specifications by referring to the manuals before operating the devices.

Additional Information

This guide describes the procedures for establishing the network connection.
It does not provide information on operation, installation, wiring method, device functionality, or device operation, which is not related to the connection procedures.
Refer to the manuals or contact your OMRON representative.

5.2. Device Configuration

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



Manufacturer	Name	Model	Version
OMRON	Serial Communications Unit	CJ1W-SCU42	Ver.2.0
OMRON	CJ2 CPU Unit	CJ2M-CPU12	Ver.2.0
OMRON	Power Supply Unit	CJ1W-PA202	
OMRON	CX-One	CXONE-AL□□C-V4 /AL□□D-V4	Ver.4.□□
OMRON	CX-Programmer	(Included in CX-One)	Ver.9.65
OMRON	CX-Protocol	(Included in CX-One)	Ver.1.992
OMRON	CX-Programmer project file	P704_CJ_CWF485_ OMRON_E5CD_V100.cxp	Ver.1.00
OMRON	CX-Protocol project file	P704_CJ_CWF_OMRON_ E5CD_V100.psw	Ver.1.00
-	Personal computer (OS: Windows 7)	-	
-	USB cable (USB 2.0 type B connector)	-	
-	Serial cable (RS-485)	-	
OMRON	Digital Temperature Controller	E5CD-RX2A6M-002	

Precautions for Correct Use

Prepare the CX-Programmer project file and the CX-Protocol project file with latest versions beforehand. To obtain the project files, contact your OMRON representative.

Precautions for Correct Use

Update CX-Programmer and CX-Protocol to the versions specified in this *Clause 5.2.* or to higher versions. If you use a version higher than the one specified, the procedures and related screenshots described in *Section 7.* and the subsequent sections may not be applicable. In that case, use the equivalent procedures described in this guide by referring to the *CX-Programmer OPERATION MANUAL* (Cat. No. W446) and the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

Precautions for Correct Use

Turn ON the terminating resistance switch on Serial Communications Unit and connect terminating resistance to the terminals of the Digital Temperature Controller at either end of the RS-422A/485 transmission path.

Additional Information

For information on the serial cable (RS-485), refer to *3-4 RS-232C and RS-422A/485 Wiring* of the *CJ Series Serial Communications Units OPERATION MANUAL* (Cat. No. W336).

Additional Information

The system configuration in this guide uses USB for the connection between the personal computer and the PLC. For information on how to install the USB driver, refer to *A-5 Installing the USB Driver* of the *CJ-series CJ2 CPU Unit Hardware USER'S MANUAL* (Cat. No. W472).

6. Serial Communications Settings

This section describes the parameters and cable wiring, which are set up in this guide.

6.1. Parameters

The following parameters are required to connect the PLC and the Digital Temperature Controller via serial communications.

Setting item	PLC (Serial Communications Unit)	Digital Temperature Controller
Unit No.	0	-
Communications Unit No. (slave address)	-	1 (default)
Serial communications port (connection)	Port 1 (RS-422A/485)	-
Terminating resistance	Terminating resistance ON (TERM: ON)	-
2-wire or 4-wire	2-wire (WIRE: 2)	2-wire (fixed)
Serial communications mode	Protocol macro	-
Data length (transmission character)	7 bits (default)	7 bits (default)
Stop bits	2 bits (default)	2 bits (default)
Parity (parity bit)	Even (default)	Even (default)
Baud rate	9,600 bps (default)	9,600 bps (default)
Protocol macro transmission method	Half-duplex (default)	-
Communications method	-	CompoWay/F (default)
Send data wait time	-	20 ms (default)

Precautions for Correct Use

The connection procedure described in this guide assumes that the following Serial Communications Unit, port and unit number are used.

Model: CJ1W-SCU42

Serial communications port: Port 1

Unit No.: 0

If you connect devices under different conditions, refer to *Section 9. Program* and create a program by changing both the CIO area and the control data of the PMCR instruction.

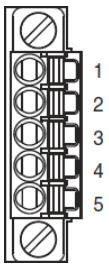
6.2. Cable Wiring

For details on cable wiring, refer to *SECTION 3 Installation and Wiring* of the *CJ Series Serial Communications Units OPERATION MANUAL* (Cat. No. W336).
Check the connector configurations and pin assignments before wiring.

■Connector configuration and pin assignment

Serial Communications Unit (CJ1W-SCU42) applicable connector: Terminal block

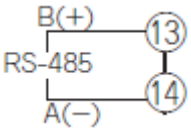
Pin No.	Symbol	Signal name	Input/Output
1 (See note 1.)	RDA	Receive data -	Input
2 (See note 1.)	RDB	Receive data +	Input
3 (See note 1.)	SDA	Send data -	Output
4 (See note 1.)	SDB	Send data +	Output
5 (See note 2.)	FG	Shield	-



Note 1: For 2-wire connection, use either pins 1 and 2 or pins 3 and 4.
2: Pin 5 (Shield) is connected to the GR terminal on the Power Supply Unit though the Serial Communications Unit. The cable shield can thus be grounded if you ground the GR terminal of the Power Supply Unit.

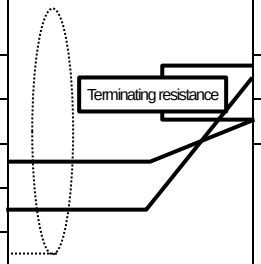
Digital Temperature Controller (E5CD) applicable connector: Terminal block

Pin No.	Signal name	Input/Output
1-12		
13	B(+)	Input/Output
14	A(-)	Input/Output
15-18		



■Cable and pin assignment

Serial Communications Unit (CJ1W-SCU42)		
RS-422A/485 interface	Signal name	Pin No.
	RDA-	1
	RDB+	2
	SDA-	3
	SDB+	4
	FG	5
Terminal block		



Digital Temperature Controller (E5CD)		
Terminal No.	Signal name	RS-485 interface
13	B(+)	
14	A(−)	
Terminal block		

*Connect 120 Ω (1/2 W) terminating resistance between B(+) and A(-) of the Digital Temperature Controller that is connected at the end of the network.

Additional Information

For information on the connector configurations and pin assignments of the other models, refer to their respective manuals.

7. Serial Communications Connection Procedure

This section describes the procedures for connecting the PLC to the Digital Temperature Controller via serial communications. The procedures for setting up the PLC and the Digital Temperature Controller in this guide are based on the factory default settings.
For the initialization, refer to *Section 8. Initialization Method*.

7.1. Work Flow

Take the following steps to connect the PLC and the Digital Temperature Controller via serial communications and to send or receive a message.

7.2. Digital Temperature Controller Setup	Set up the Digital Temperature Controller.
↓	
7.2.1. Parameter Settings	Set parameters for the Digital Temperature Controller.
↓	
7.3. PLC Setup	Set up the PLC.
↓	
7.3.1. Hardware Settings	Set the hardware switches on the Serial Communications Unit and connect the cables.
↓	
7.3.2. Opening the Project File and Going Online with the PLC	Start CX-Programmer, open the project file, and go online with the PLC.
↓	
7.3.3. Creating an I/O Table	Create an I/O table for the PLC.
↓	
7.3.4. Parameter Settings	Set parameters for the Serial Communications Unit.
↓	
7.3.5. Transferring the Project Data	Transfer the created project data to the PLC.
↓	
7.3.6. Starting CX-Protocol and Opening the Project File	Start CX-Protocol and open the project file.
↓	
7.3.7. Going Online and Transferring the Protocol Data	Go online with CX-Protocol and transfer the protocol data to the Serial Communications Unit.
↓	

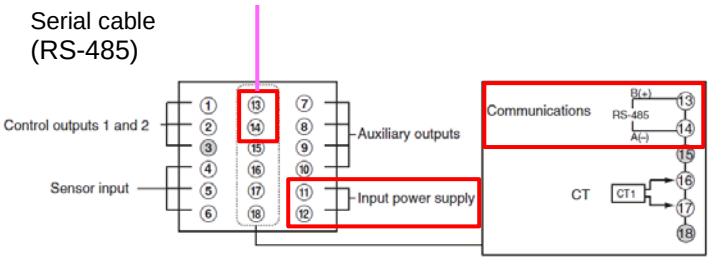
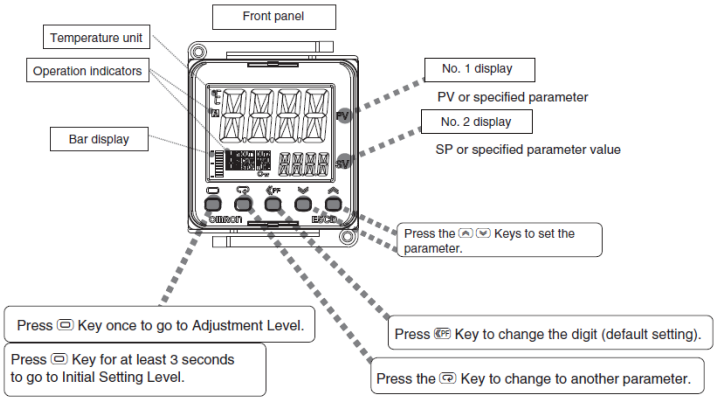
7.4. Serial Communication Status Check	Start the send/receive processing and confirm that serial communications performs normally.
↓	
7.4.1. Starting the Trace	Start tracing with CX-Protocol.
↓	
7.4.2. Executing the Communications Sequence	Execute the communications sequence with CX-Programmer.
↓	
7.4.3. Checking the Trace Data	Check that correct data is sent and received, using the trace data in CX-Protocol.
↓	
7.4.4. Checking Received Data	With CX-Programmer, check that correct data is written to the I/O memory of the PLC.

7.2. Digital Temperature Controller Setup

Set up the Digital Temperature Controller.

7.2.1. Parameter Settings

Set parameters for the Digital Temperature Controller.

1	Connect the power supply and a serial cable to the terminal block located on the back of Digital Temperature Controller. *Only the parameters in Communications Setting Level are described in this guide. If you use the parameters in Adjustment Level that is specific to each of the models, refer to their respective manuals.	
2	Check the positions of each of the keys, No.1 and No. 2 displays and Operation indicators. In this guide, the keys are described as follows: □ (Level) Key (Mode) Key (Up) Key (Down) Key	
3	Turn ON Digital Temperature Controller.	
4	The current temperature is displayed on No. 1 display once Digital Temperature Controller is turned ON. (Operation Level) Press the □ (Level) Key for at least 3 seconds.	 □ (Level) Key for at least 3 seconds

5 "CN-t" (Initial Setting Level) is displayed on No. 1 display.

Press the □ (Level) Key again for less than 1 second.

□ (Level) Key

6 The display changes to Communications Setting Level. "PSEL" (Protocol Setting) and "CWF" (CompoWay/F) are displayed on No. 1 and No. 2 displays, respectively.

*If the setting value is different, press the ⌃ (Up) or ⌄ (Down) Key to change the parameter.

Press the ↩ (Mode) Key.

< Setting value>
CWF / Mod
(default: CWF)
CWF: CompoWay/F
Mod: Modbus-RTU

↩ (Mode) Key

7 "U-No" (Communications Unit No.) is displayed.
Check that Communications Unit No. is 1.

*If the setting value is different, change it in the same way as step 6.

Press the ↩ (Mode) Key.

<Setting value>
0 to 99 (default: 1)

↩ (Mode) Key

8 "bPS" (Communications Baud Rate) is displayed.
Check that Communications Baud Rate is 9.6 kbps.

*If the setting value is different, change it in the same way as step 6.

Press the ↩ (Mode) Key.

<Setting value>
9.6, 19.2, 38.4 or 57.6 kbps
(default: 9.6)

↩ (Mode) Key

9

"LEN" (Communications Data Length) is displayed.
Check that Communications Data Length is 7 bits.

*If the setting value is different, change it in the same way as step 6.

Press the (Mode) Key.

<Setting value>
7 or 8 bits (default: 7)

(Mode) Key

10

"SbLt" (Communications Stop Bits) is displayed.
Check that Communications Stop Bits is 2 bits.

*If the setting value is different, change it in the same way as step 6.

Press the (Mode) Key.

<Setting value>
1 or 2 bits (default: 2)

(Mode) Key

11

"PRTY" (Communications Parity) is displayed.
Check that Communications Parity is EVEN.

*If the setting value is different, change it in the same way as step 6.

Press the (Mode) Key.

<Setting value>
NONE, EVEN or ODD
(default: EVEN)

(Mode) Key

12

"SdWt" (Send Data Wait Time) is displayed.
Check that Send Data Wait Time is 20.

*If the setting value is different, change it in the same way as step 6.

Press the (Level) Key for less than 1 second.

<Setting value>
0 to 99 ms (default: 20)

(Level) Key

13	"LN-t" ((Initial Setting Level) is displayed. Press the □ (Level) Key for at least 1 second.	 □ (Level) Key for at least 1 second
14	The display returns to Operation Level as shown in step 4.	
15	Turn OFF Digital Temperature Controller.	

7.3. PLC Setup

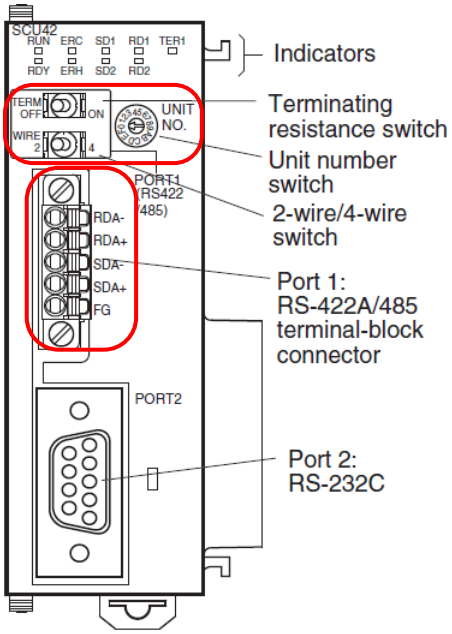
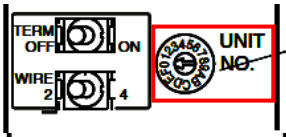
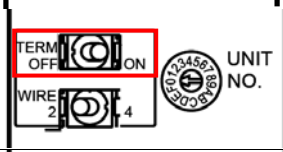
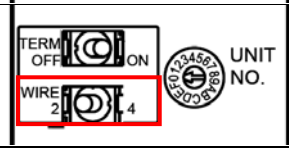
Set up the PLC.

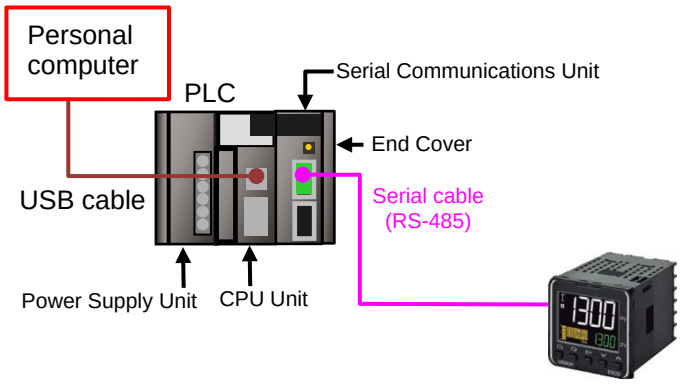
7.3.1. Hardware Settings

Set the hardware switches on the Serial Communications Unit and connect the cables.

Precautions for Correct Use

Make sure that the power supply is OFF when you set up.
If it is ON, the settings described in the following steps and subsequent procedures may not be applicable.

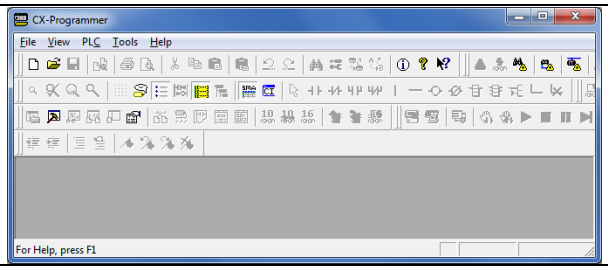
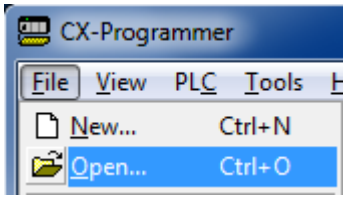
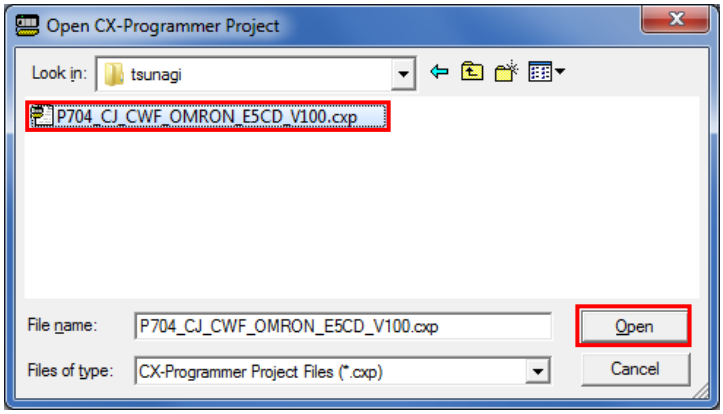
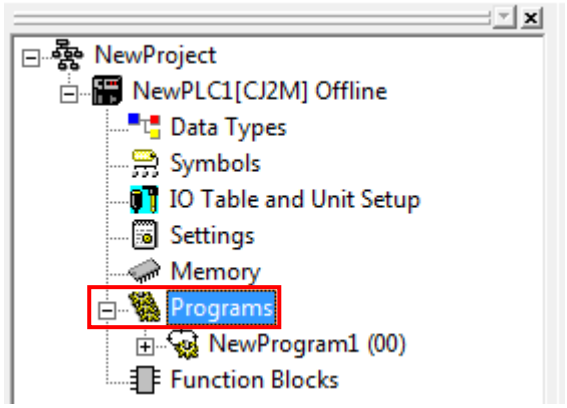
1	Make sure that PLC is powered OFF.	
2	Check the positions of the hardware switches and Port 1 on the front panel of Serial Communications Unit by referring to the figure on the right.	
3	Set Unit number switch to *0*. The unit number is set to 0 as the factory default setting.	
4	Set Terminating resistance ON/OFF switch to *ON*. (Terminating resistance ON).	 ・TERM (Terminating resistance ON/OFF switch) OFF: Terminating resistance OFF ON: Terminating resistance ON
5	Set 2-wire or 4-wire switch to *2* (2-wire).	 ・WIRE (:2-wire or 4-wire switch) 2: 2-wire, 4: 4-wire

6	Connect Serial Communications Unit to PLC as shown on the right. Connect Digital Temperature Controller and Port 1 on Serial Communications Unit with the serial cable. Connect Personal computer and PLC with a USB cable.	

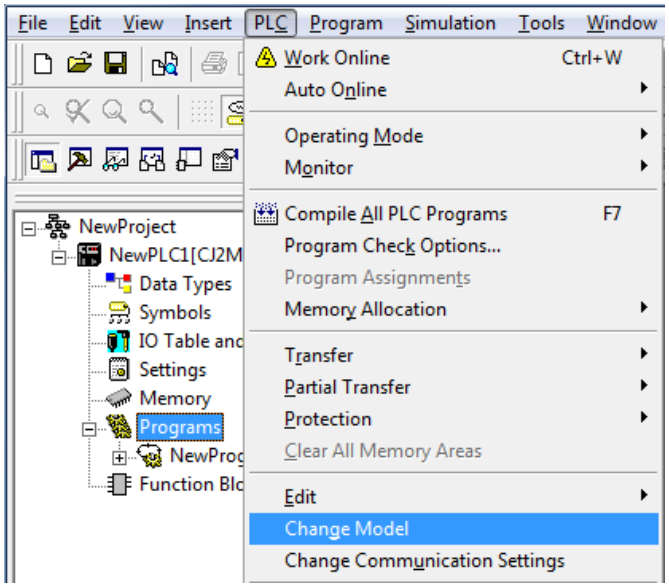
7.3.2. Opening the Project File and Going Online with the PLC

Start CX-Programmer, open the project file, and go online with the PLC.

Install CX-Programmer and the USB driver on your personal computer beforehand.

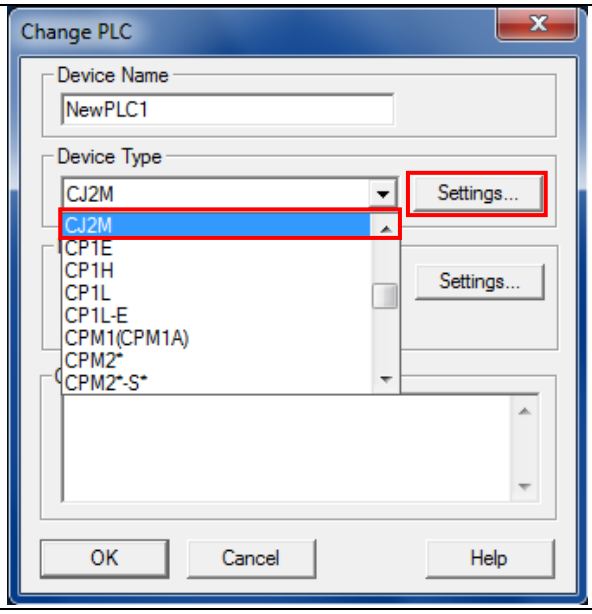
1	Turn ON PLC and Digital Temperature Controller.	
2	Start CX-Programmer. *If the User Account Control Dialog Box is displayed at start, make a selection to start CX-Programmer.	
3	CX-Programmer starts up.	
4	Select ***Open*** from the File Menu.	
5	The Open CX-Programmer Project Dialog Box is displayed. Select *P704_CJ_CWF_OMRON_E5CD_V100.cxp* and click **Open**. *Obtain the project file from OMRON.	
6	After opening the project file, select **Programs** in the project workspace.	 (Project workspace)

7 Select ***Change Model*** from the PLC Menu.



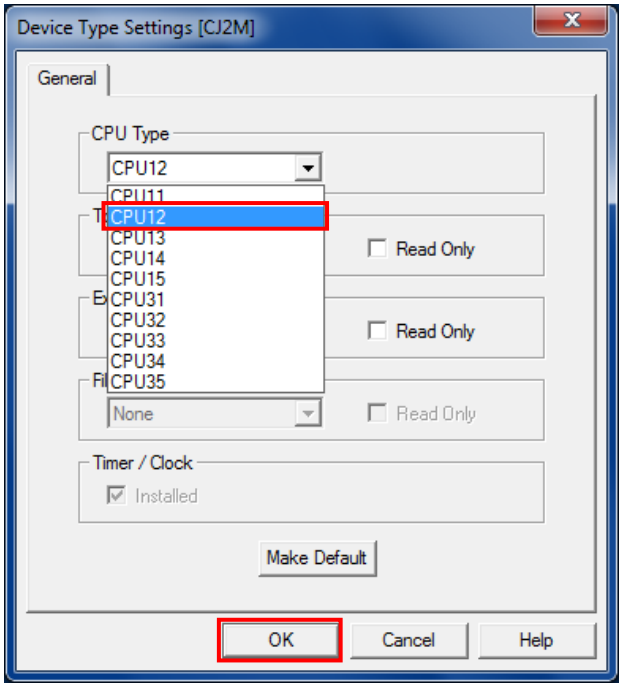
8 The Change PLC Dialog Box is displayed.
From the pull-down list of Device Type, select the device type of PLC to use.
Click **Settings**.

