


Programmable Controller CJ-series

# General-purpose Serial Connection Guide (RS-232C)

## SHIMADZU CORPORATION

Shimadzu Analytical Balance /  
Electronic Balance  
(ATX-R/ATY-R/UPX/UPY/UW/UX Series)

A teal-colored rectangular box with a thin white border. Inside the box, the words "Network", "Connection", and "Guide" are stacked vertically in a white, sans-serif font.

Network  
Connection  
Guide

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## 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 provided by SHIMADZU CORPORATION (hereinafter referred to as "SHIMADZU") and OMRON Corporation (hereinafter referred to as "OMRON"), which pertain to this guide.

Manufacturer	Cat. No.	Model	Manual name
OMRON	W472	CJ2M-CPU□□ CJ2H-CPU6□ CJ2H-CPU6□-EIP	CJ Series CJ2 CPU Unit Hardware USER'S MANUAL
OMRON	W473	CJ2M-CPU□□ CJ2H-CPU6□ CJ2H-CPU6□-EIP	CJ Series CJ2 CPU Unit Software USER'S MANUAL
OMRON	W336	CJ1W-SCU□1-V1 CJ1W-SCU□2	CJ Series Serial Communications Units OPERATION MANUAL
OMRON	W474	CJ2□-CPU□□	CJ Series Programmable Controllers INSTRUCTIONS REFERENCE MANUAL
OMRON	W446	CXONE-AL□□C-V4 / AL□□D-V4	CX-Programmer OPERATION MANUAL
OMRON	W344	CXONE-AL□□C-V4 / AL□□D-V4	CX-Protocol OPERATION MANUAL
SHIMADZU	321-78327	ATX-R series ATY-R series	Analytical Balance Instruction Manual
SHIMADZU	321-78282	UPX series UPY series	Top-loading Balance Instruction Manual
SHIMADZU	321-78048	UW series UX series	Electronic Balance Instruction Manual

## 2. Terms and Definitions

The terms and definitions used in this guide are given below.

Term	Explanation and Definition
protocol macro	Data transfer procedures (protocols) with general-purpose external devices are created and stored in Serial Communications Boards or Serial Communications Units. These protocols enable data to be exchanged with general-purpose external devices by executing the protocol macro instruction (hereinafter referred to as "the PMCR instruction") in a CPU Unit.
protocol	A set of rules governing the data transmission procedure that unifies independent communication processes for a specific general-purpose device. A protocol consists of more than one sequence.
sequence	An independent process that can be performed by executing the PMCR instruction in a program. The sequence started by the instruction executes its steps in a given order.
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 created per sequence.
send message	A communication frame (command) sent to a general-purpose external device. The send message is invoked by steps in the sequence and is sent to general-purpose external devices.
receive message	A communication frame (response) sent from a general-purpose external device. The receive message is invoked by steps in the sequence and is compared with data received from general-purpose external devices.
receive matrix	A function to register and use some communication frames (responses) when more than one communication frame is expected to be received from a general-purpose external device. The receive processing can be executed according to registered communication frames by using this function.

### 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 November 2019. 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 SHIMADZU Analytical Balance ATX-R/ATY-R series or Electronic Balance UPX/UPY/UW/UX series (hereinafter collectively referred to as the "Balance") to an OMRON CJ-series Programmable Controller + Serial Communications Unit (hereinafter referred to as the "PLC") via serial communications and for checking their serial communication connection.

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

This guide uses the pre-configured program (ladder program in the CX-Programmer project file and the protocol data in the CX-Protocol project file) in order to check the serial communication connection by sending a message of "single output with stability information" to and receiving a response from the Balance.

Sending "single output with stability information" and receiving a response

PLC	Serial communications (RS-232C)	Balance
Sends command data	Command data →	Executes the command
Receives response data and stores in memory	← Response data	Returns response data

Contact OMRON to obtain latest versions of the CX-Programmer and CX-Protocol project files before proceeding.