*CJ2M is selected in this guide.



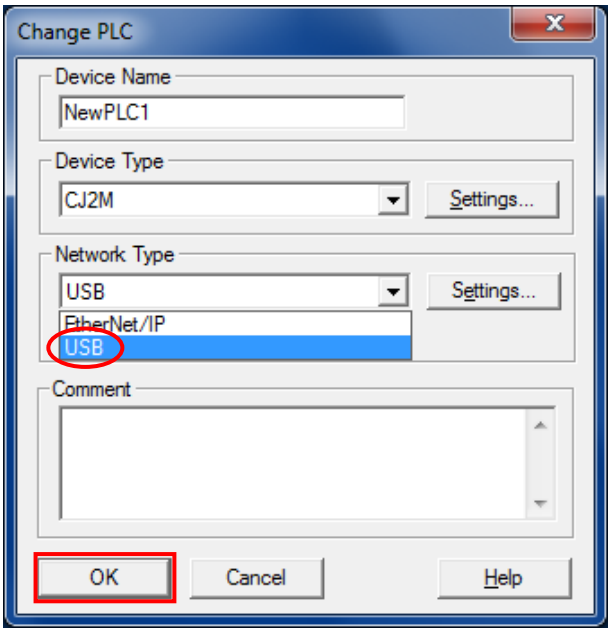
9 The Device Type Settings Dialog Box is displayed.
From the pull-down list of CPU Type, select the CPU type to use.
Click **OK**.

*CPU12 is selected in this guide.

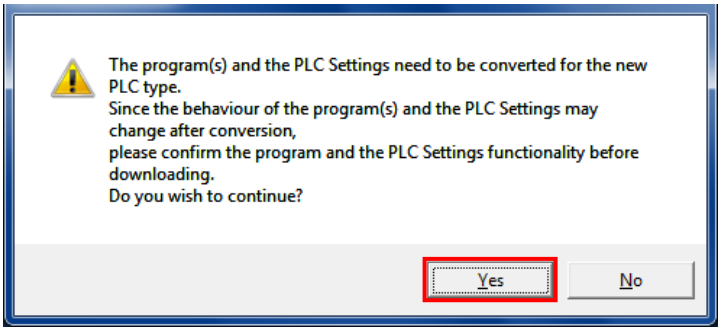


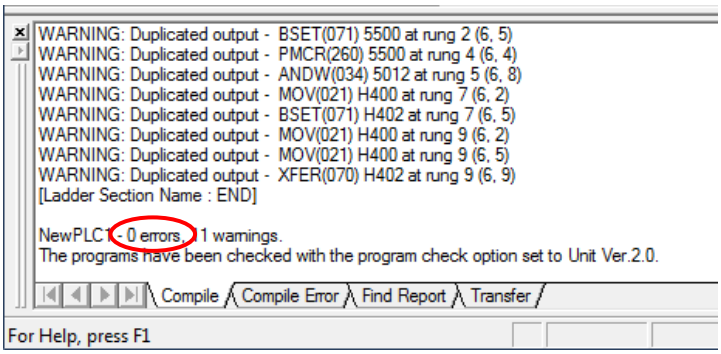
10 Check that the network type is set to USB in the Change PLC Dialog Box. Click **OK**.

*If not, select ***USB*** from the pull-down list.



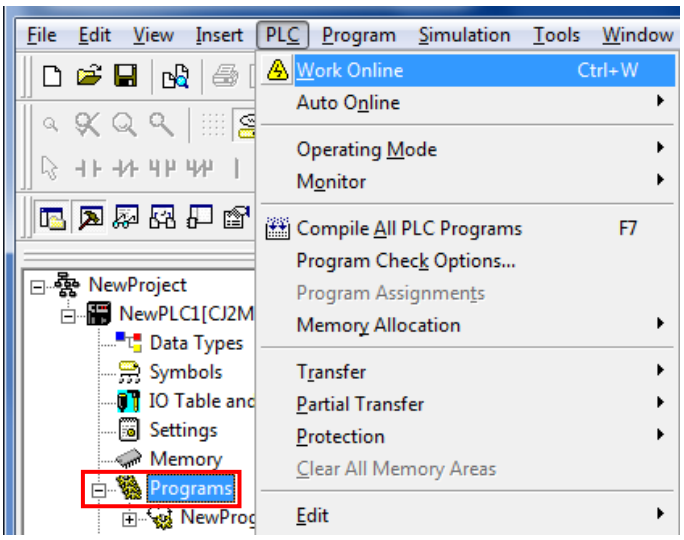
*If you have changed the device type in step 8 or the CPU type in step 9, the dialog box on the right will be displayed. Confirm that there is no problem, and click **Yes**. Make sure that the program has been converted normally. ("0 errors" must be shown.) (Although the duplicated output warnings are detected as shown on the right, they are not problems.)

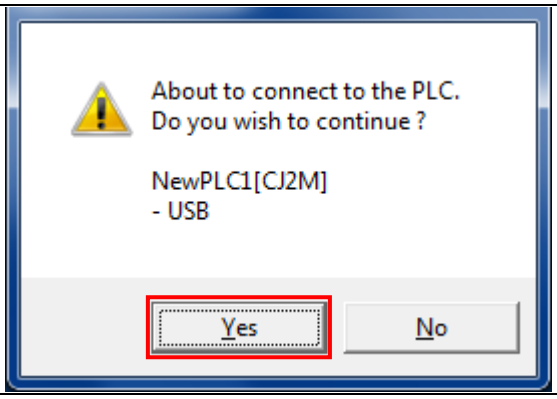
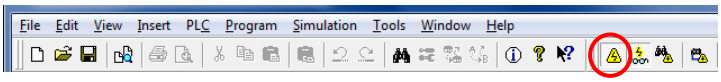




11 Select **Programs** in the project workspace.

Select ***Work Online*** from the PLC Menu.



12	The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**.	
13	Check that CX-Programmer and PLC are online. *The  icon is pressed down during online connection.	

Additional Information

If the online connection to the PLC cannot be established, check the cable connection.
After checking the cable connection, return to step 7, check the settings described in steps 8 to 10, and try online again.
For details, refer to *Connecting Directly to a CJ2 CPU Unit Using a USB Cable* of the *CX-Programmer OPERATION MANUAL* (Cat. No. W446).

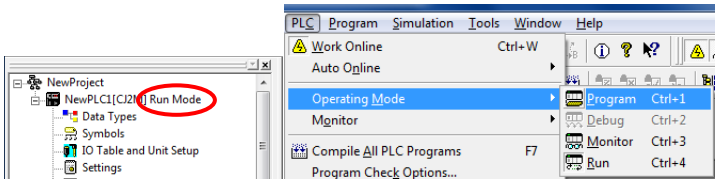
Additional Information

Some dialog boxes described in this guide may not be displayed depending on the environmental settings of CX-Programmer. For details on the environmental settings, refer to *Options and Preferences* in *CHAPTER 3 Project Reference* of the *CX-Programmer OPERATION MANUAL* (Cat. No. W446).
The procedures with CX-Programmer in this guide assume that the check box "Confirm all operations affecting the PLC" has been selected on the PLCs Tab Page.

7.3.3. Creating an I/O Table

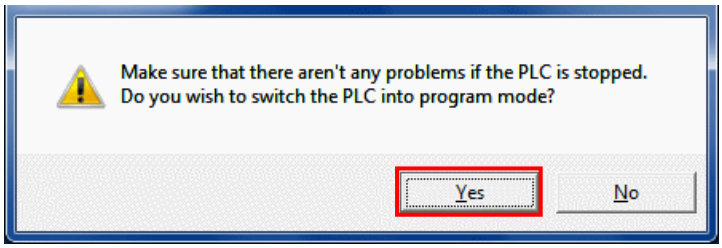
Create an I/O table for the PLC.

1 If the operating mode of PLC is Run Mode or Monitor Mode, change it to Program Mode by following the steps below.



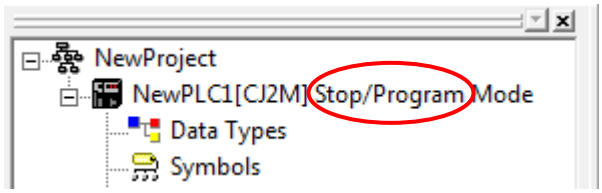
(1)Select ***Operating Mode*** - ***Program*** from the PLC Menu in CX-Programmer.

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



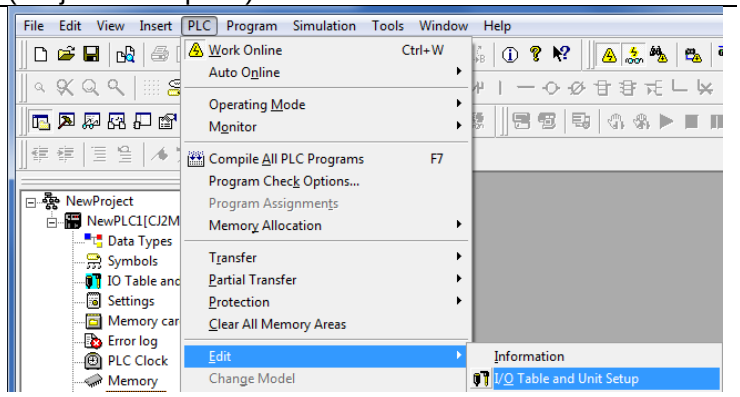
*Refer to *Additional Information* on the previous page for the settings concerning the dialog display.

(3)Check that Stop/Program Mode is displayed to the right of the PLC model in the project workspace of CX-Programmer.

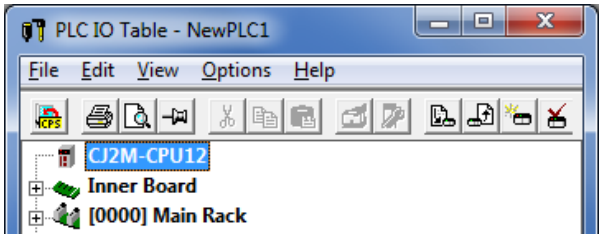


(Project workspace)

2 Select ***Edit*** - ***I/O Table and Unit Setup*** from the PLC Menu in CX-Programmer.



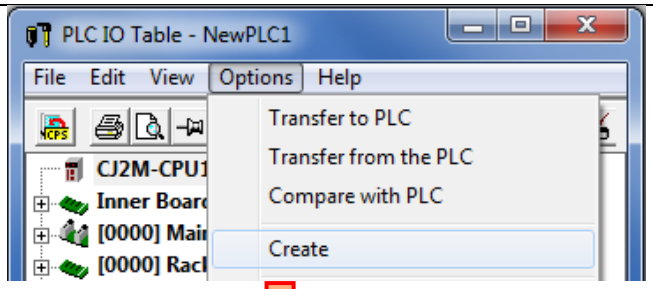
The PLC I/O table Window is displayed.



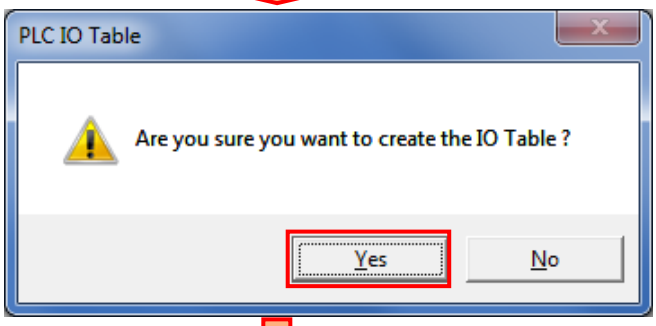
Precautions for Correct Use

The PLC will be reset after creating and transferring an I/O table in step 3 and the subsequent steps. Always confirm safety before creating and transferring an I/O table.

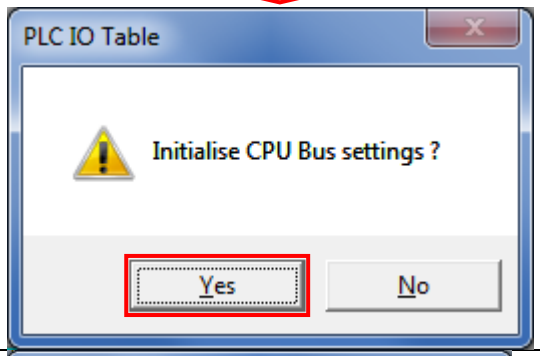
3 Select ***Create*** from the Options Menu of the PLC IO Table Window.



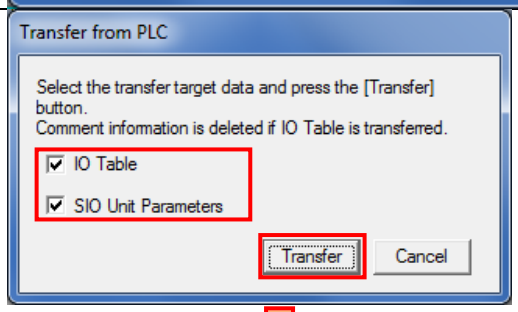
The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**.



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

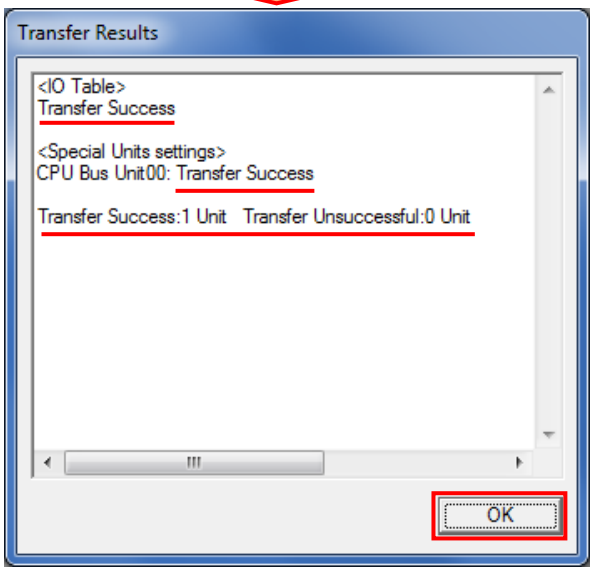


4 The Transfer from PLC Dialog Box is displayed.
Select *IO Table* and *SIO Unit Parameters*.
Click **Transfer**.



When the transfer is completed, the Transfer Results Dialog Box is displayed.
Check that the transfer is successfully completed by referring to the message in the dialog box.
When an I/O table is created successfully, the dialog box displays as follows:
Transfer Success: 1 Unit
Transfer Unsuccessful: 0 Unit

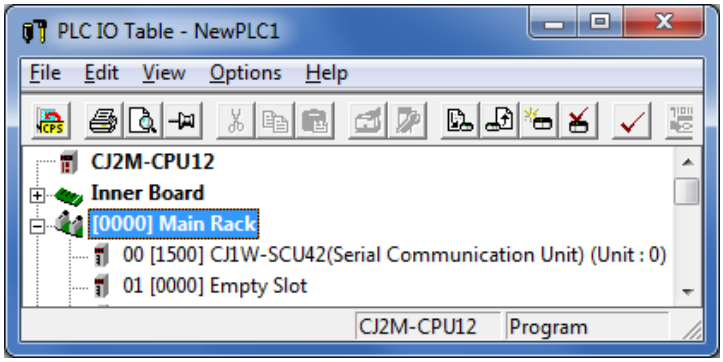
Click **OK**.



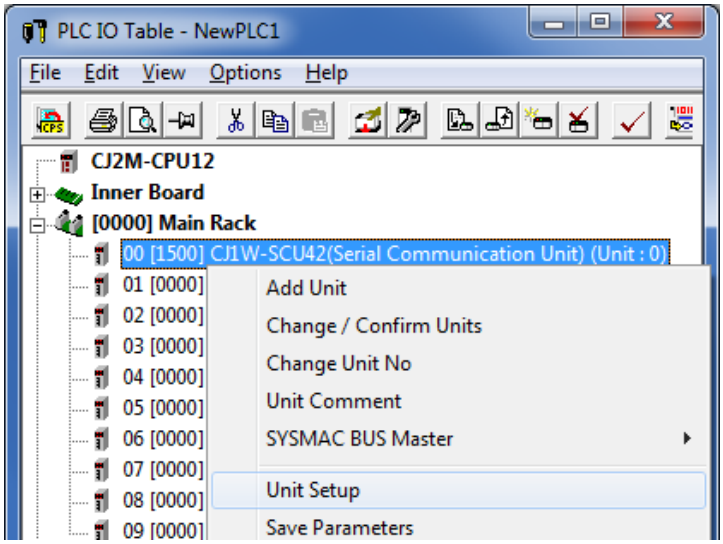
7.3.4. Parameter Settings

Set parameters for the Serial Communications Unit.

1 Double-click **[0000] Main Rack** in the PLC IO Table Window to expand the tree.

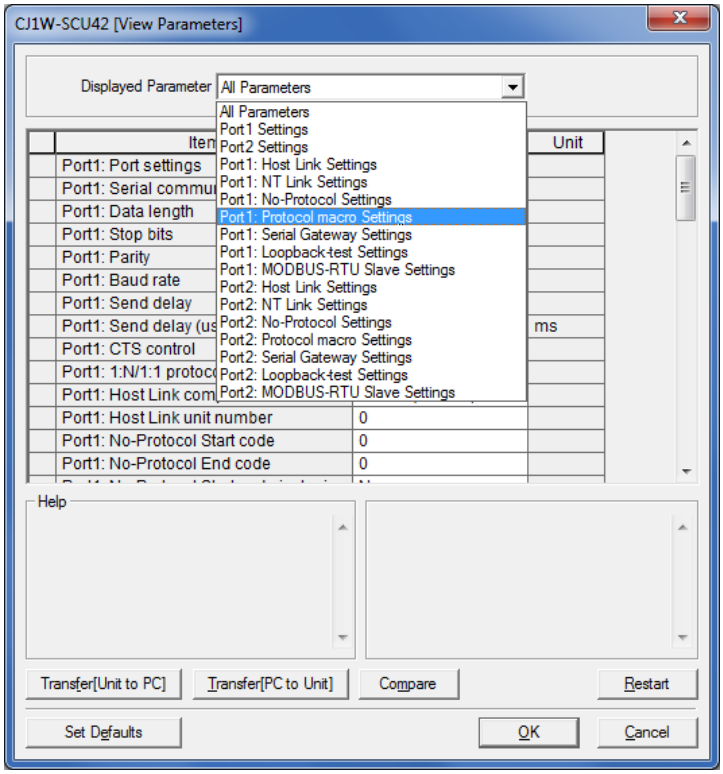


2 Right-click **00 [1500] CJ1W-SCU42** and select ***Unit Setup***.

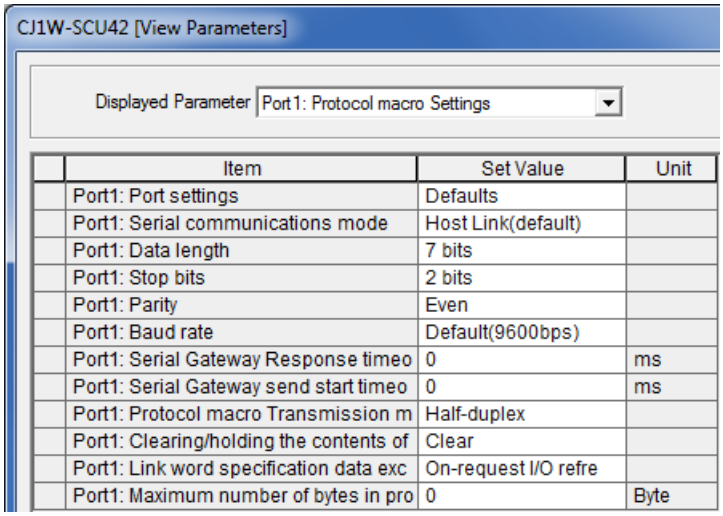


3 The View Parameters Dialog Box is displayed.
Select ***Port1: Protocol macro Settings*** from the pull-down list of Displayed Parameter.

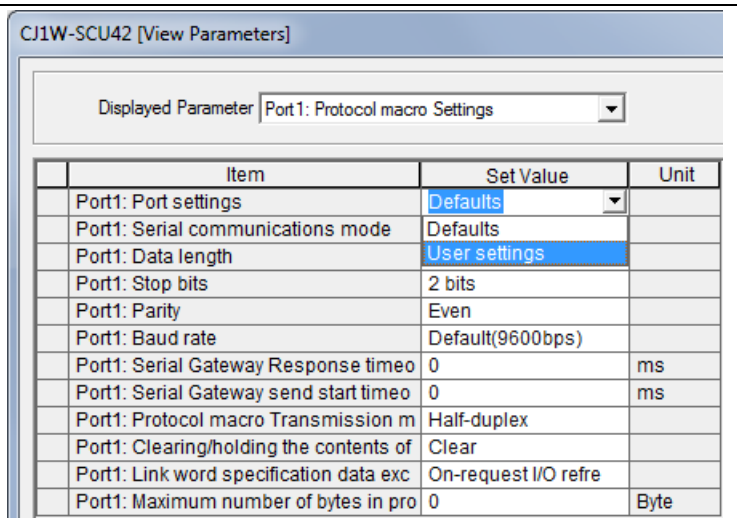
*This setting is required to use Port 1 of Serial Communications Unit.



4 The setting items of "Port1: Protocol macro Settings" are listed as shown in the figure on the right.
(The figure on the right shows the default values.)



5 Select ***User settings*** from the pull-down list of Set Value for "Port1: Port settings".

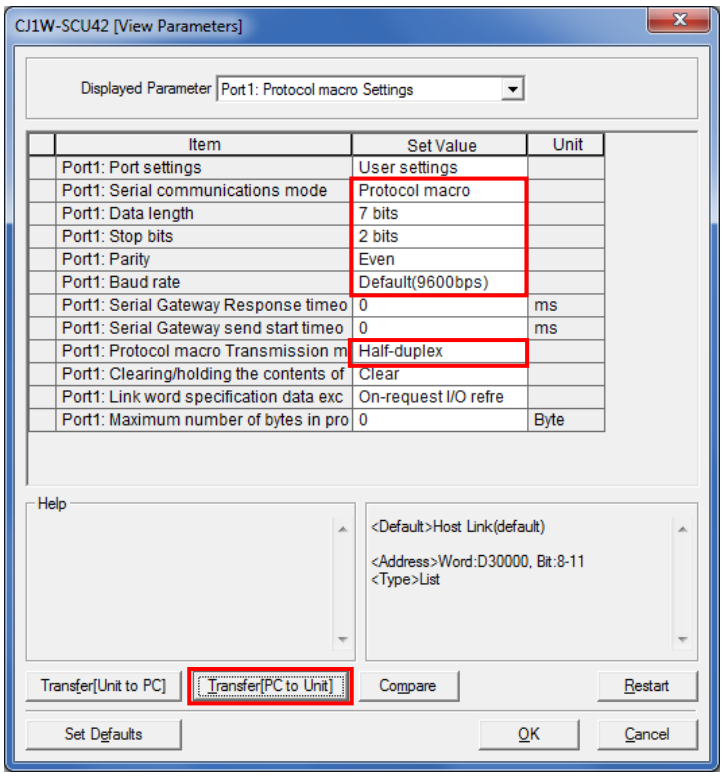


6 Set the following parameters in the same way as step 5.

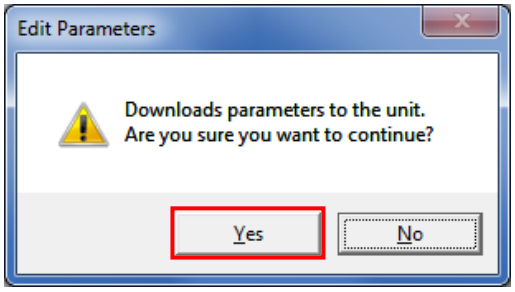
- Serial communications mode: Protocol macro
- Data length: 7 bits
- Stop bits: 2 bits
- Parity: Even
- Baud rate: Default(9600bps)
- Protocol macro Transmission method: Half-duplex

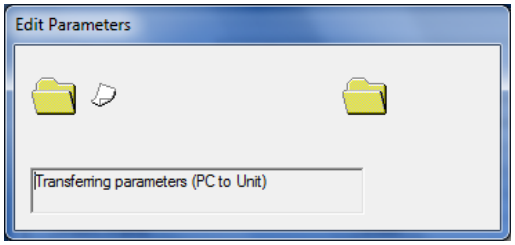
*Use the default values for other parameters.

Click **Transfer[PC to Unit]**.

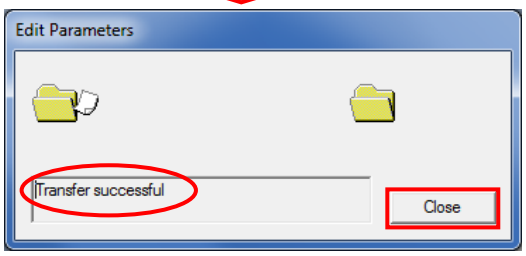


7 The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**.

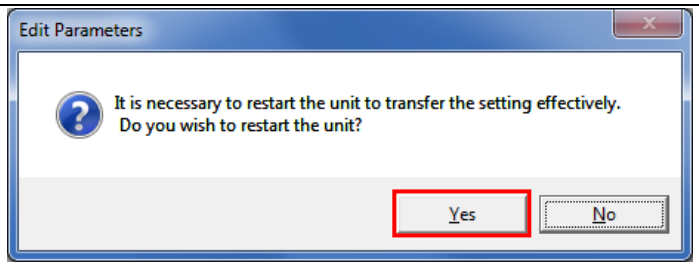




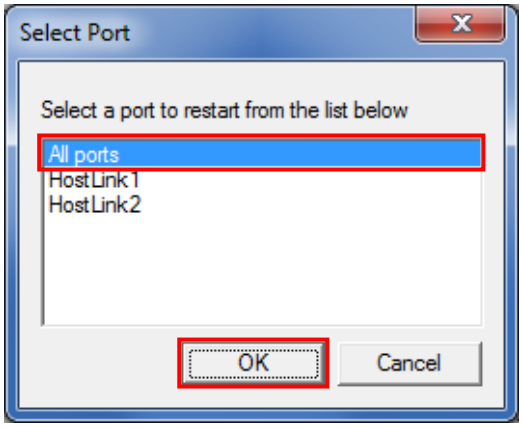
Check that the transfer is completed as shown on the right. Click **Close**.



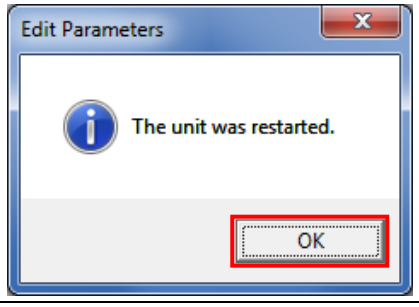
8 The dialog box on the right is displayed. Check the contents and click **Yes**.



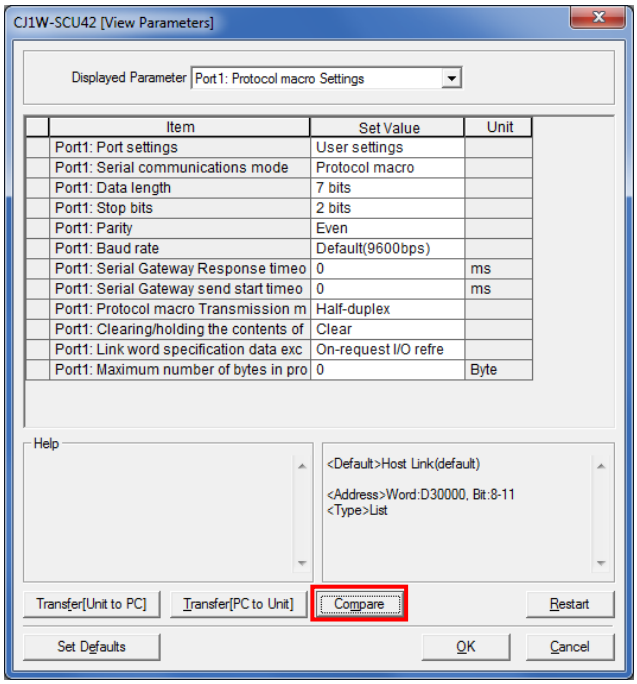
The Select Port Dialog Box is displayed. Select *All ports* and click **OK**.



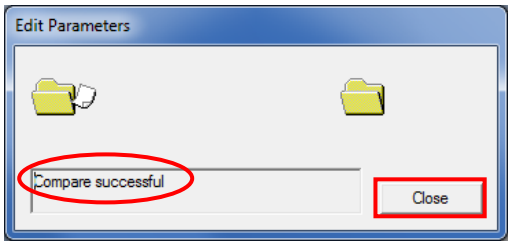
9 The dialog box on the right is displayed. Check the contents and click **OK**.



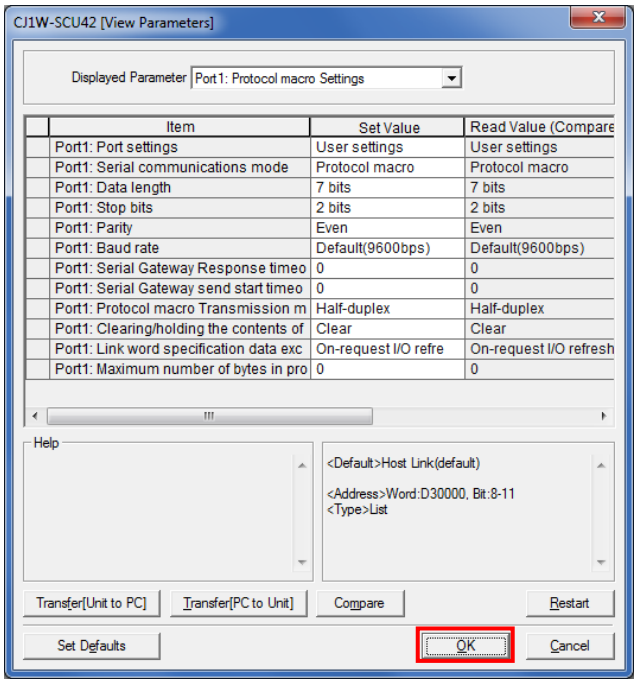
10 Click **Compare** in the View Parameters Dialog Box.



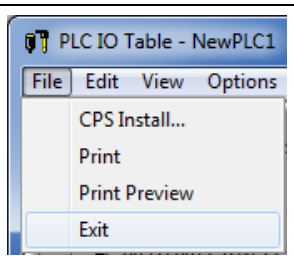
11 Check that a message stating "Compare successful" is displayed as shown on the right. Click **Close**.



12 Click **OK** in the View Parameters Dialog Box.



13 Select ***Exit*** from the File Menu of the PLC IO Table Window to close.

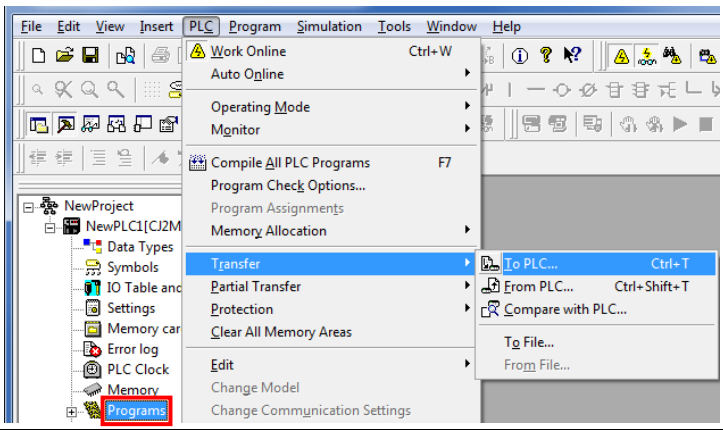


7.3.5. Transferring the Project Data

Transfer the created project data to the PLC.

1 Select **Programs** in the project workspace of CX-programmer.

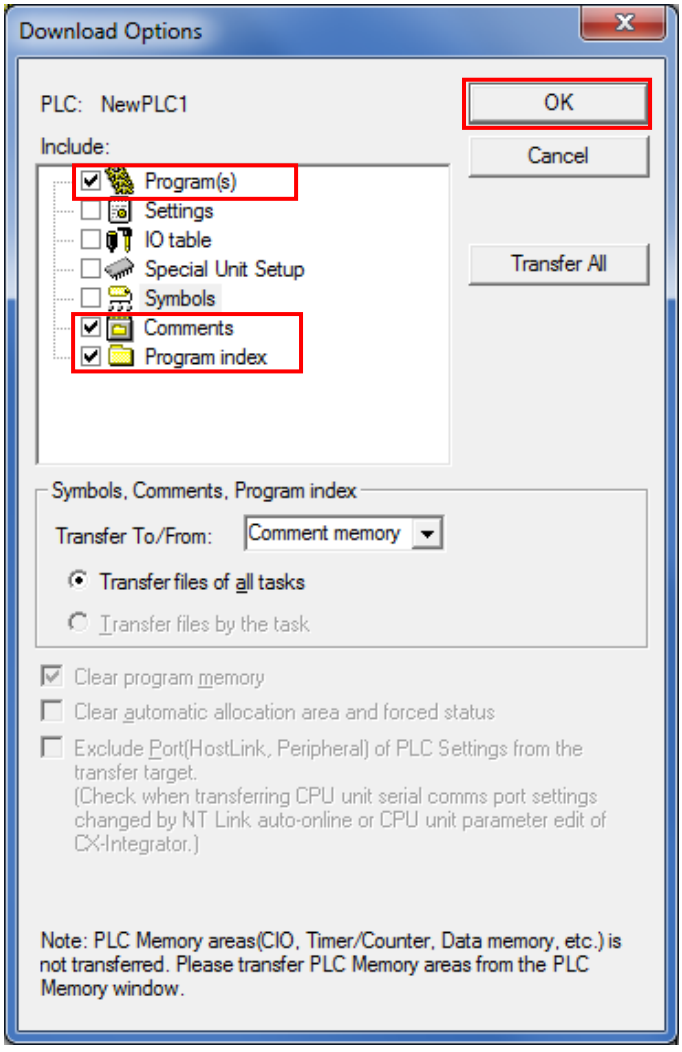
Select ***Transfer*** - ***To PLC*** from the PLC Menu.



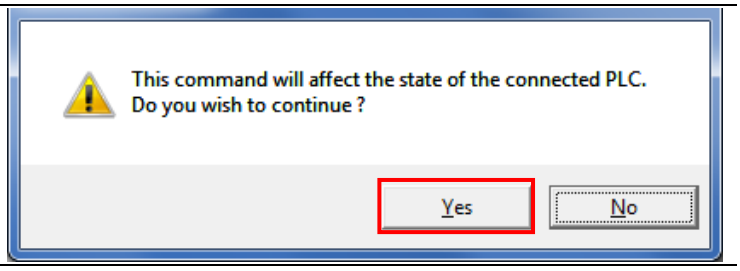
2 Select *Program(s)*, *Comments* and *Program index*. Click **OK**.

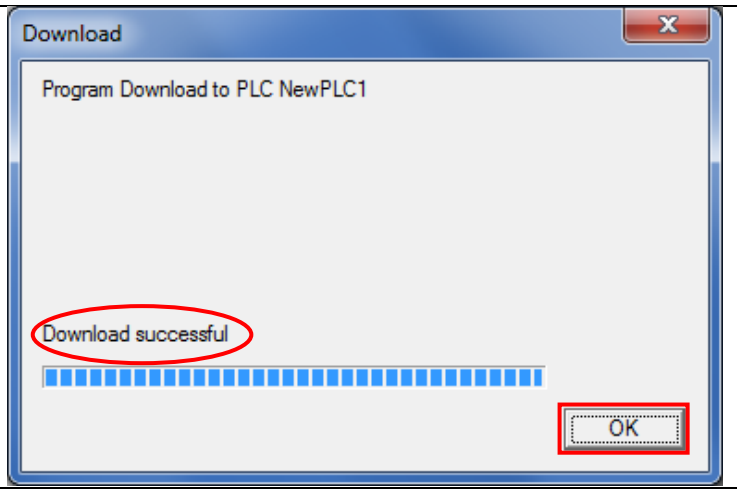
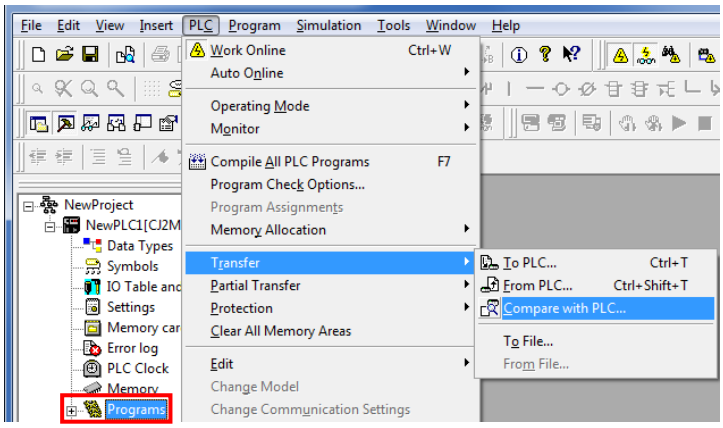
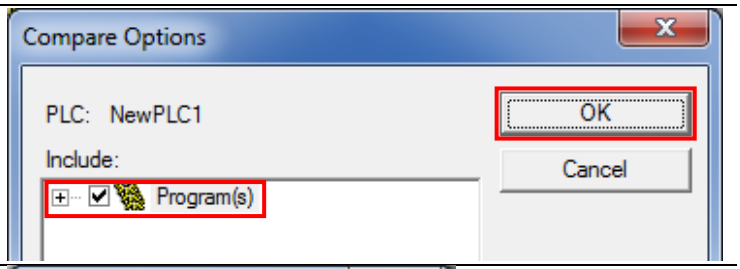
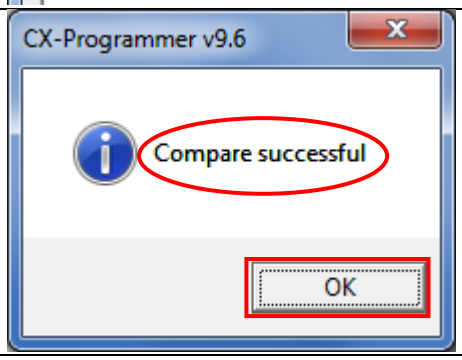
*The I/O table and Special Unit Setup are unnecessary to transfer here, because they are already set in *7.3.3. Creating an I/O Table* and *7.3.4. Parameter Settings*.

*The *Comments* and the *Program index* Check Boxes may not be displayed depending on the device type. In that case, select *Program(s)* only and transfer the project data.



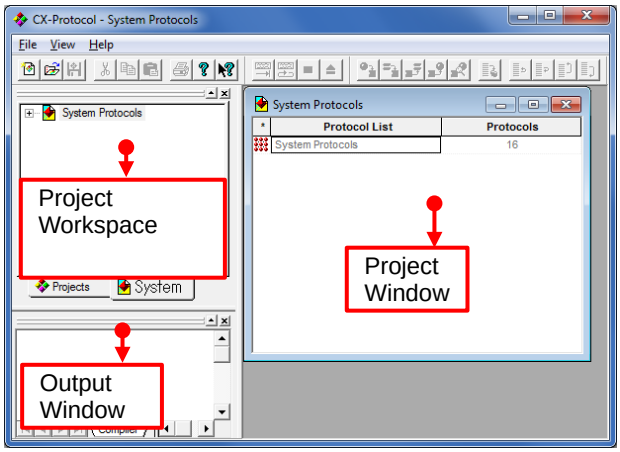
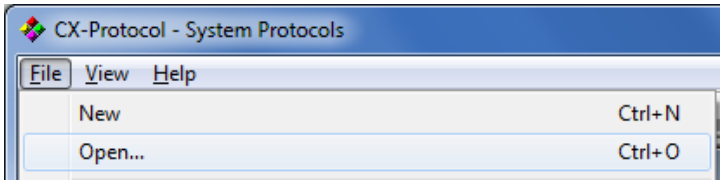
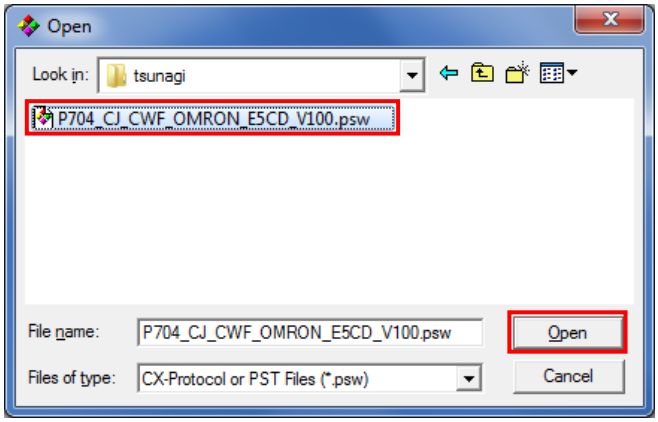
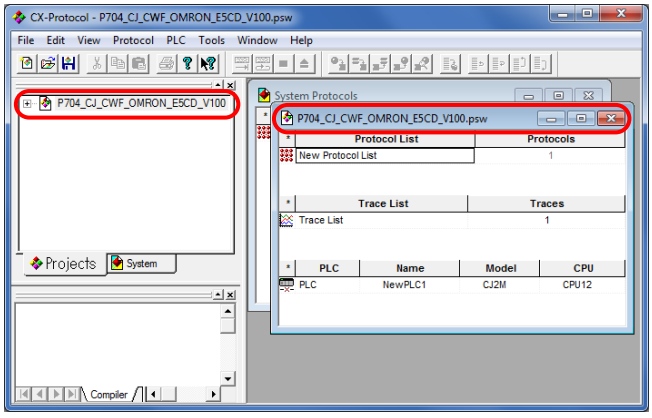
3 The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**.



4	The dialog box on the right is displayed (stating "Download successful") when the transfer is completed. Click **OK**.	
5	Select **Programs** in the project workspace. Select ***Transfer*** - ***Compare with PLC*** from the PLC Menu.	
6	Select *Program(s)* and click **OK**.	
7	Check that a message is displayed stating "Compare successful". Click **OK**.	

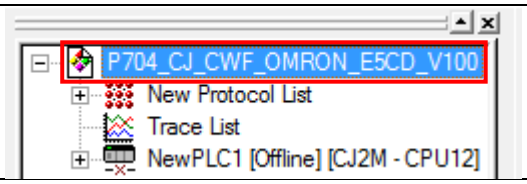
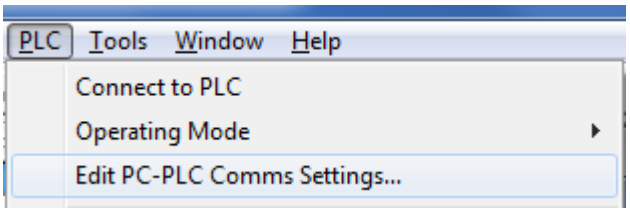
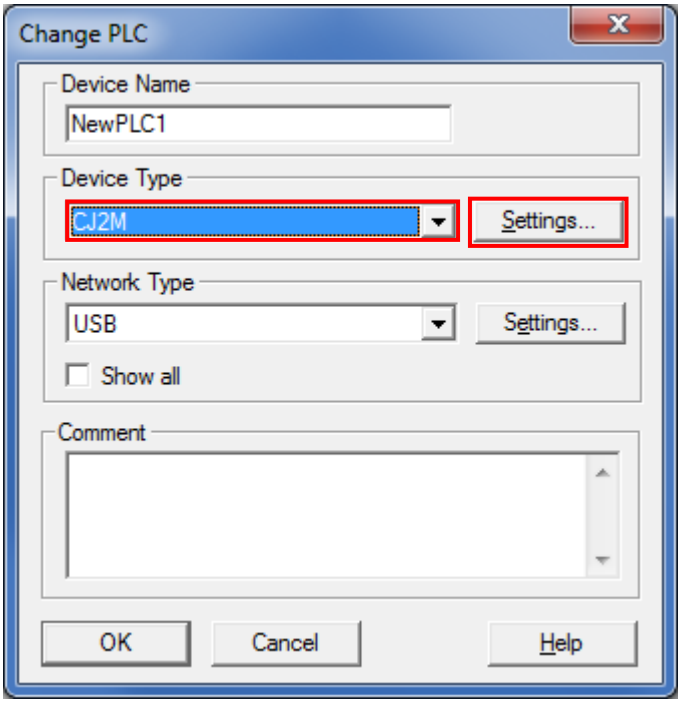
7.3.6. Starting CX-Protocol and Opening the Project File

Start CX-Protocol and open the project file.

1	Start CX-Protocol. *If the User Account Control Dialog Box is displayed at start, make a selection to start CX-Protocol.	
2	Start CX-Protocol. The following panes are displayed in this window. Top left: Project Workspace Bottom left: Output Window Right: Project Window	
3	Select ***Open*** from the File Menu.	
4	The Open Dialog Box is displayed. Select *P704_CJ_CWF_OMRON_E5CD_V100.psw* and click **Open**. *Obtain the project file from OMRON.	
5	The project data read are displayed in both the Project Workspace and the Project Window.	

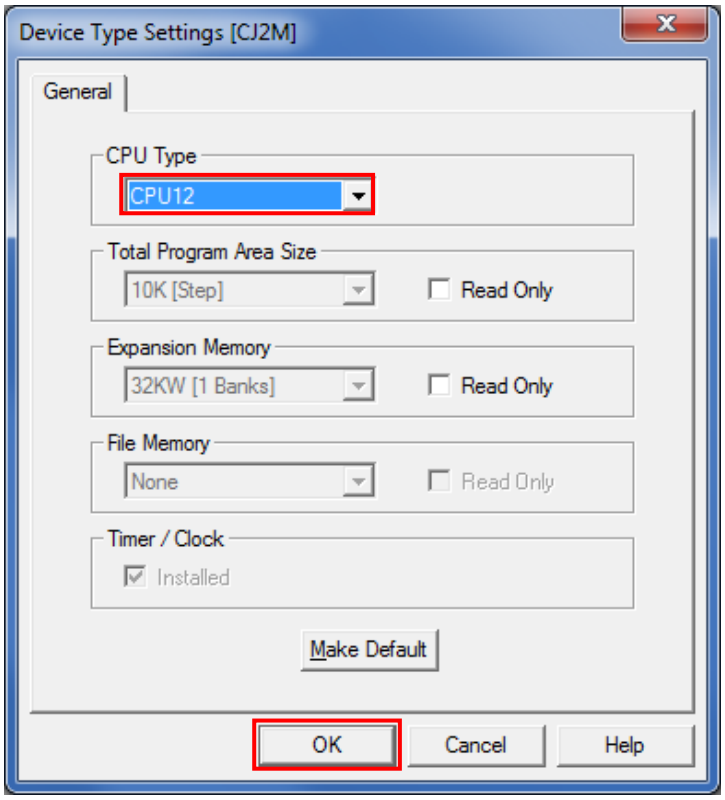
7.3.7. Going Online and Transferring the Protocol Data

Go online with CX-Protocol and transfer the protocol data to the Serial Communications Unit.

1	Double-click **P704_CJ_CWF_OMRON_E5CD_V100** in the Project Workspace to display a tree.	
2	Select ***Edit PC-PLC Comms Settings*** from the PLC Menu.	
3	The Change PLC Dialog Box is displayed. From the pull-down list of Device Type, select the device type of PLC to use. Click **Settings**. *CJ2M is selected in this guide.	

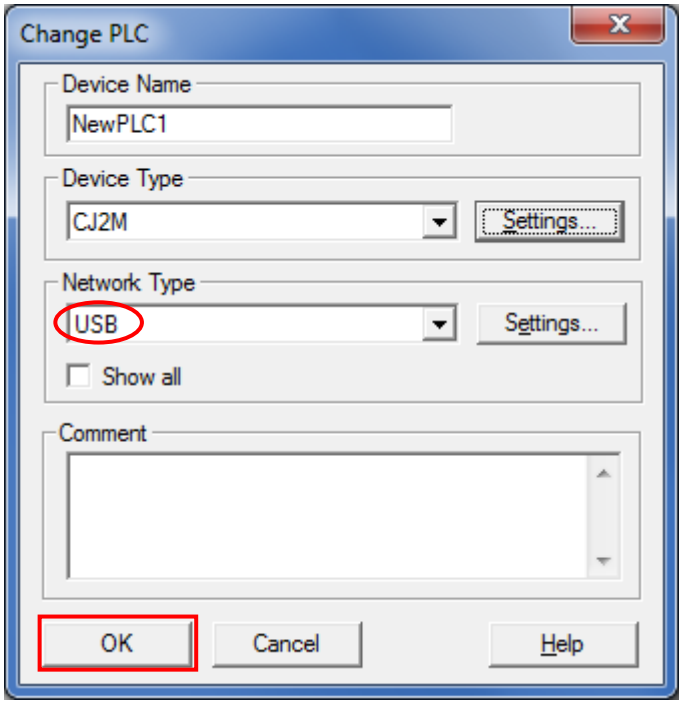
4 The Device Type Settings Dialog Box is displayed.
From the pull-down list of CPU Type, select the CPU type to use. Click **OK**.

*CPU12 is selected in this guide.

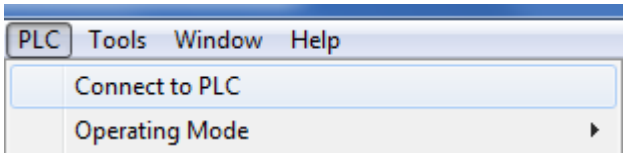


5 Check that the network type is set to USB in the Change PLC Dialog Box.
Click **OK**.

*If not, select ***USB*** from the pull-down list.

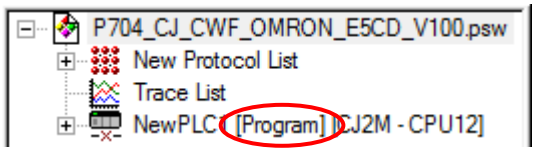


6 Select ***Connect to PLC*** from the PLC Menu.

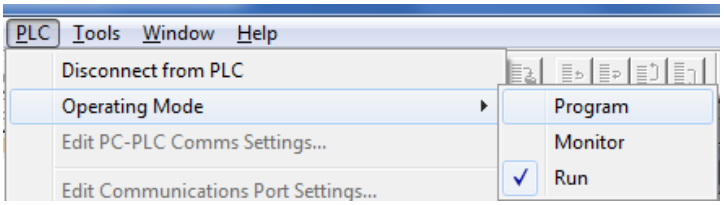


7 In the Project Workspace, the PLC mode displayed next to the PLC Icon changes from Offline to Program. It means that PLC is online and in operating mode.

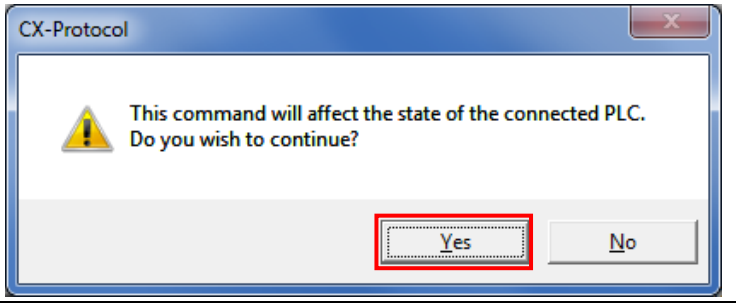
*If the other operating mode (Monitor or Run) is displayed, change it to Program mode by following step 8.



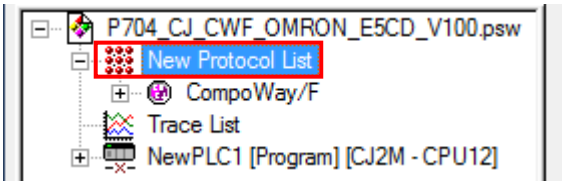
8 If the operating mode is Monitor mode or Run mode in step 7, select ***Operating Mode*** - ***Program*** from the PLC Menu.



The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**. Check that the operating mode changes to Program mode as shown in step 7.

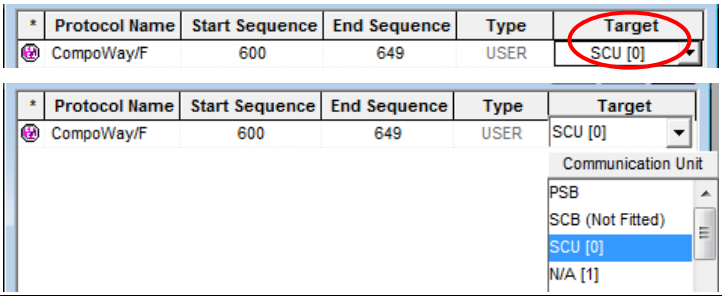


9 Double-click **New Protocol List** in the Project Workspace to display a tree.

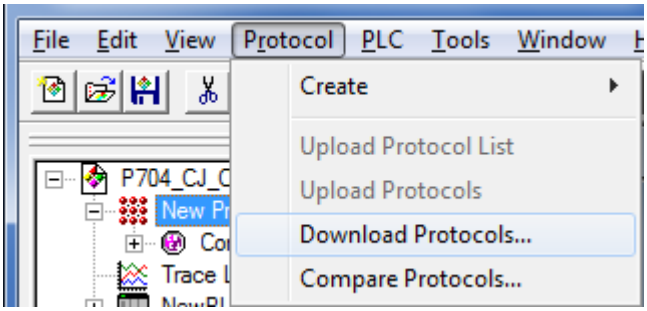


10 The Project Window on the right is displayed. Check that SCU [0] is selected in the *Target* Column.

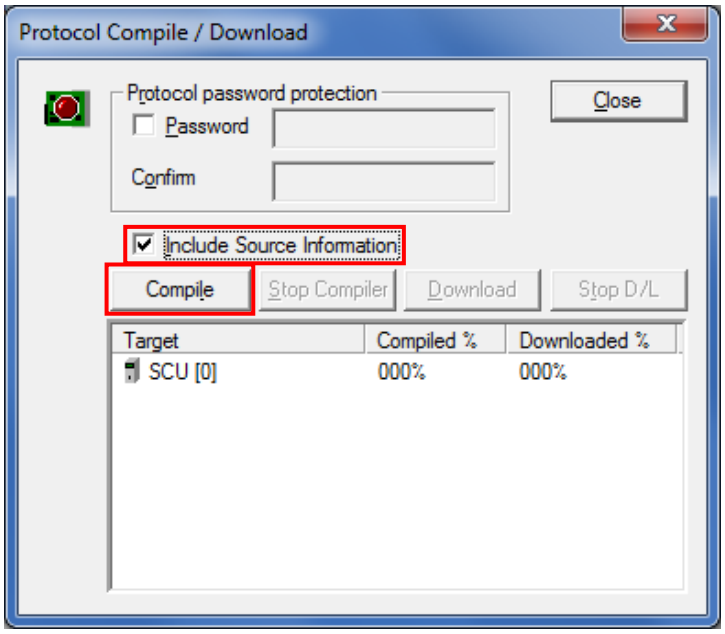
*If SCU [0] is not shown, select ***SCU [0]*** as shown in the figure on the right.



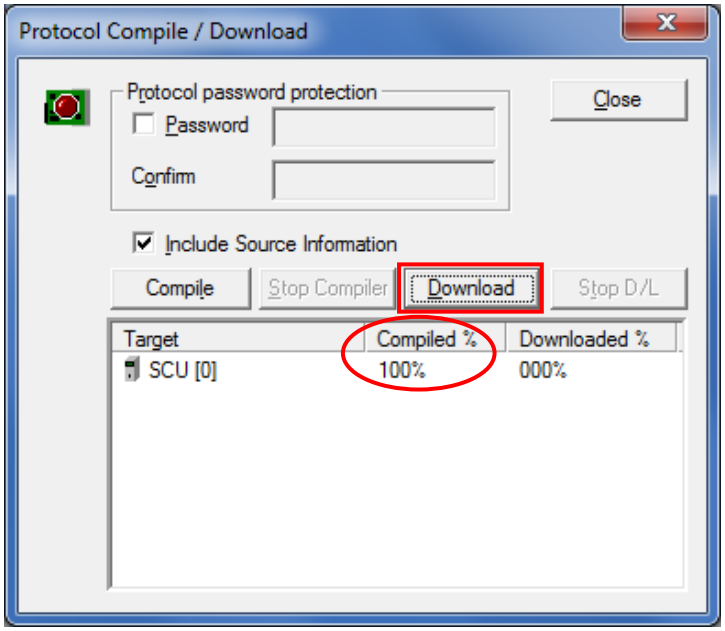
11 Click **New Protocol List** in the Project Workspace and select ***Download Protocols*** from the Protocol Menu.



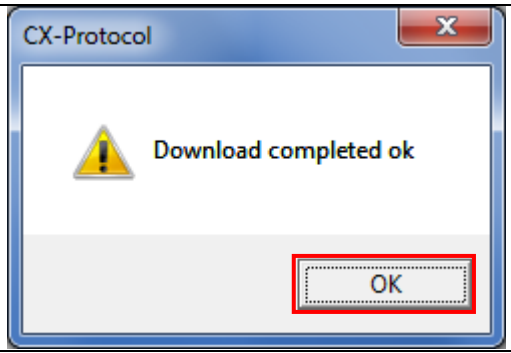
12 The dialog box on the right is displayed. Select *Include Source Information* and click **Compile**.



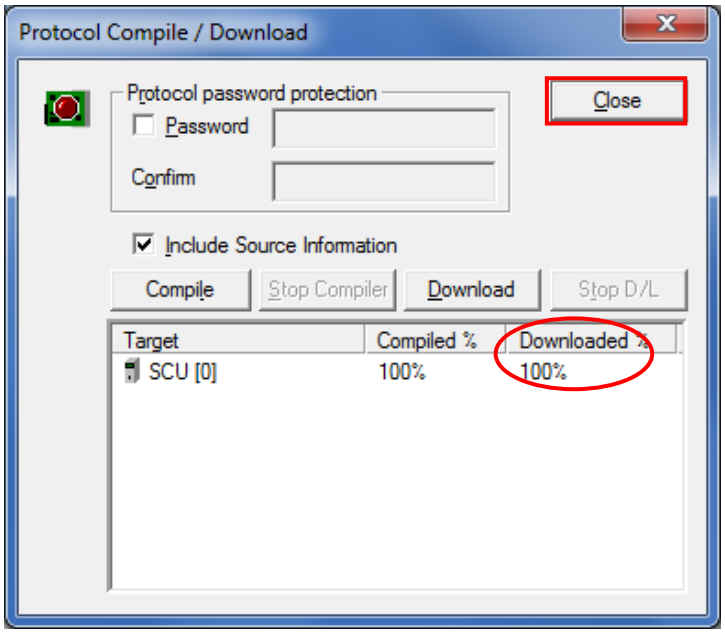
13 The compiling is complete when 100% is displayed in the *Complied %* Column.
Click **Download** after checking that the compiling is completed.



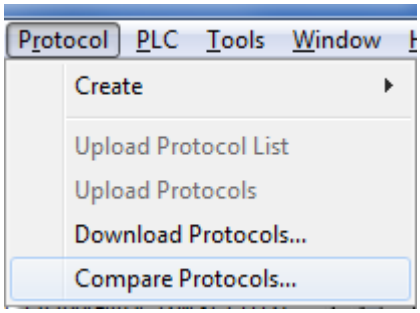
14 The dialog box on the right is displayed. Confirm that there is no problem, and click **OK**.



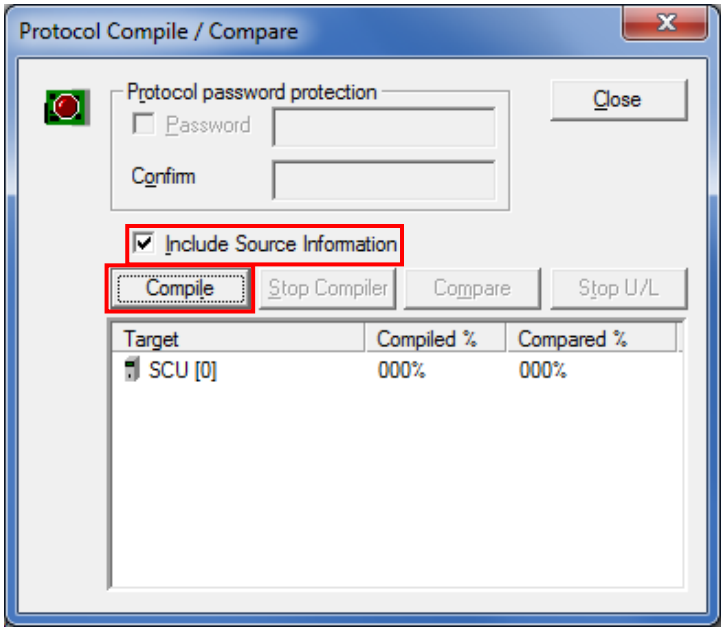
15 Check that 100% is displayed in the *Downloaded %* Column as shown on the right.
Click **Close**.



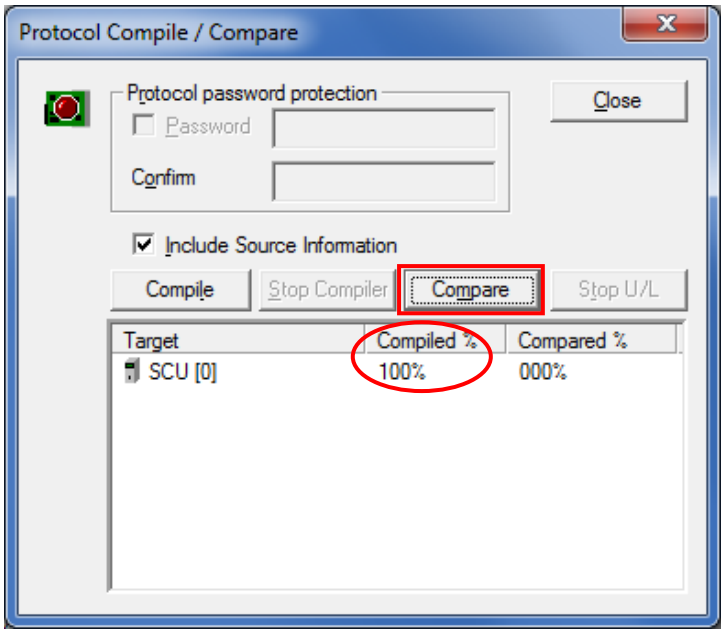
16 Select ***Compare Protocols*** from the Protocol Menu.



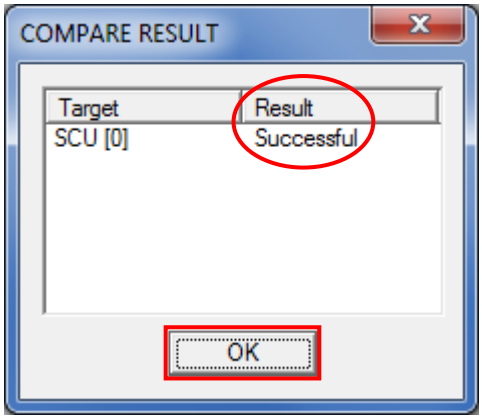
17 The dialog box on the right is displayed. Select *Include Source Information* and click **Compile**.



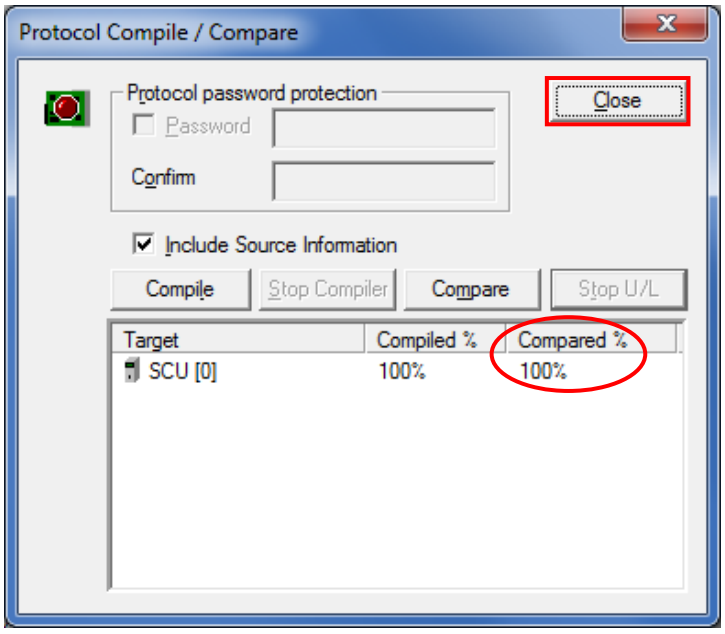
18 The compiling is complete when 100% is displayed in the *Complied %* Column.
Click **Compare** after checking that the compiling is completed.



19 The dialog box on the right is displayed. Check that Successful is displayed in the *Result* Column.
Click **OK**.



20 Check that 100% is displayed in the *Compared %* Column as shown on the right.
Click **Close**.



7.4. Serial Communication Status Check

Start the send/receive processing and confirm that serial communications performs normally.

⚠ Caution

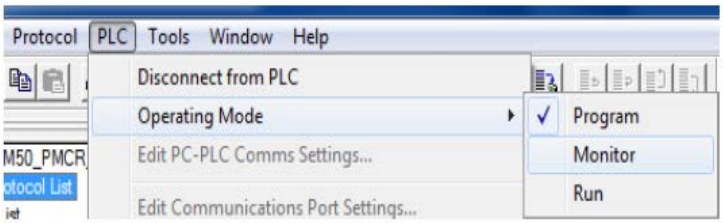
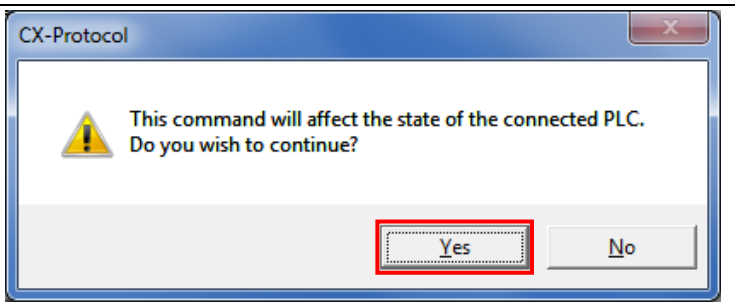
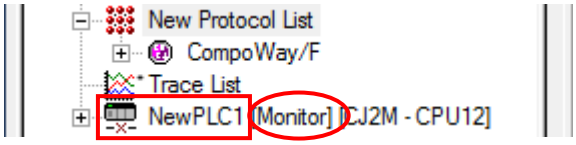
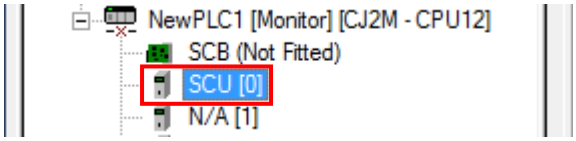
If the PLC memory is changed by malfunction during the monitoring of power flow and present value status in the Ladder Section Window or in the Watch Window, the devices connected to Output Units may malfunction, regardless of the operating mode of the CPU Unit.
Always ensure safety before monitoring power flow and present value status in the Ladder Section Window or in the Watch Window.

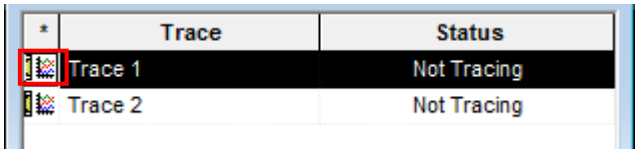
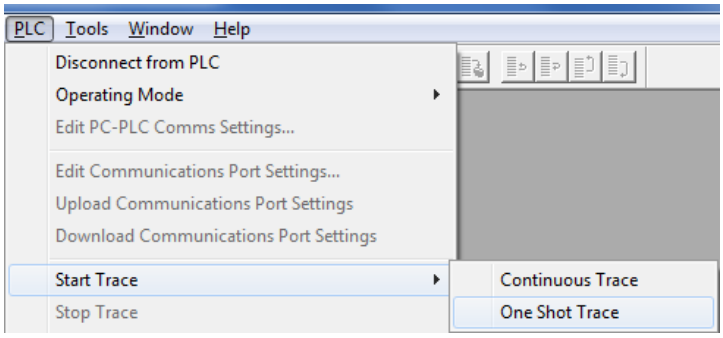
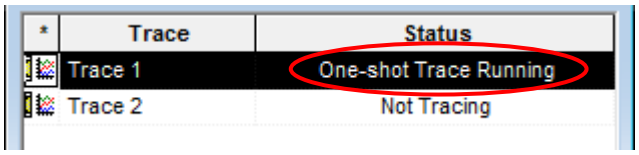
Precautions for Correct Use

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

7.4.1. Starting the Trace

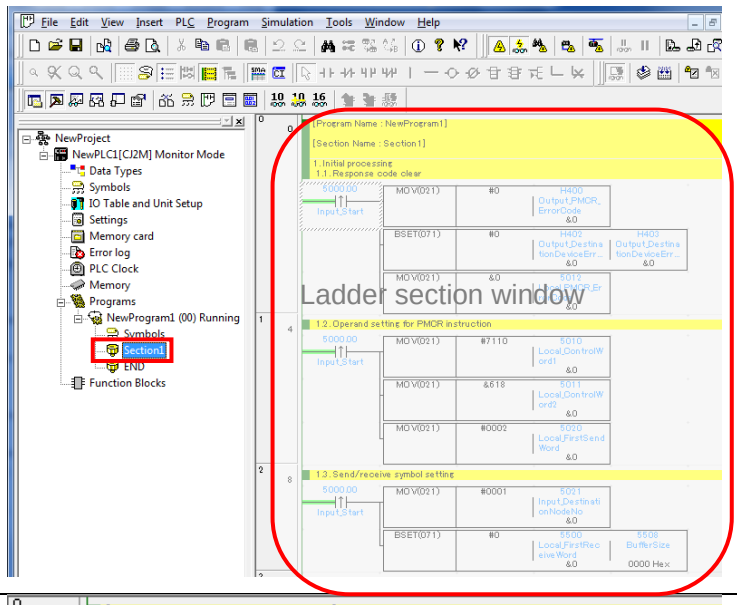
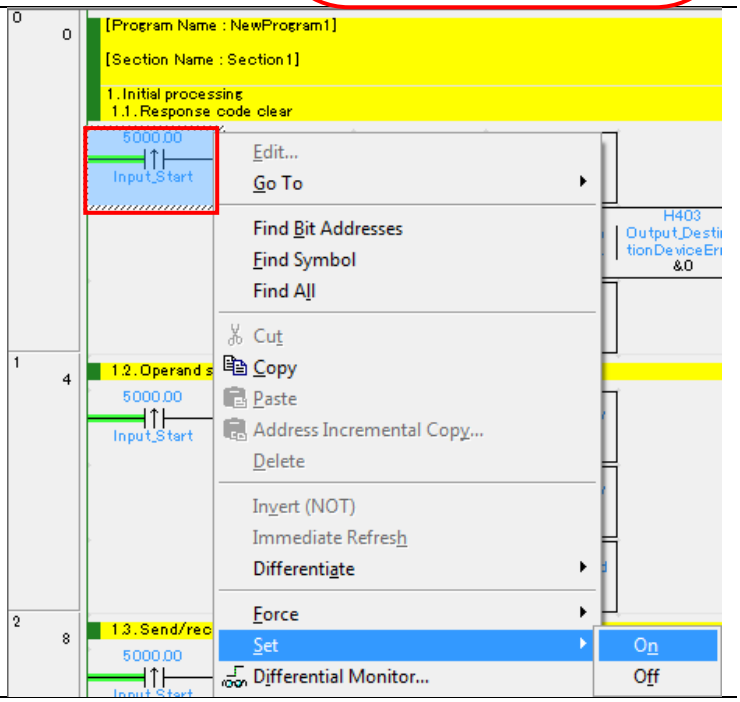
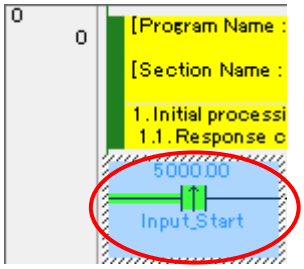
Start tracing with CX-Protocol.

1	Select ***Operating Mode*** - ***Monitor*** from the PLC Menu in CX-Protocol.	
2	The dialog box on the right is displayed. Confirm that there is no problem, and click **Yes**.	
3	Check that the operating mode changes to Monitor mode. Double-click NewPLC1.	
4	The tree under NewPLC1 expands. Select Serial Communications Unit. (SCU [0] is selected as shown on the right.)	

5	Select the **Trace 1** Icon () in the Project Window. (Check that the Trace 1 is highlighted as shown in the figure on the right.) *Trace 1 corresponds to Port 1 of Serial Communications Unit.	
6	Select ***Start Trace*** - ***One Shot Trace*** from the PLC Menu.	
7	Check that the status of Trace 1 in the Project Window changes to One-shot Trace Running.	

7.4.2. Executing the Communications Sequence

Execute the communications sequence with CX-Programmer.

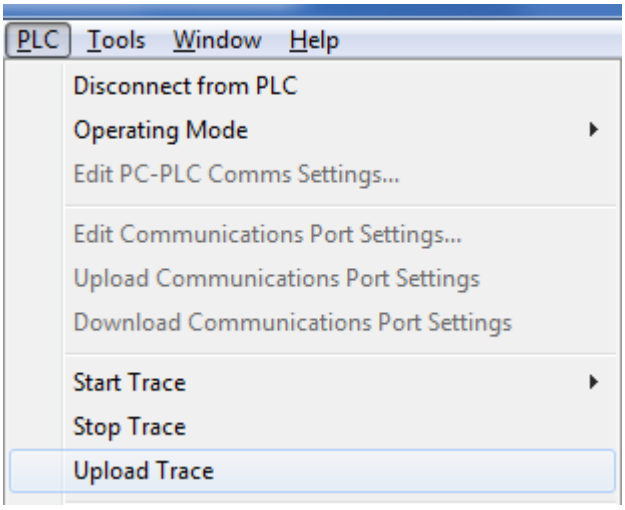
1	Expand the tree under Programs in the project workspace of CX-Programmer and double-click **Section1**. The Ladder Section Window shows the Section1 ladder program.	
2	In the Ladder Section Window, right-click **Input_Start** and select ***Set*** - ***On***.	
3	Check that the Input_Start contact is turned ON as shown in the figure on the right.	

7.4.3. Checking the Trace Data

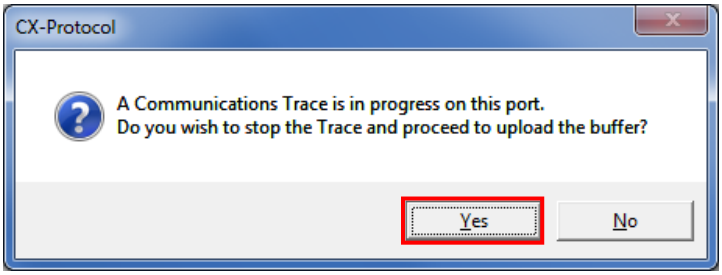
Check that correct data is sent and received, using the trace data in CX-Protocol.

1 Select ***Upload Trace*** from the PLC Menu in CX-Protocol.

*Once the trace data is stored, the menu item "Upload Trace" will be selectable.



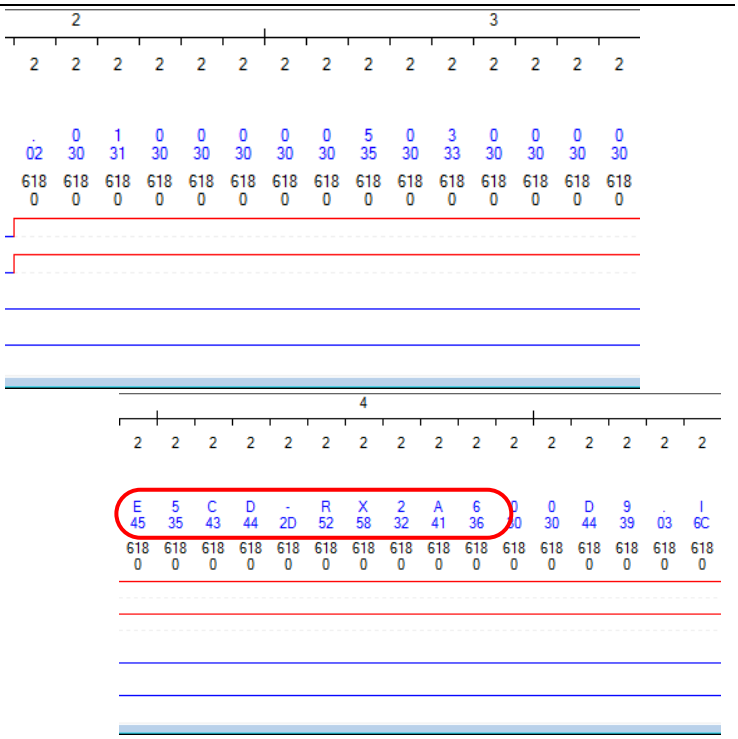
2 The dialog box on the right is displayed. Check the contents and click **Yes**.



3 Check the receive message in the trace data file as shown in the figure on the right.

(In the example on the right, "45 35 43 44 2D 52 58 32 41 36" in hexadecimal and "E5CD-RX2A6" in string are received as properties of the Digital Temperature Controller.)

*The example shows that the received data (properties of Digital Temperature Controller) is "E5CD-RX2A6" in string; however, the received data varies depending on Digital Temperature Controller used.



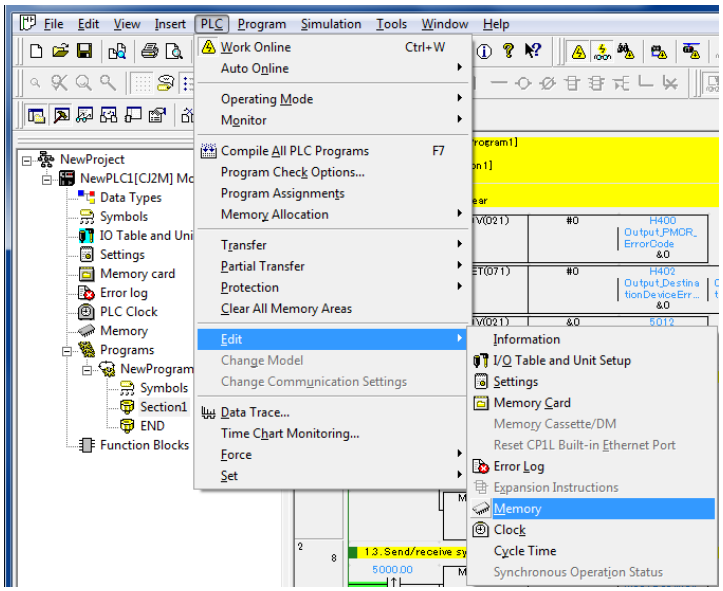
First row of receive message: in string

Second row of receive message: in hexadecimal

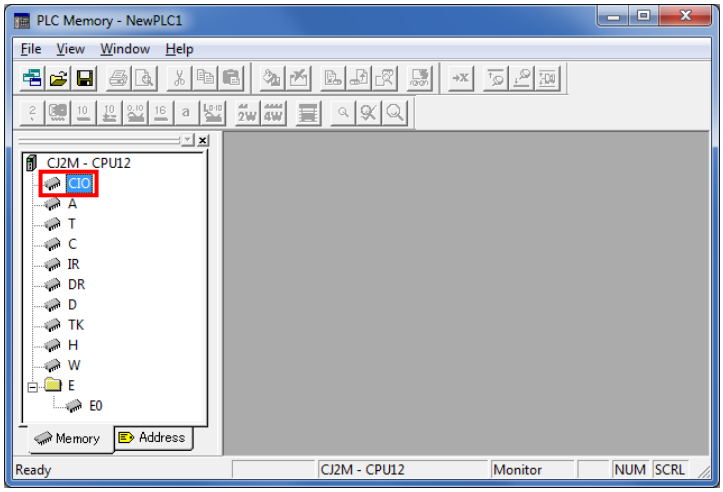
7.4.4. Checking Received Data

With CX-Programmer, check that correct data is written to the I/O memory of the PLC.

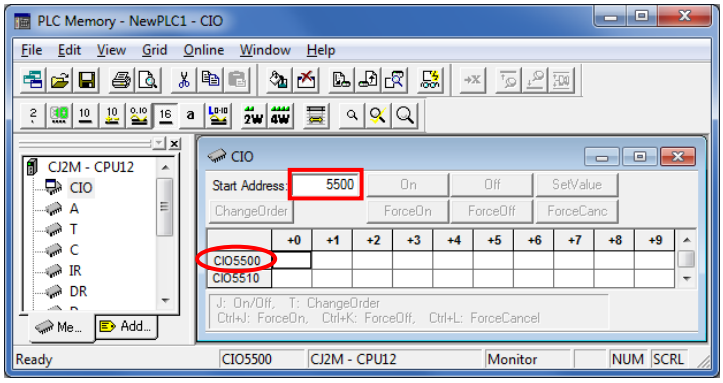
1 Select ***Edit*** - ***Memory*** from the PLC Menu in CX-Programmer.



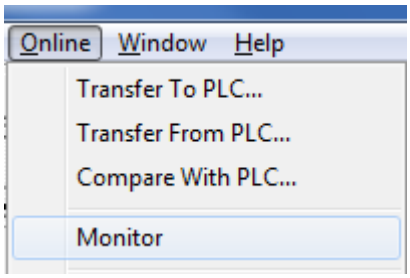
2 Double-click **CIO** in the *Memory* Tab of the PLC Memory Window.



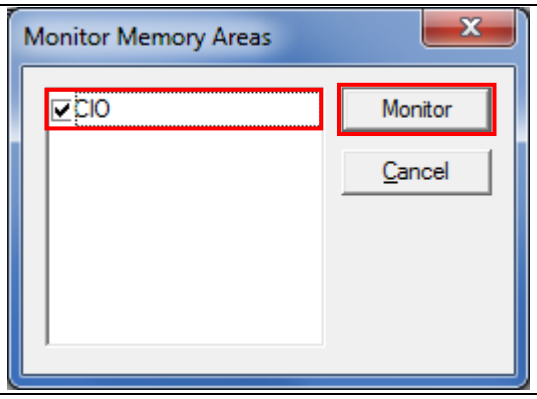
3 Enter *5500* in the *Start Address* Field of the CIO Area.
Check that the start address changes to CIO5500.



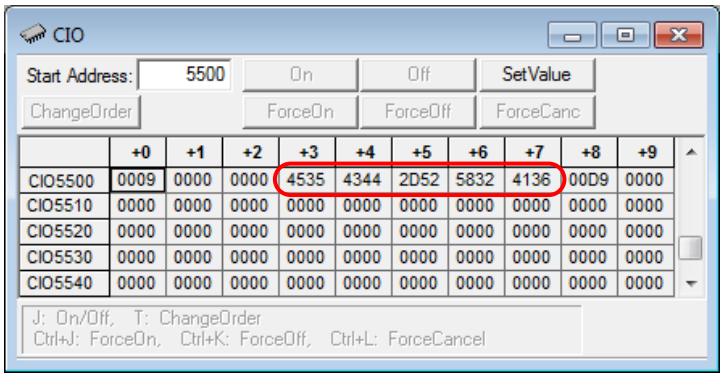
4 Select ***Monitor*** from the Online Menu.



5 The Monitor Memory Areas Dialog Box is displayed.
Select *CIO* and click **Monitor**.



6 Check received data (properties of Digital Temperature Controller) in the CIO Area as shown on the right.



*In the example on the right, the stored data starting from CIO5503 is in hexadecimal and is described as follows:
4535 4344 2D52 5832 4136
These values can be expressed as a string "E5CD-RX2A6" which is the same as the trace data described in step 3 of *7.4.3. Checking the Trace Data*.

*The number of words being used (0009 in hexadecimal) is stored in CIO5500.
The properties of Digital Temperature Controller are stored in the addresses from CIO5503 to CIO5507.

*For details, refer to *9.2.2. PMCR Instruction Operand Settings*.

8. Initialization Method

The setting procedures in this guide are based on the factory default settings.
Some settings may not be applicable unless you use the devices with the factory default settings.

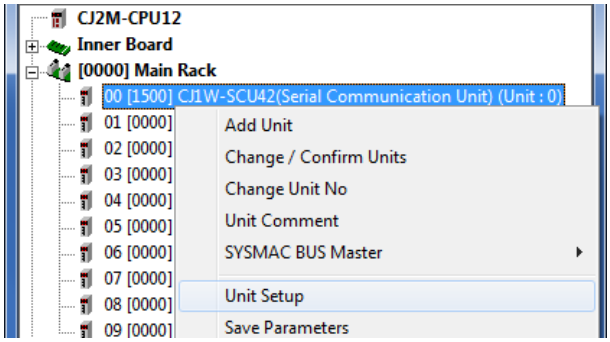
8.1. Initializing a PLC

To initialize the settings of a PLC, it is necessary to initialize a Serial Communications Unit and a CPU Unit. Change the operating mode of the PLC to PROGRAM mode before the initialization.

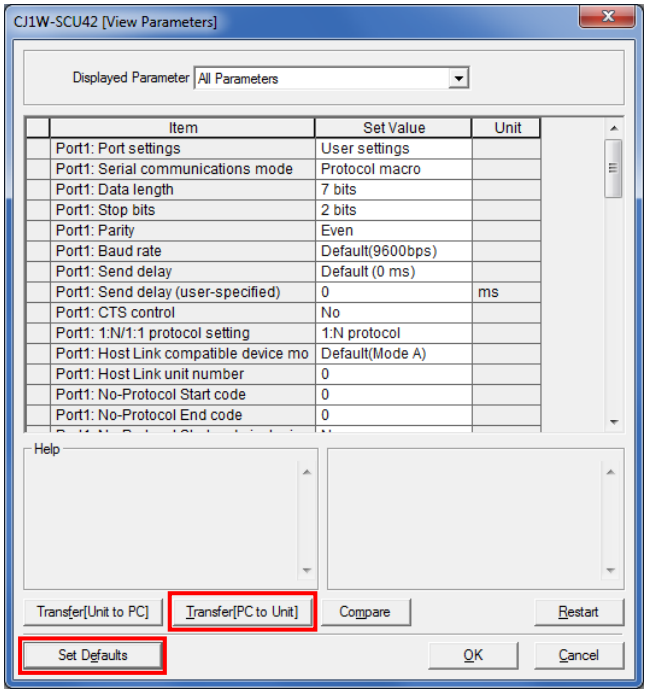
8.1.1. Serial Communications Unit

To initialize the settings of a Serial Communications Unit, select ***Edit*** - ***I/O Table and Unit Setup*** from the PLC Menu in CX-Programmer and perform the following steps.

(1) Right-click Serial Communications Unit in the PLC IO Table Window and select ***Unit Setup*** from the menu.

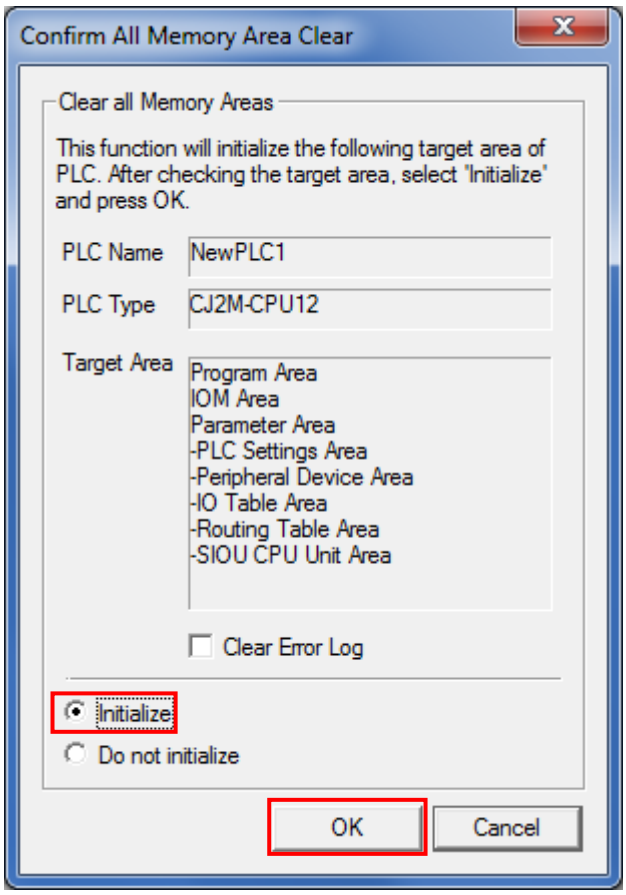


(2) In the CJ1W-SCU42 [View Parameters] Dialog Box, click **Set Defaults** first, then click **Transfer[PC to Unit]**.



8.1.2. CPU Unit

To initialize the settings of a CPU Unit, select ***Clear All Memory Areas*** from the PLC Menu in CX-Programmer. Select *Initialize* in the Confirm All Memory Area Clear Dialog Box and click **OK**.



8.2. Initializing a Digital Temperature Controller

To initialize the settings of a Digital Temperature Controller, refer to *Parameter Initialization* in *6-8 Advanced Function Setting Level* of the *Digital Temperature Controllers User's Manual* (Cat. No. H224/H174/H185).

9. Program

This section describes the details on the program used in this guide.

9.1. Overview

The following explains the specifications and functions of the program that are used to check the connection between the Digital Temperature Controller (hereinafter referred to as the "Destination Device") and the PLC (Serial Communications Unit (hereinafter referred to as the "SCU")).

This program uses the protocol macro function of the SCU, to send/receive the "Properties Read" command to/from the Destination Device and detect a normal end or an error end.
A normal end of the send/receive processing means a normal end of the communications sequence.
An error end means an error end of the communications sequence and an error of the Destination Device (identified in the response data from the Destination Device)

Here, the prefix "&" is added to decimal data and the prefix "#" is added to hexadecimal data when it is necessary to distinguish between decimal and hexadecimal data. (e.g., "&1000" for decimal data and "#03E8" for hexadecimal data)

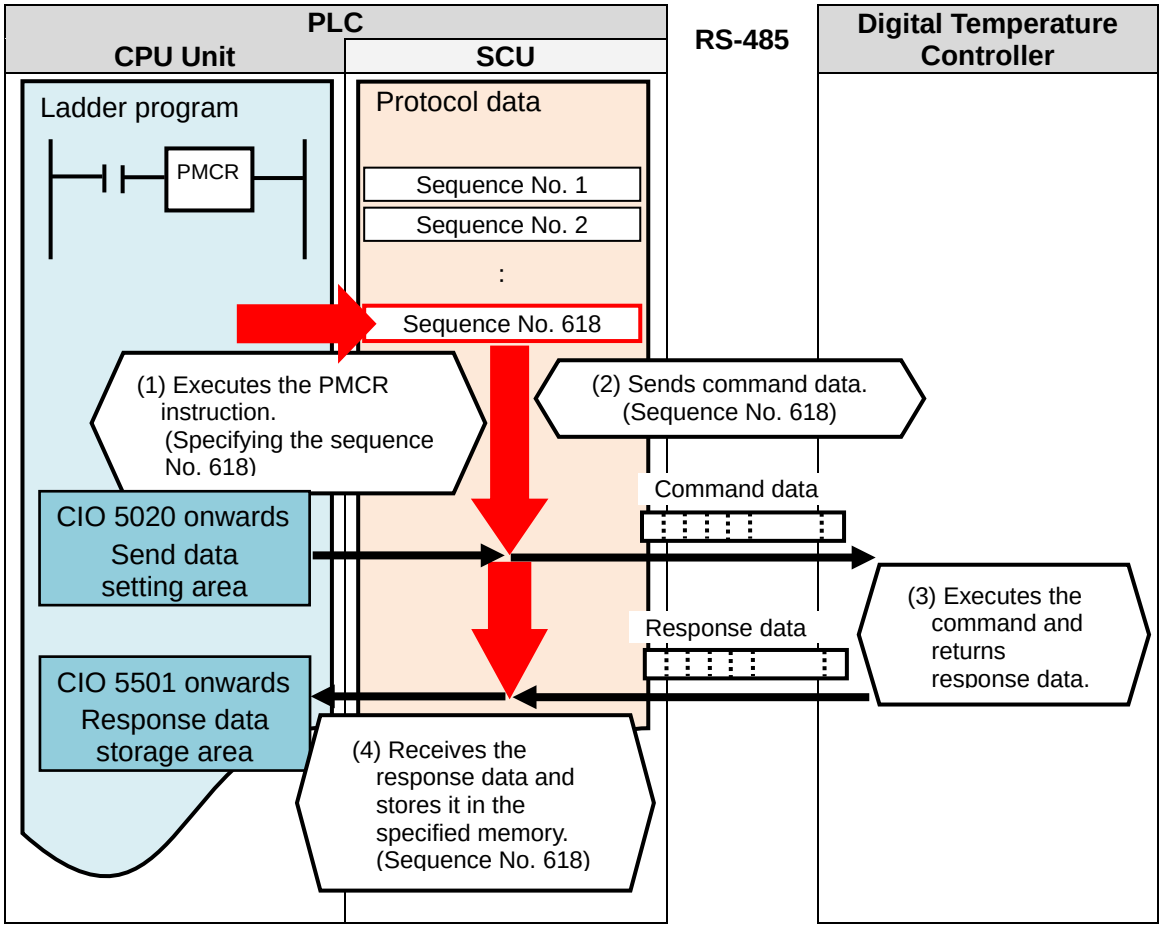
Additional Information

OMRON has confirmed that normal communications can be performed using this program under the conditions of *5.2. Device Configuration*. However, we do not guarantee the normal operation under disturbances such as electrical noise or device performance variation.

9.1.1. Outline of Processing

The following figure shows the data flow from when the PLC (SCU) sends command data to Destination Device via serial communications until the PLC receives response data from the Destination Device.

(1)The ladder program executes the PMCR instruction for which the communications sequence No. 618 is specified.
(2)The PLC reads the parameters (which are set in the send data setting area) according to the send message defined by the communications sequence No. 618, and sends command data to Digital Temperature Controller.
(3)The Digital Temperature Controller executes the command by receiving the command data from the PLC, and returns response data to the PLC.
(4)The PLC receives the response data from Digital Temperature Controller according to the receive message defined by the communications sequence No. 618, and stores the data in the response data storage area.



9.1.2. PMCR Instruction and Send/Receive Messages

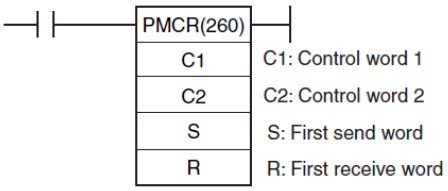
The following describes the PMCR instruction and the general operation of sending/receiving a message.

Additional Information

For details, refer to *Serial Communications Instructions (PMCR)* in *SECTION 3 Instructions* of the *CJ Series Programmable Controllers INSTRUCTIONS REFERENCE MANUAL* (Cat. No. W474).

●PMCR Instruction Operands

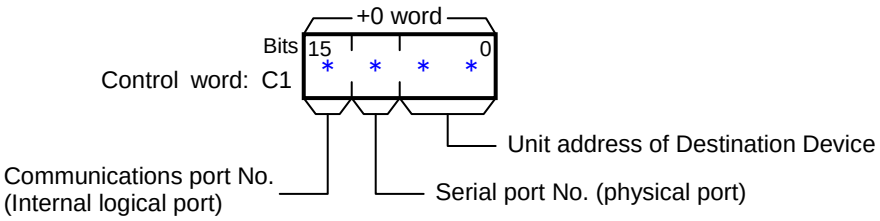
Instruction	Mnemonic	Variations	Function code	Function
PROTOCOL MACRO	PMCR	@PMCR	260	Starts a communications sequence (protocol data) that is registered in a Serial Communications Board (CS Series only) or Serial Communications Unit.

	PMCR
Symbol	

C1: Control word 1

The following three items are set for SCU.

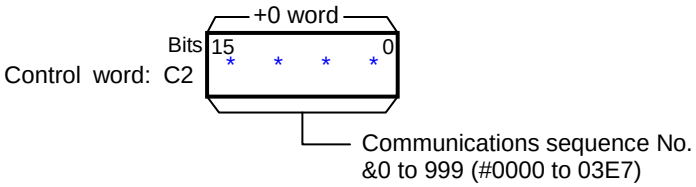
- Communications port No. (internal logical port): #0 to #7
- Serial port No. (physical port): #1 or #2 (#1: PORT1, #2: PORT2)
- Unit address of Destination Device: # unit number + #10



C2: Control word 2

The communications sequence number is set, which is registered as protocol data.

For information on the communications sequence number registered in this protocol data, refer to *9.2.1 Communications Sequence Number*.



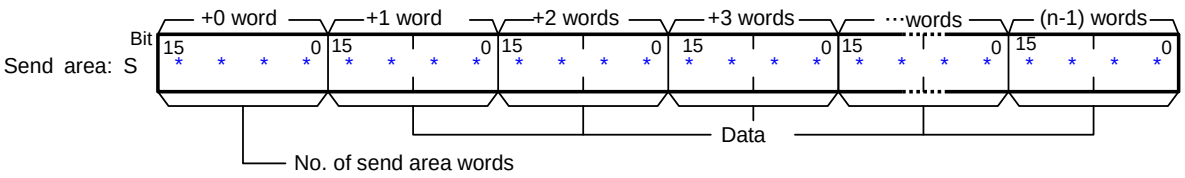
[S: First send word (send area specification)]

The first word of the words required to send data is specified. S contains the number of words (n) to be sent. (i.e., including the S word)

Between #0000 and #00FA (n=&0 and &250) words can be send.

The send data (variable data) is entered in the words from S+1 to S+(n-1).

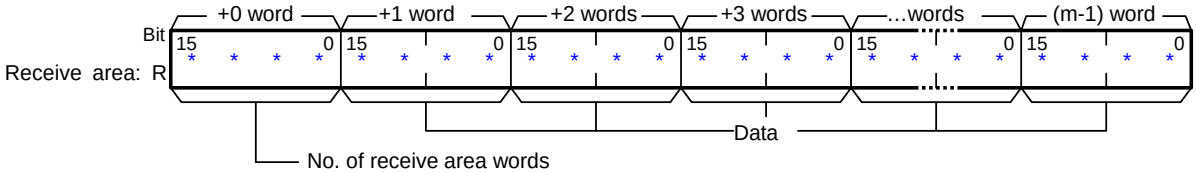
If there is no operand specified in the execution sequence, such as a direct or linked word, set constant #0000 for S.



[R: First Receive Word (receive area specification)]

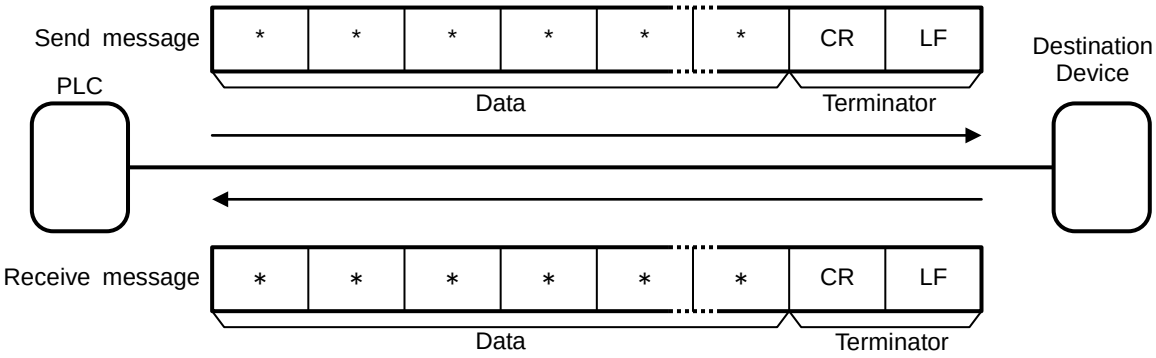
The number of receive words (m) is automatically stored in R (i.e., including the R word).

The received data is stored in the words from R+1 to R+(m-1). (m=&0 to &250 or #0000 to #00FA)

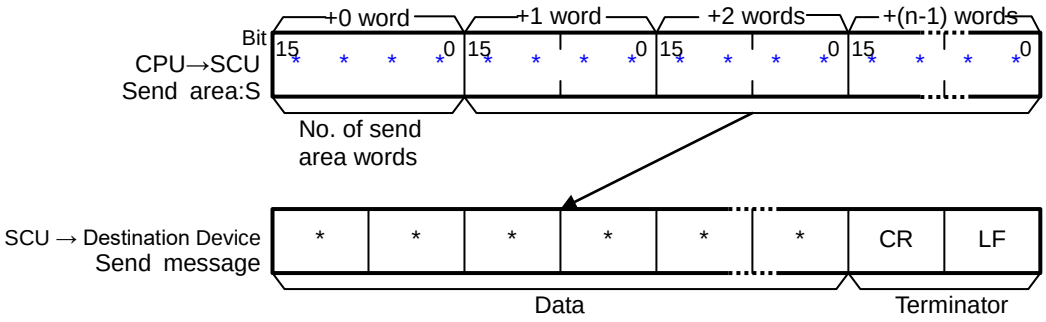


●Send/Receive Messages

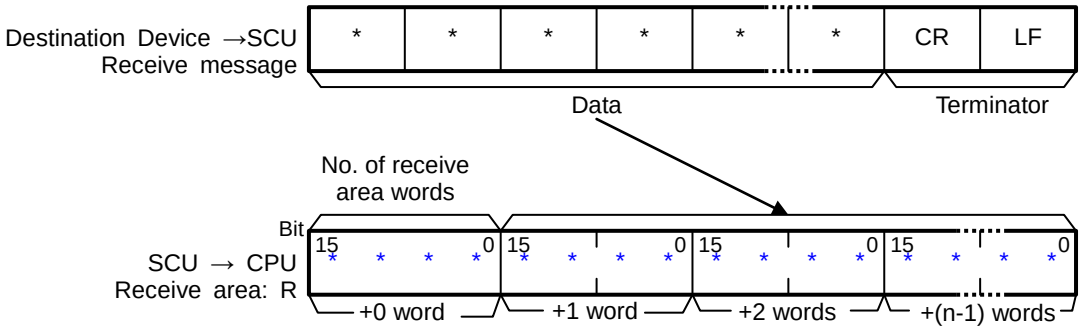
[Frames of send/receive messages]



[Relationship between send area S (PMCR instruction operand) and send message]



[Relationship between receive area R (PMCR instruction operand) and receive message]



9.2. Communications Sequence

The following describes the communications sequence that is used for the PMCR instruction in this program.

9.2.1. Communications Sequence Number

A communications sequence that is registered in the SCU is identified by a communications sequence number. The Destination Device executes the command corresponding to the communications sequence number that is specified in the program for executing the PMCR instruction.

The protocol data used in this guide includes the following communications sequence.

No.	Command name	Description
618	Properties Read	Reads the properties of the Destination Device.

9.2.2. PMCR Instruction Operand Settings

The PMCR instruction operands for the communications sequence No. 618 (#026A) "Properties Read" are shown below.

・Control word C1 setting (C1: CIO 5010)

Word	Description (data type)	Data (description)
C1	Communications port No. (1-digit hex)	#7110 (communications port No. 7, serial port No. 1 and #unit number + #10)
	Serial port No. (1-digit hex)	
	Unit address of Destination Device (2-digit hex)	

・Control word C2 setting (C2: CIO 5011)

Word	Description (data type)	Data (description)
C2	Communications sequence No.	&618 (Properties Read)

・First send word S setting (S: CIO 5020)

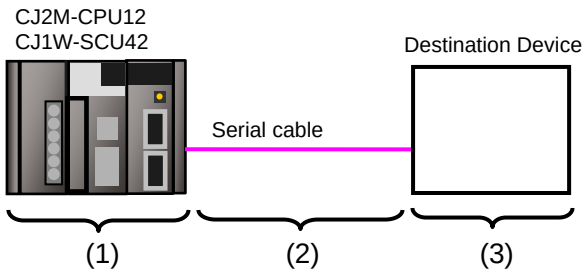
Word	Description (data type)	Data (description)
S	Number of send words (4-digit hex)	#0002 (send data: 2 words)
S＋1	Node number	#0001 (destination node No.)

・First receive word R setting (R: CIO 5500)

Word	Description (data type)	Data (description)
R	Number of receive words (4-digit hex)	Stores the number of words used, including the R word
R+1	End code (CompoWay/F) (UINT)	Stores the CompoWay/F end code.
R+2	MRES/SRES (FINS-mini) (UINT)	Stores the end code of the command execured on the Destination Device.
R+3	Model numbers 1 and 2 (WORD)	Stores the read-out properties of the Destination Device.
R+4	Model numbers 3 and 4 (WORD)	
R+5	Model numbers 5 and 6 (WORD)	
R+6	Model numbers 7 and 8 (WORD)	
R+7	Model numbers 9 and 10 (WORD)	
R+8	Buffer size (WORD)	

9.3. Error Detection Processing

With this program, the error detection processing is performed according to the following descriptions (1) to (3). For information on error codes, refer to *9.8. Error Processing*.



(1)Errors at the execution of the PMCR instruction (PMCR instruction errors)

An incorrect communications sequence number and an incorrect memory address, both of which prevent the execution of the PMCR instruction, are detected as PMCR instruction errors. If an error occurs, the error code (1519.00 to 03) will be generated to identify the error, which indicates the port operating status in the CIO area allocated to the SCU.

(2)Errors in communications with the Destination Device (Communications error)

Errors that occur in communications with the Destination Device, such as character corruption and transmission errors caused by unmatched baud rate setting, are detected as communications errors. If an error occurs, the Sequence Abort End Completion flag (1519.10) in the CIO area allocated to the SCU will be turned ON to identify the error.

(3)Errors in the Destination Device (Destination Device errors)

Destination Device errors include a command error, a parameter error, a data error and an execution failure in the Destination Device. An error is identified in the response data that is returned from the Destination Device. With this program, an error can be detected by comparing difference in frames between a receive message in normal (hereinafter referred to as a "normal message") and a receive message in error (hereinafter referred to as an "error message"). Refer to *9.6.6. Receive Message Settings* for details.

Normal message

STX	“01”	“00”	“00”	“03”	“05”	“00”	“00”	***	ETX	**
Send Start	Node No.	Sub Address	End code	MRC	SRC	MRES	SRES	Data	Send End	BCC

Error message

STX	“01”	“00”	“**”	“03”	“05”	“**”	“**”	ETX	**
Send start	Node No.	Sub Address	End code	MRC	SRC	MRES	SRES	Send end	BCC

Error message

STX	“01”	“00”	“**”	ETX	**
Send start	Node No.	Sub address	End code	Send end	BCC

Additional Information

For information on the CIO area allocated to the SCU, refer to *9.4.2 Lists of Allocations*.

9.4. Memory Maps

The memory maps of this program are shown below.

9.4.1. Lists of Addresses

The tables below list the addresses necessary to execute this program.
You can change the allocations below to any addresses.

Precautions for Correct Use

Make sure that there is no duplicated address when changing the addresses.

●Input memory

The below addresses are used to operate this program.

Address	Data type	Variable name	Description
5000.00	BOOL	Input_Start	Starts the send/receive processing when this flag changes from OFF to ON.
5021	UINT	Input_DestinationNodeNo	Sets the node number of the Destination Device (send destination).

●Output memory

The execution results of the program are stored in these addresses.

Address	Data type	Variable name	Description
5000.02	BOOL	Output_NormalEnd	Turns ON when the send/receive processing ends normally.
5000.03	BOOL	Output_ErrorEnd	Turns ON when one or more of the following errors occur. (1) PMCR instruction error (2) Communications error (3) Destination Device error
5503	WORD	Output_Model 1_2	Stores the model numbers 1 and 2 received from the Destination Device.
5504	WORD	Output_Model 3_4	Stores the model numbers 3 and 4 received from the Destination Device.
5505	WORD	Output_Model 5_6	Stores the model numbers 5 and 6 received from the Destination Device.
5506	WORD	Output_Model 7_8	Stores the model numbers 7 and 8 received from the Destination Device.
5507	WORD	Output_Model 9_10	Stores the model numbers 9 and 10 received from the Destination Device.
5508	WORD	Output_BufferSize	Stores the buffer size received from the Destination Device.
H400	UINT	Output_PMCR_ErrorCode	Stores the error code when a PMCR instruction error or a communications error occurs.

Address	Data type	Variable name	Description
H402	UINT	Output_DestinationDevice ErrorCode[0]	Stores the error code received from the Destination Device when an error occurs in the Destination Device. (CompoWay/F)
H403	UINT	Output_DestinationDevice ErrorCode[1]	Stores the error code received from the Destination Device when an error occurs in the Destination Device. (FINS-mini)

●Internal memory

These addresses are used to operate this program only.

Address	Data type	Variable name	Description
5000.01	BOOL	Local_PMCRExecuting	Indicates the PMCR instruction execution status. Turns ON when the PMCR instruction is being executed, and turns OFF when the PMCR instruction is not executed.
5000.04	BOOL	Local_PMCRNormalEnd	Turns ON when the PMCR instruction ends normally.
5000.05	BOOL	Local_PMCRErrorEnd	Turns ON when a communications error (such as a transmission error) occurs.
5000.06	BOOL	Local_DestinationDevice Error	Turns ON when a Destination Device error occurs.
5000.07	BOOL	Local_PMCRError	Turns ON when a PMCR instruction error (any of the following three errors) occurs. (1) Sequence number error (2) Data read/write range error (3) Protocol data syntax error
5010	UINT	Local_ControlWord1	Execution parameter of the PMCR instruction.
5011	UINT	Local_ControlWord2	Execution parameter of the PMCR instruction.
5012	UINT	Local_PMCR_ErrorCode	Stores the error code when a PMCR instruction error occurs.
5020	UINT	Local_FirstSendWord	Sets the number of send words of the PMCR instruction.
5500	UINT	Local_FirstReceiveWord	Stores the number of words received from the Destination Device.
5501	UINT	Local_ResposeCode[0]	Stores the error code of the Destination Device (end code of CompoWay/F) when a Destination Device error occurs.
5502	UINT	Local_ResposeCode[1]	Stores the error code of the Destination Device (MRES/SRES of FINS-mini) when a Destination Device error occurs.

9.4.2. Lists of Allocations

The tables below list the addresses necessary to execute this program.

●CIO area

These addresses are allocated and fixed in the CIO area according to the unit number (unit address) that is set for the SCU.

Unit number 0 is used in this program.

Address	Data type	Variable name
1509	UINT	ProtocolMacroErrorCode_SCU_0_P1
1509.10	BOOL	SequenceAbortEndCompletion_SCU_0_P1
1509.11	BOOL	SequenceEndCompletion_SCU_0_P1
1509.15	BOOL	ProtocolMacroExecuting_SCU_0_P1

Additional Information

For details on the CIO area allocated to the SCU, refer to *2-3-2. CIO Area* of the *CJ Series Serial Communications Units OPERATION MANUAL* (Cat. No. W336).

●Related auxiliary area

The following address is allocated and fixed in the related auxiliary area according to the communications port number (logical port) that is specified in the program (PMCR instruction operands).

The communications port No. 7 is used in this program.

Address	Data type	Variable name
A202.07	BOOL	CommPortEnabledFlag_P7

Additional Information

For information on the related auxiliary area for the PMCR instruction, refer to *Related Auxiliary Area Words and Bits* in *Serial Communications Instructions (PMCR)* in *SECTION 3. Instructions* of the *CJ Series Programmable Controllers INSTRUCTIONS REFERENCE MANUAL* (Cat. No. W474).

9.5. Ladder Program

9.5.1. Functional Components of the Ladder Program

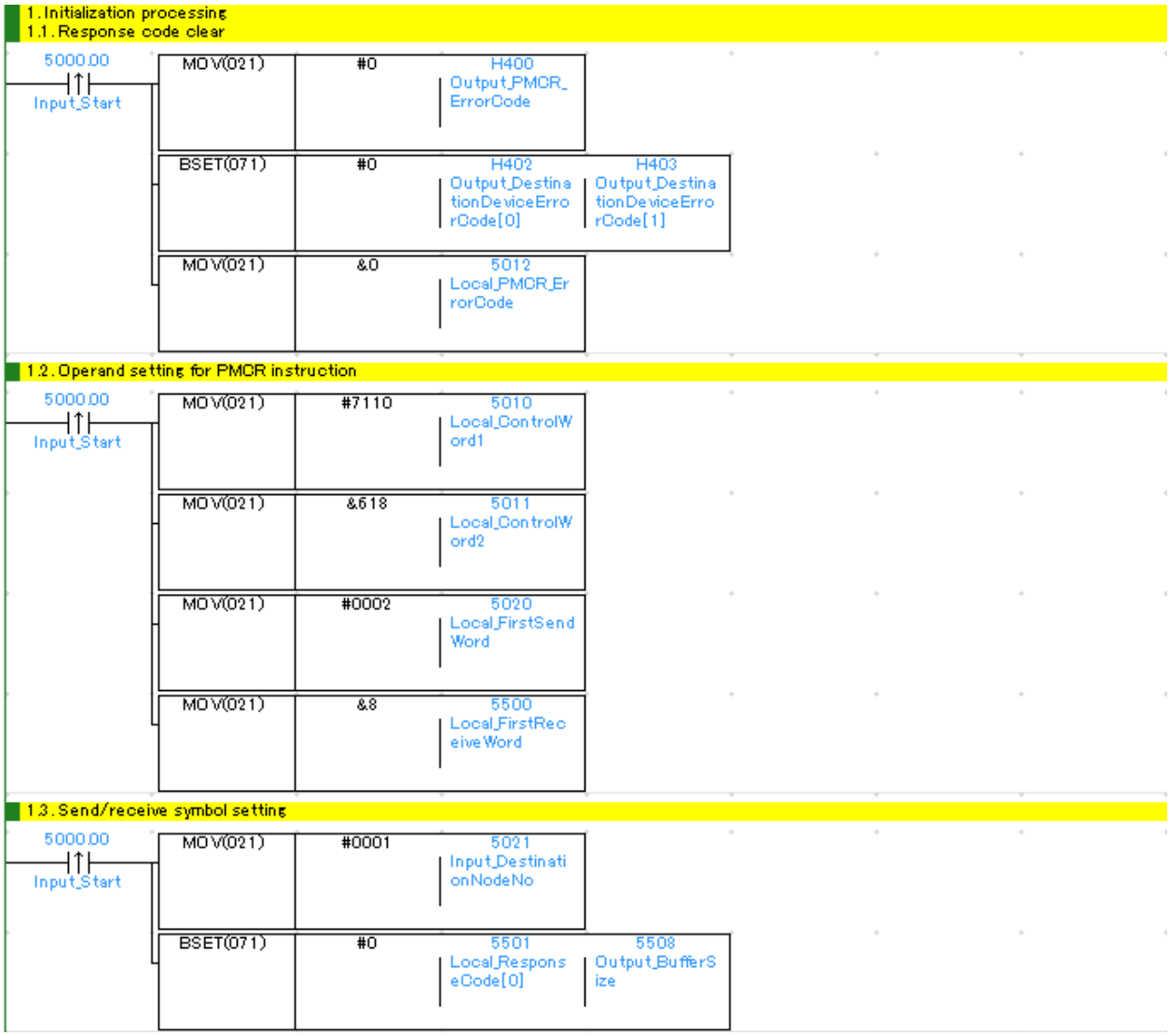
The functional components of this program are shown below.

Major classification	Minor classification	Description
1.Initialization processing	1.1. Response code clear 1.2. Operand setting for PMCR instruction 1.3. Send/receive symbol setting	The area of use is cleared, and the initialization setting is performed as a preparation for communications.
2.PMCR instruction execution management	2.1. PMCR instruction executing 2.2. PMCR instruction execution processing 2.3. Normal/error detection processing	The communications sequence registered in SCU is identified and executed. A normal end or an error end is detected based on the related flags or receive data after the execution.
3.Normal end state management	3.1. Normal end processing 3.2. Response code setting	The normal completion flag is turned ON. The response code for a normal end is set.
4.Error end state management	4.1. Error end processing 4.2. Response code setting	The error end flag is turned ON. The response code corresponding to the error cause is set.

9.5.2. Detailed Description of Each Functional Component

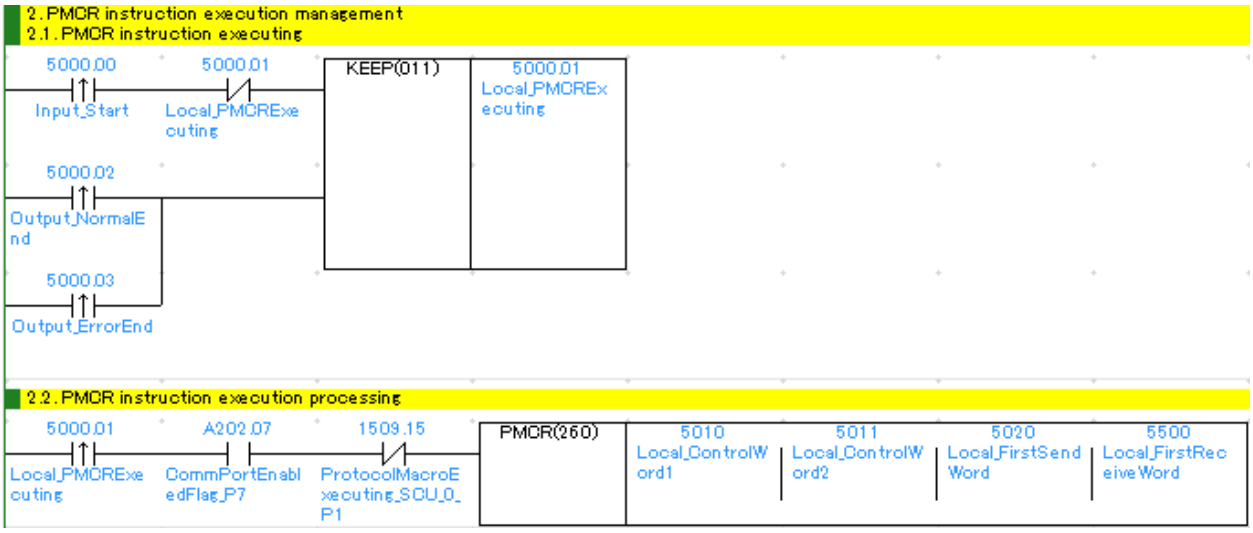
The program used in this guide is shown below.

●1. Initialization processing



No.	Name	Description
1.1.	Response code clear	Clears the error code storage areas to zero.
1.2.	Operand setting for PMCR instruction	Sets execution parameters (operands) of the PMCR instruction.
1.3.	Send/receive symbol setting	Initializes the receive data storage areas.

●2. PMCR instruction execution management



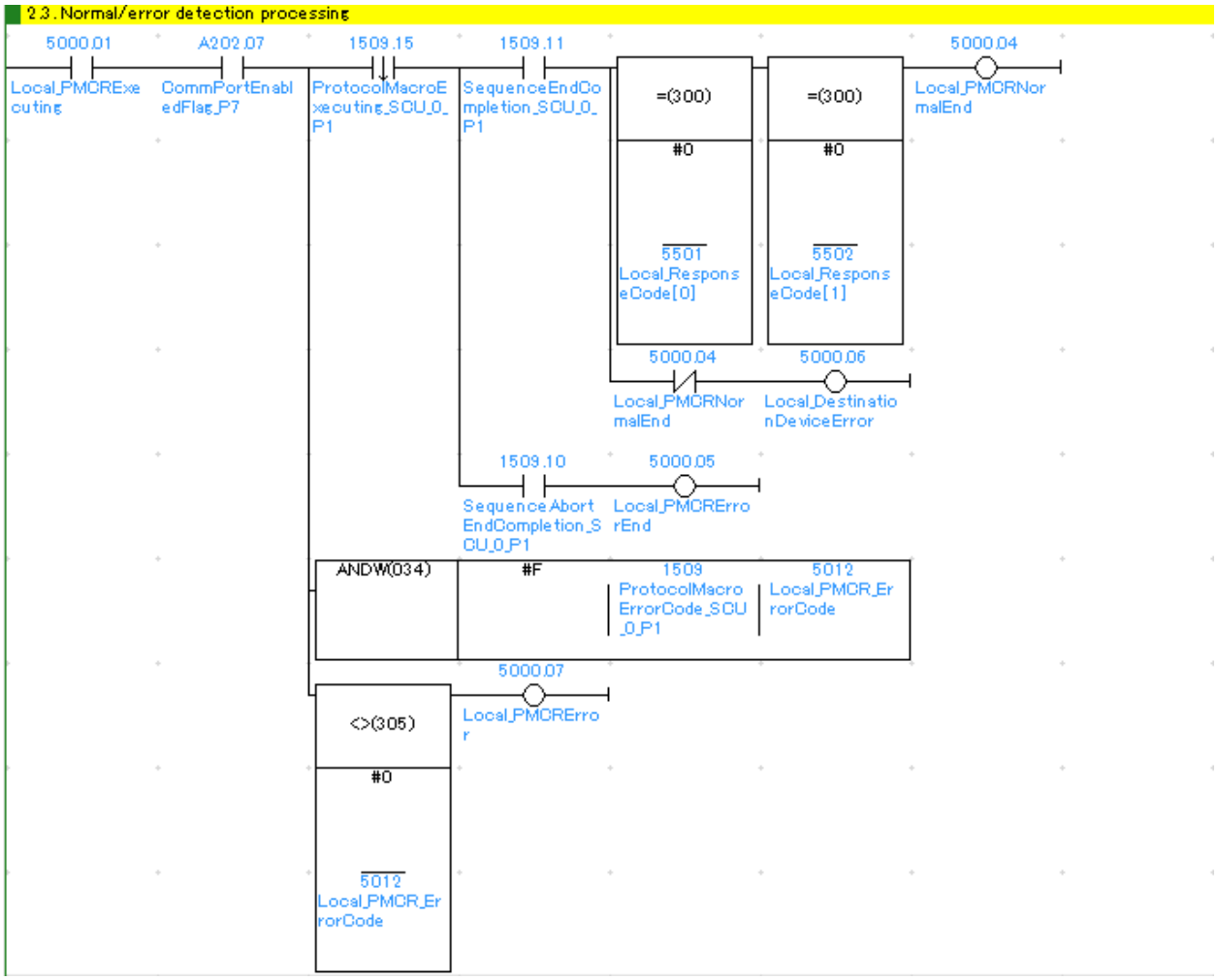
No.	Name	Description
2.1.	PMCR instruction executing	Enters the PMCR instruction executing status. The executing state is reset at a normal end or an error end of the send/receive processing.
2.2.	PMCR instruction execution processing	Executes the PMCR instruction under the following conditions. - Communications port No.7 can be used. - Protocol macro is not being executed.

Precautions for Safe Use

Thoroughly check the overall program before specifying an area to store the data that is received after the PMCR instruction. Otherwise, the data may be written to an unintended memory area.

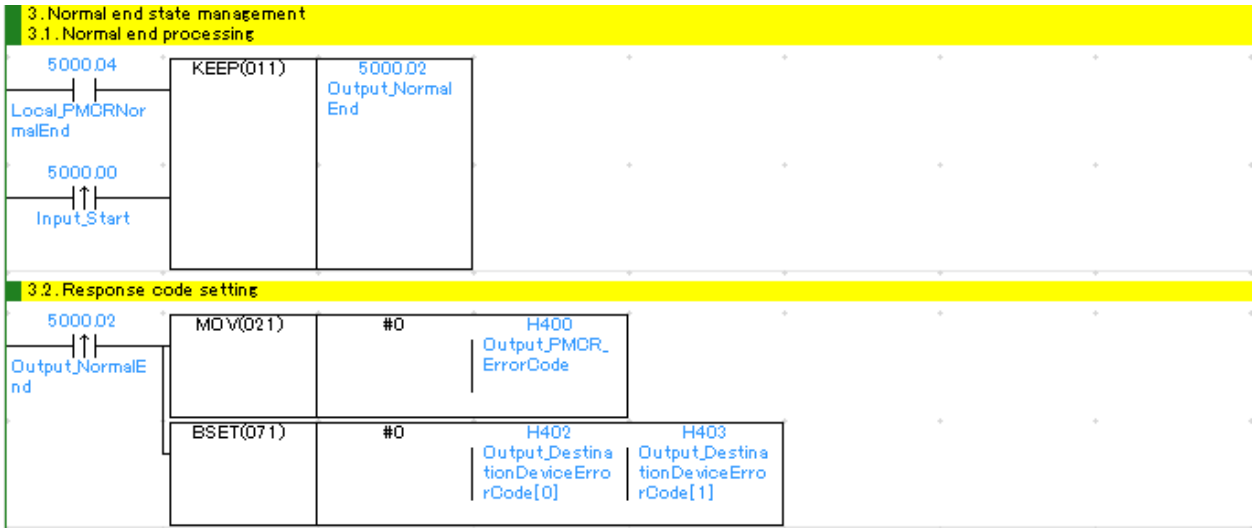
Precautions for Correct Use

The communications port No. 7 is used in this program.
Do not use the communications port No.7 for other purposes.
If you have no choice but to use the communications port No. 7, check that Communications Port Enabled Flag (A202.07) is ON.



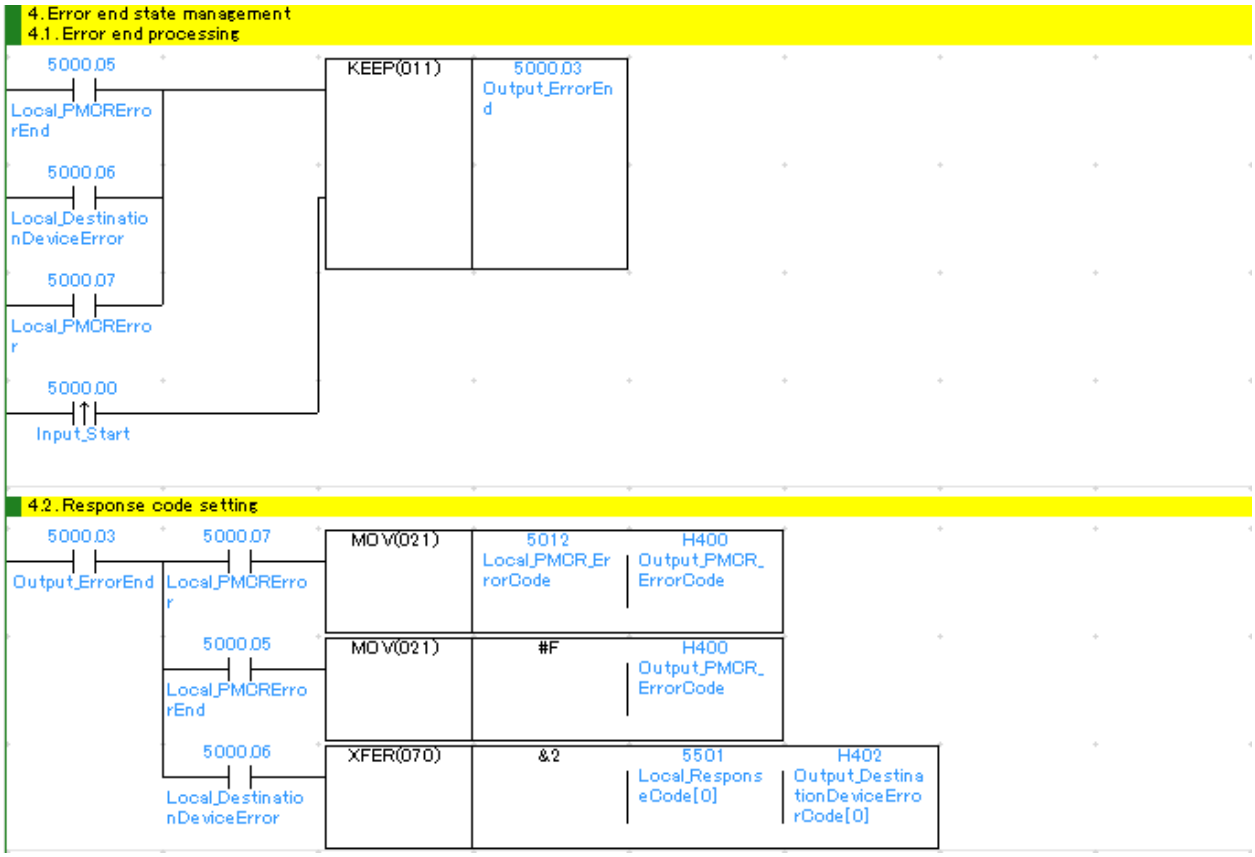
No.	Name	Description
2.3.	Normal/error detection processing	Detects a normal end or an error end, based on the results of send/receive processing. It is considered as a normal end when all the following conditions are met. (1)Normal end of PMCR instruction (No PMCR instruction error) (2)Normal end of communications sequence (No communications error) (3)Normal message received from the Destination Device (No Destination Device error) If any of these conditions is not met and an error occurs, the corresponding error flag will turn ON.

●3. Normal end state management



No.	Name	Description
3.1.	Normal end processing	Turns ON the normal end flag if a normal end of the send/receive processing is detected in *2.3. Normal/error detection processing*.
3.2.	Response code setting	Sets response code "#0000" for a normal end in the response code storage areas.

●4. Error end state management



No.	Name	Description
4.1.	Error end processing	Turns ON the error end flag if an error end of the send/receive processing is detected in *2.3. Normal/error detection processing*.
4.2.	Response code setting	Sets the response code corresponding to the error in the response code storage area when an error occurs.

Additional Information

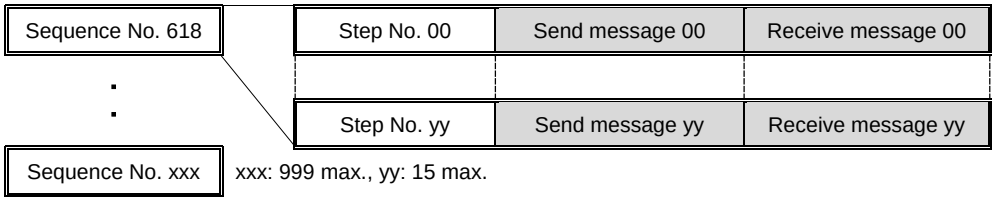
Refer to *9.8 Error Processing* for information on the response codes.

9.6. Protocol Data

The protocol data consists of sequence, step, send/receive message and matrix.
The protocol data structure is described as follows:

●When there is only one receive message for a step (send/receive once)

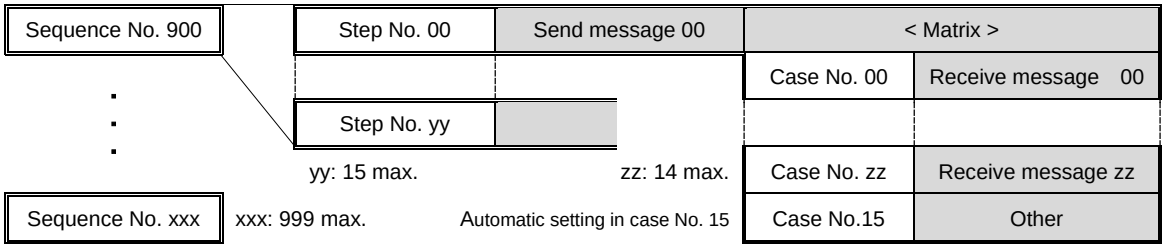
・One each of receive and send messages is set for a step.



●When there is more than one receive message for a step (send/receive once)

・The send message and matrix are set for a step.

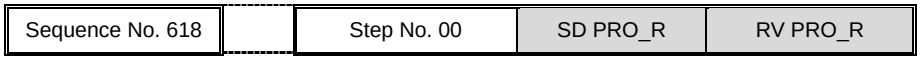
・More than one receive message is set in the case numbers 00 to 14 of matrix.
("Other" is automatically set in the case number 15.)



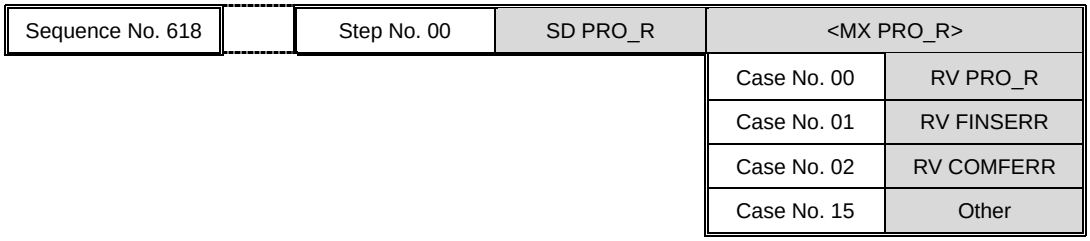
9.6.1. Protocol Data Structure

The protocol data in this guide uses a modified standard system protocol.
There are three different receive messages (one normal message and two error messages) for the send message (SD PRO_R), and those messages are set in the matrix (MX PRO_R).
The protocol data structure used in this guide is shown below.

(Standard system protocol before modification)



(After modification)



RV PRO_R for receiving a normal message
RV FINSERR, RV COMFERR and Other for receiving an error message
(Refer to *9.6.6. Receive Message Settings* for details.)

9.6.2. Procedure of Protocol Data Processing

The procedure of protocol data processing is shown below.

1.	[Step No. 00] Sending the send message (SD PRO_R)	
	↓	
2.	When step No.00 ends normally	When step No.00 ends in error
	↓	↓
3.	Next Process: Matrix Executes the case No. 00, 01, 02 and 15, and terminates the communications sequence as an End.	Error Process: Abort Aborts the step and ends the communications sequence.
	↓	↓
	(End)	**(End)**

9.6.3. Sequence Settings

The Destination Device executes the "Properties Read" command corresponding to the communications sequence No. 618 that is used in the protocol data in this guide.
The communications sequence settings include the time for monitoring the send and receive processing (monitoring time).

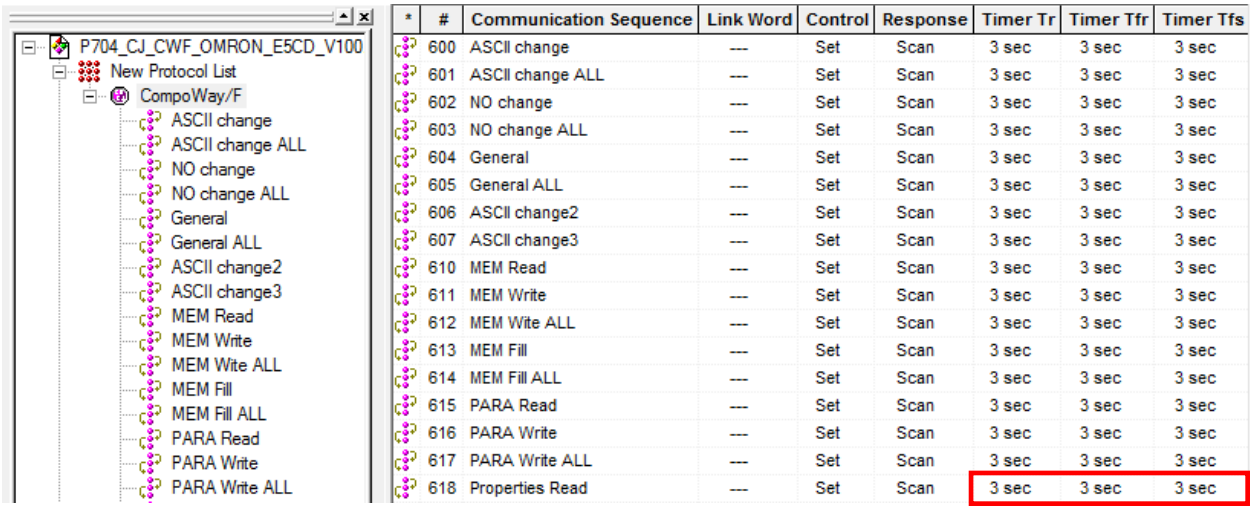
Additional Information

For details on communications sequence settings, refer to *5-2 Creating Sequences and Steps* of the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

●Monitoring time

The monitoring time (Timer Tr, Tfr, and Tfs) that is set for the communications sequence is described below.

[Screenshot of the communications sequence settings]



[Settings]

Item	Name	Description
Timer Tr	Receive wait monitoring time	Monitors the time from when the receive command of the step in the sequence is recognized until the first byte (header) is received. This timer is set to 3 seconds in the protocol data used in this guide.
Timer Tfr	Receive finish monitoring time	Monitors the time from reception of the first byte to reception of the last byte of the data in the step in the sequence. This timer is set to 3 seconds in the protocol data used in this guide.
Timer Tfs	Send finish monitoring time	Monitors the time from transmission of the header to transmission of the last byte of the data. This timer is set to 3 seconds in the protocol data used in this guide.

Additional Information

For information on the calculation method of monitoring time, refer to *4-5 Calculation Method of Monitoring Time* of the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

9.6.4. Step Settings

The step that is set for the communications sequence No. 618 is described below.
The step settings include retry count, send/receive messages (message names), next process and error process.
The sequence of the protocol data used in this guide consists of the step No. 00 only.

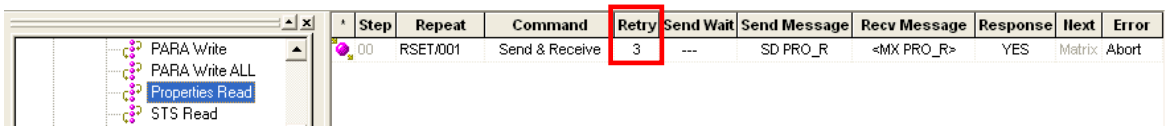
Additional Information

For details on the step settings, refer to *3-3 Step Attributes* of the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

●Retry count

The retry count that is set for the step is shown below. The step is repeated the number of designated times (0 to 9 times) when an error occurs. If the error still remains after the designated number of retry repetitions, the system goes to the error process.
The retry count can be set only for steps in which the Send&Receive command is set.

[Screenshot of the step settings]



[Settings]

Step No.	Retry count
00	3

●Send/Receive messages (message names)

The send/receive messages that are set for the step are shown below.
Here, the registered send message name and matrix name are selected.

[Screenshot of the step settings]

[Settings]

Step No.	Send message	Receive message
00	SD PRO_R	<MX PRO_R>

The matrix is indicated with a pair of marks < > at the beginning and end of a receive message. The matrix is used when more than one receive message exists.

●Next process and error process

The next process and error process that are both set for the step are shown below.

The process set in the *Next* Column is executed when execution of the step ends normally.

If a communications error occurs, the process set in the *Error* Column is executed.

[Screenshot of the step settings]

[Settings]

Step No.	Next process	Error process
00	Matrix	Abort

[Process list]

Process	Description
End	Ends the communications sequence.
Next	Goes to the next step number.
Abort	Aborts the step and ends the communications sequence.
Goto	Goes to a designated step number.
Matrix	Follows the next process that is set for each receive message in the matrix.

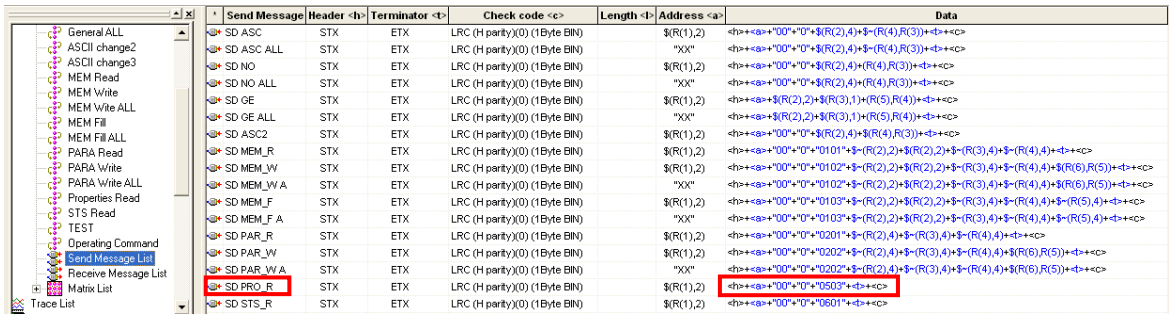
9.6.5. Send Message Settings

The send message that is set in this guide is described below.

Additional Information

For details on the send message settings, refer to *3-4 Communication Message Attributes* of the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

[Screenshot of the send message settings]



●[Send message (SD PRO_R)]

[Settings]

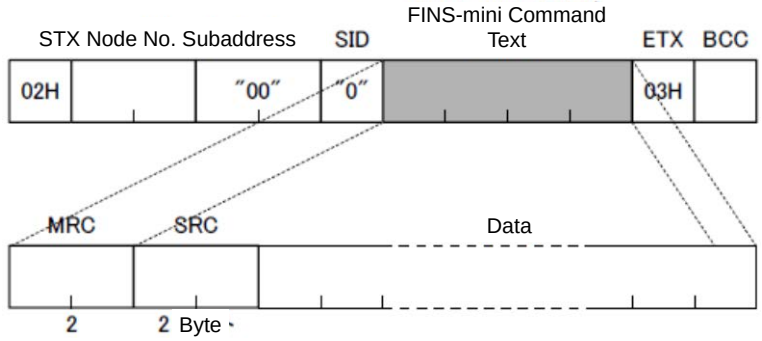
<h>+<a>+"00"+"0"+"0503"+<t>+<c>

(1) (2) (3) (4) (5)

No.	Code	Description
(1)	<h > (Header)	Type: Code, Data: 02 hex
(2)	<a > (Address) $(R(1),2)	(R(1),2): Converts 2-byte data and sends it from the word (first send word specified with the PMCR instruction operand + 1). $: Forward direction ASCII conversion (Converts the send message from hexadecimal code to ASCII code, and outputs the send data from the lower byte.) (S+1 word *Local_SendDataNodeNo*)
(3)	"00", "0", "0503"	Constant ASCII
(4)	<t > (Terminator)	Type: Code, Data: 03 hex
(5)	<c> (Check code)	Type: LRC (horizontal parity) (0) (1-byte BIN) Setting range: 2 to 6

[Send message command frame]

This is the command frame of the message that is sent by the SCU to the Destination Device according to the settings of the send message (SD PRO_R).



Command	Number of bytes	Remarks
STX	1	Fixed: STX (This code indicates the beginning of the communications frame.)
Node No.	2	Variable: The value between 01 and 99 can be set. (“XX” for a broadcast transmission) 01 is set in the protocol data used in this guide.
Subaddress	2	Fixed: 00
SID	1	Fixed: 0
MRC	2	05 is set in the protocol data used in this guide. (Reads the properties of the Destination Device.)
SRC	2	03 is set in the protocol data used in this guide. (Reads the properties of the Destination Device.)
Data*	From 0 onwards	This is not used for the "Properties Read" command.
ETX	1	Fixed: ETX (This code indicates the end of the text.)
BCC	1	Abbreviation of Block Check Character Stores the result of the BCC calculation from Node No. up to ETX.

* When Data is not used, it is removed from the frame, and ETX is shifted next to SRC.

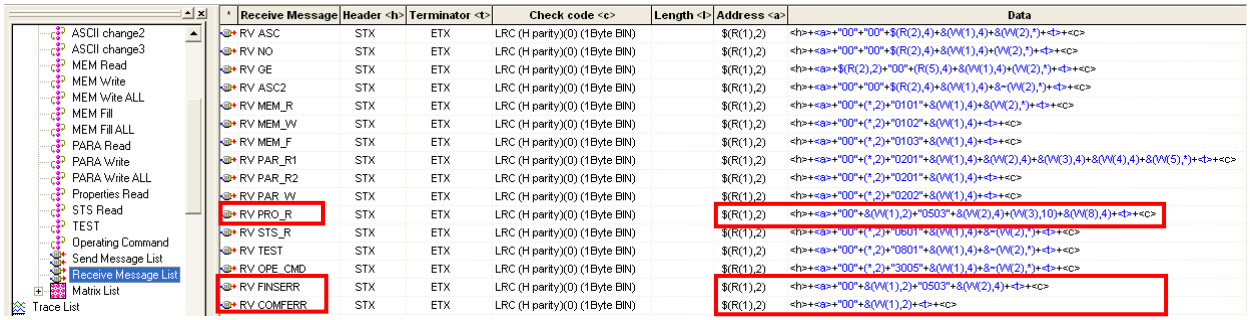
9.6.6. Receive Message Settings

The receive message that is set in this guide is described below, which corresponds to the response frame of normal or error message.

Additional Information

For details on the receive message settings, refer to *3-4 Communication Message Attributes* of the CX-Protocol OPERATION MANUAL (Cat. No. W344).

[Screenshot of the receive message settings]



Receive Message	Header <h>	Terminator <t>	Check code <c>	Length <l>	Address <a>	Data
RV ASC	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+"00"+$(R(2),4)+&(W(1),4)+&(W(2),*)+<t>+<c>
RV NO	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+"00"+$(R(2),4)+&(W(1),4)+(W(2),*)+<t>+<c>
RV GE	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+$(R(2),2)+"00"+(R(5),4)+&(W(1),4)+(W(2),*)+<t>+<c>
RV ASC2	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+"00"+$(R(2),4)+&(W(1),4)+&~(W(2),*)+<t>+<c>
RV MEM_R	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0101"+&(W(1),4)+&(W(2),*)+<t>+<c>
RV MEM_W	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0102"+&(W(1),4)+<t>+<c>
RV MEM_F	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0103"+&(W(1),4)+<t>+<c>
RV PAR_R1	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0201"+&(W(1),4)+&(W(2),4)+&(W(3),4)+&(W(4),4)+&(W(5),*)+<t>+<c>
RV PAR_R2	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0201"+&(W(1),4)+<t>+<c>
RV PAR_W	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0202"+&(W(1),4)+<t>+<c>
RV PRO_R	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+&(W(1),2)+"0503"+&(W(2),4)+(W(3),10)+&(W(8),4)+<t>+<c>
RV STS_R	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0601"+&(W(1),4)+&~(W(2),*)+<t>+<c>
RV TEST	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"0801"+&(W(1),4)+&~(W(2),*)+<t>+<c>
RV OPE_CMD	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+(*,2)+"3005"+&(W(1),4)+&~(W(2),*)+<t>+<c>
RV FINSERR	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+&(W(1),2)+"0503"+&(W(2),4)+<t>+<c>
RV COMFERR	STX	ETX	LRC (H parity)(0) (1Byte BIN)		$(R(1),2)	<h>+<a>+"00"+&(W(1),2)+<t>+<c>

●Normal or error message detection

In this guide, the normal or error message can be detected by the end code of the receive message in the protocol data.

●Receive message (RV PRO_R) (normal message)

[Settings]

<h>+<a>+"00"+&(W(1),2)+"0503"+&(W(2),4)+(W(3),10)+&(W(8),4)+<t>+<c>

(1) (2) (3) (4) (3) (5) (6) (7) (8) (9)

In the standard system protocol RV PRO_R, a CompoWay/F communications error is read and discarded by the code "(*,2)"; however, in the protocol data used in this guide, the end code from the Destination Device is converted and stored by the code "&(W(1),2)" as shown in (4), to detect whether there is an error or not.

●Message name (RV FINSERR) (error message)

[Settings] (FINS-mini protocol error detection)

<h>+<a>+"00"+&(W(1),2)+"0503"+&(W(2),4)+<t>+<c>

(1) (2) (3) (4) (3) (5) (8) (9)

●Message name (RV COMFERR) (error message)

[Settings] (CompoWay/F protocol error detection)

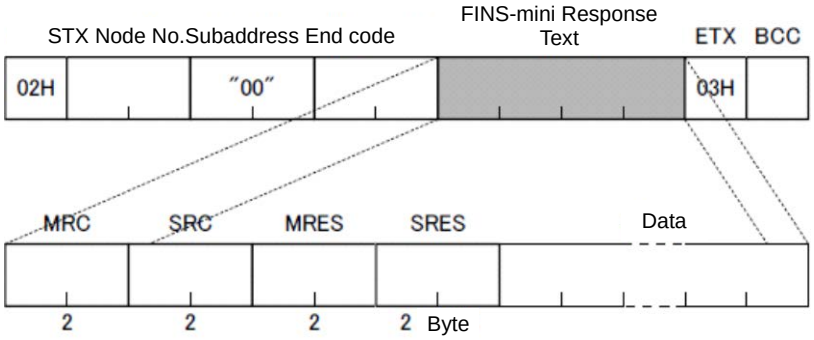
<h>+<a>+"00"+&(W(1),2)+<t>+<c>

(1) (2) (3) (4) (8) (9)

No.	Code	Description
(1)	<h > (Header)	Type: Code, Data: 02 hex
(2)	<a > (Address) $(R(1),2)	(R(1),2): Converts 2-byte data and compares the receive data with the word (first send word specified with the PMCR instruction operand + 1). $: Forward direction ASCII conversion (Converts the send message from hexadecimal code to ASCII code, and outputs the send data from the lower byte.)
(3)	“00”, “0503”	Constant ASCII
(4)	&(W(1),2)	(W(1),2): Converts 2-byte data and stores it in the word (first receive word specified with the PMCR instruction operand + 1). &: Forward direction hexadecimal conversion (Converts the receive message from ASCII code to hexadecimal code, and stores the receive data from the lower byte.)
(5)	&(W(2),4)	(W(2),4): Converts 4-byte data and stores it in the word (first receive word specified with the PMCR instruction operand + 2). &: Forward direction hexadecimal conversion (Converts the receive message from ASCII code to hexadecimal code, and stores the receive data from the rightmost byte.)
(6)	(W(3),10)	(W(3),10): Converts 10-byte data and stores it in the word (first receive word specified with the PMCR instruction operand +3).
(7)	&(W(8),4)	(W(8),4): Converts 4-byte data and stores it in the word (first receive word specified with the PMCR instruction operand + 8). &: Forward direction hexadecimal conversion (Converts the receive message from ASCII code to hexadecimal code, and stores the receive data from the rightmost byte.)
(8)	<t> (Terminator)	Type: Code, Data: 03 hex
(9)	<c> (Check code)	Type: LRC (horizontal parity) (0) (1-byte BIN) Setting range: RV PRO_R = 2 to 9 RV FINSERR=2 to 7 RV COMFERR=2 to 5

[Response frame of receive message]

This is the response frame of the receive message that is received by the SCU from the Destination Device.



Command	Number of bytes	Remarks
STX	1	Fixed: STX (This code indicates the beginning of the communications frame.)
Node number	2	Variable: Between 01 and 99 The unit number of the Destination Device that returns the response. 01 is set in the protocol data used in this guide.
Subaddress	2	Fixed: 00
End code	2	Destination Device error code[0] (CompoWay/F) (Refer to *9.8 Error Processing*.)
MRC *1	2	Returns the send command value. 05 is returned in the protocol data used in this guide. (Reads the properties of the Destination Device.)
SRC *1	2	Returns the send command value. 03 is returned in the protocol data used in this guide. (Reads the properties of the Destination Device.)
MRES *1	2	Destination Device error code [1] (FINS-mini) (Refer to *9.8 Error Processing*.)
SRES *1	2	Destination device error code [1] (FINS-mini) (Refer to *9.8 Error Processing*.)
Data *1 *2	From 0 onwards	Reads the model (fixed to 10 bytes) and communications buffer size with the "Properties Read" command.
ETX	1	Fixed: ETX (This code indicates the end of the text.)
BCC	1	Abbreviation of Block Check Character Stores the result of the BCC calculation from the node number up to ETX.

*1 If the CompoWay/F command cannot be executed, these commands are removed from the frame, and ETX is shifted next to End code. In this case, only the end code is returned.

*2 If the response does not use Data or if the specified FINS-mini command cannot be executed, Data is removed from the frame, and ETX is shifted next to SRES.

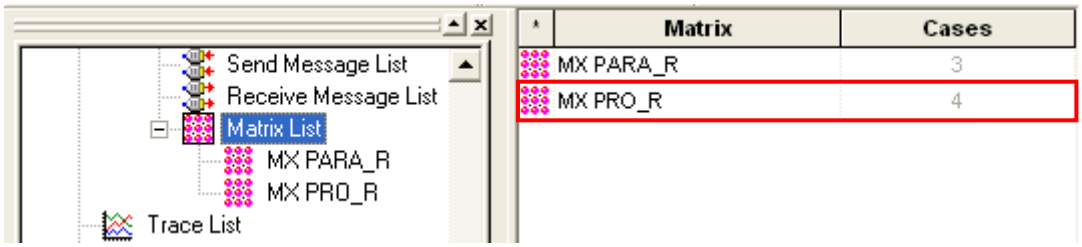
9.6.7. Matrix Settings

The matrix (MX PRO_R) that is set in this guide is described below.

Additional Information

For details on matrix settings, refer to *3-5 Creating Matrices* of the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

[Screenshot of the matrix setting]

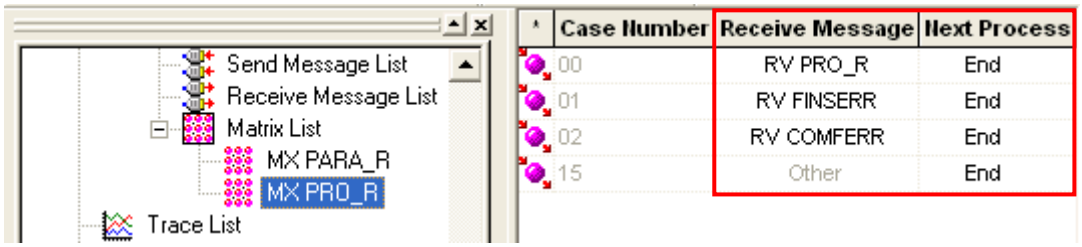


*The above screenshot shows that four cases are set in the matrix (MX PRO_R).

●Receive matrix (MX PRO_R)

The following shows that four cases (case No. 00, 01, 02 and 15) are set in the matrix (MX PRO_R).

[Screenshot of the case number setting]



[Settings]

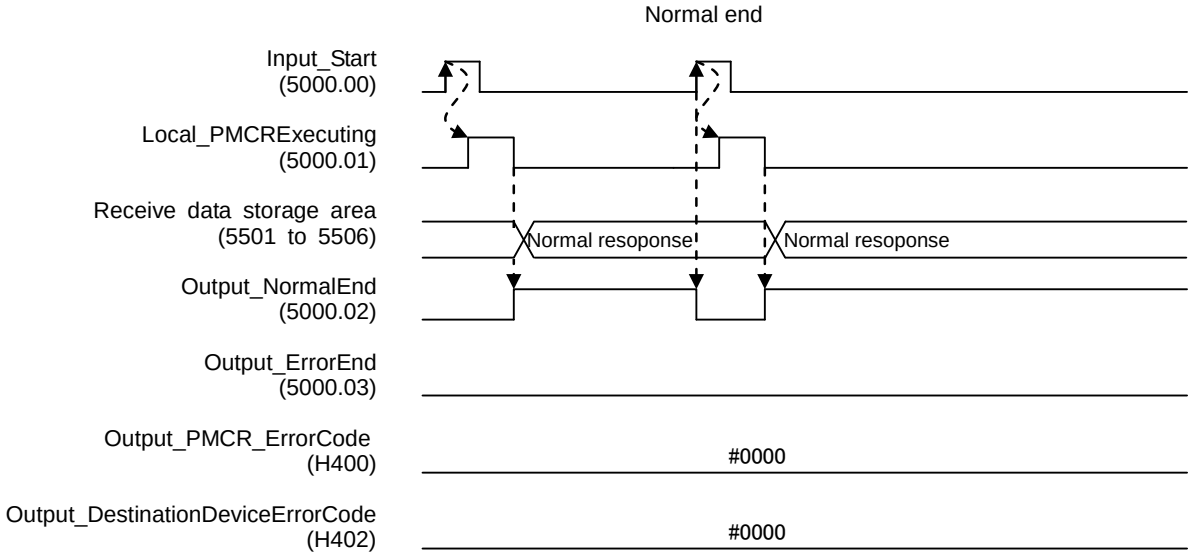
The table below shows the receive message and next process for each case number.

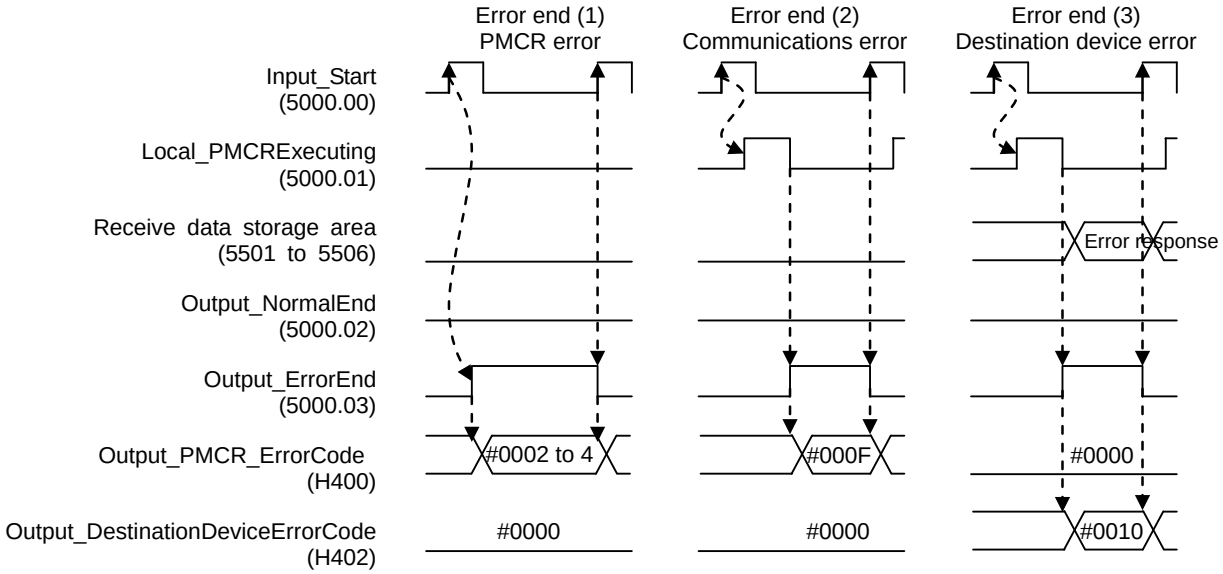
Case No.	Receive message	Next process
00	RV PRO_R	End
01	RV FINSERR	End
02	RV COMFERR	End
15	Other	End

An actually received message is compared with each of the following expected receive messages set in the matrix: "RV PRO_R" (normal message), "RV FINSERR" and "RV COMFERR" (error messages) and "Other" (other receive message) in that order.
If the actually received message is matched with either the normal or error message, control will be passed to the next process as required. If not matched, control will be passed to the next process designated with "Other". The ladder program checks the received result to detect an error in the Destination Device.

9.7. Timing Charts

The timing charts are shown below.





9.8. Error Processing

The errors that may occur during the program execution are described below.

9.8.1. Protocol Macro Error Codes

The SCU detects these errors by monitoring the macro operation.

The error codes include either (1) PMCR instruction error or (2) Communications error (e.g., transmission error), and are stored in H400 (*Output_PMCR_ErrorCode*).

[Error code list]

Error code	Name	Classification	Description
#0002	Sequence No. error	(1)PMCR instruction error	The sequence number specified for the PMCR instruction does not exist in the Unit.
#0003	Data read/write area exceeded error	(1)PMCR instruction error	When data is written or read to/from the CPU Unit, the specified area range is exceeded.
#0004	Protocol data syntax error	(1)PMCR instruction error	A code that cannot be executed occurs while the protocol macro is executed. (Example: A header occurs after a delimiter.)
#000F	Transmission error	(2)Communications error	Communications cannot perform due to an error in the transmission path.

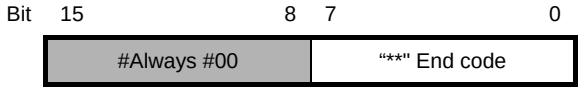
Additional Information

For details and troubleshooting on the protocol macro errors, refer to *12-3 Troubleshooting* of the *CJ Series Serial Communications Units OPERATION MANUAL* (Cat. No. W336).

9.8.2. Destination Device Error Codes

A Destination Device error is detected by monitoring communications of the Destination Device when the SCU sends a command. The error code of the CompoWay/F error is stored in H402 (*Output_DestinationDeviceErrorCode[0]*), and the error code of the Fins-mini error in the Destination Device is stored in H403 (*Output_DestinationDeviceErrorCode[1]*).

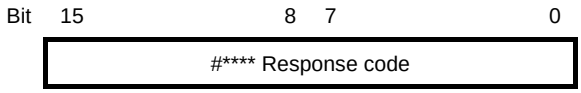
[Frame] ([H402])



[Error code list]

End code	Name	Description	Priority
00	Normal completion	The command ended normally without error.	None
0F	FINS command error	The specified FINS command could not be executed. The FINS response code should indicate why the command could not be executed.	8
10	Parity error	The sum total of bits whose received data is "1" does not match the set value of the "communications parity" bit.	2
11	Framing error	Stop bit is "0".	1
12	Overrun error	An attempt was made to transfer new data when the reception data buffer was already full.	3
13	BCC error	The calculated BCC value is different from the received BCC value.	5
14	Format error	-The command text contains characters other than 0 to 9, and A to F. -There was no SID and command text, or there was no command text. -"MRC/SRC" not included in command text.	7
16	Subaddress error	-Illegal (unsupported) subaddress -There was no subaddress, SID and command text. -Subaddress was less than two characters, and there was no SID and command text	6
18	Frame length error	The received frame exceeds the specified (supported) number of bytes.	4

[Frame] ([H403])



[Response code list]

Response code	Error name	Priority
0000	Normal completion	None
0401	Unsupported command	1
1001	Command too long	2
1002	Command too short	3
1101	Area type error	4
1103	Start address out-of-range error	5
1104	End address out-of-range error	6
1003	Number of elements/data mismatch	7
110B	Response too long	8
1100	Parameter error	9
3003	Read-only error	10
2203	Operation error	11

Additional Information

For details on the Destination Device errors and troubleshooting, refer to the *Digital Temperature Controllers User's Manual* (Cat. No. H224/H174/H185) and the *Digital Temperature Controllers Communications Manual* (Cat. No. H225/H175/H186).

10. Revision History

Revision code	Date of revision	Description of revision
01	June 2018	First edition

OMRON Corporation **Industrial Automation Company**
Tokyo, JAPAN
Contact: www.ia.omron.com

Regional Headquarters
OMRON EUROPE B.V.
Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON ASIA PACIFIC PTE. LTD.
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

Authorized Distributor:

Cat. No. P704-E1-01 0618-(0618)