Name	File name	Version
CX-Programmer project file (extension: cxp)	P732_CJ_PMCR232C_SHIMADZU_E-Balance_V100.cxp	Ver.1.00
CX-Protocol project file (extension: psw)	P732_CJ_PMCR_SHIMADZU_E-Balance_V100.psw	Ver.1.00

### Caution

This guide aims to explain wiring methods, communications settings and setting procedures necessary to connect the devices used in this guide. 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 established normally. Both functionality and performance are therefore not fully considered for the program.

When you build a system, please use the wiring methods, communications settings and setting procedures described in this guide as references, 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
SHIMADZU	Analytical Balance	ATX-R series ATY-R series
SHIMADZU	Electronic Balance	UPX series UPY series UW series UX series



#### 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 those 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.



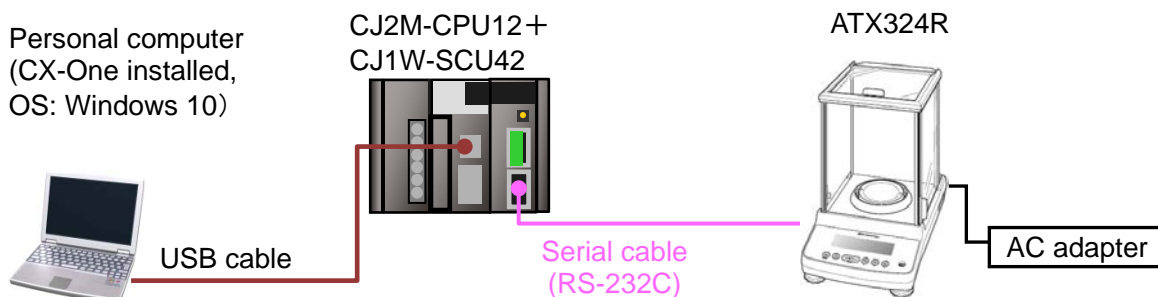
#### Additional Information

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 the manufacturers.



## 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	(provided in CX-One package)	Ver.9.71
OMRON	CX-Protocol	(provided in CX-One package)	Ver.2.01
OMRON	CX-Programmer project file	P732_CJ_PMCR232C_SHIMADZU_E-Balance_V100.cxp	Ver.1.00
OMRON	CX-Protocol project file	P732_CJ_PMCR_SHIMADZU_E-Balance_V100.psw	Ver.1.00
—	Personal computer (OS: Windows 10)	—	
—	USB cable (USB 2.0-compliant, USB-B connector)	—	
—	Serial cable (RS-232C)	—	
SHIMADZU	Balance	ATX324R	
SHIMADZU	AC Adapter	(supplied with the Balance)	



### Precautions for Correct Use

Contact OMRON to obtain latest versions of the CX-Programmer and CX-Protocol project files before proceeding.



### Precautions for Correct Use

Update CX-Programmer and CX-Protocol to the versions specified above 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).



### **Additional Information**

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

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### **Additional Information**

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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).

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## 6. Serial Communications Settings

This section describes the parameters and cable wiring that are used in this guide.

### 6.1. Parameters

The following parameters are required to connect the Balance and the PLC via serial communications.

#### ATX-R/ATY-R series

Item	PLC (Serial Communications Unit)	ATX-R/ATY-R series
Unit number	0	—
Communications port (communications type)	Port 2 (RS-232C)	—
Serial communications mode	Protocol macro	—
Communication specifications	—	MODE.2 (standard settings 2) <sup>*1</sup>
Data (bit) length	8 bits	8 (fixed)
Stop bit (length)	1 bit	1 (fixed)
Parity	None	None (fixed)
Baud rate (communication speed)	1200 bps	1200 bps (fixed)
Protocol macro transmission method (Full-duplex / Half-duplex)	Full-duplex	—
Handshake	—	Hardware
Data format	—	Shimadzu standard (fixed)
Delimiter	—	CR (fixed)

<sup>\*1</sup>When setting the communication specifications to "MODE.2" (standard settings 2), the following items are all set at once: data (bit) length, stop bit (length), parity, baud rate (communication speed), handshake and data format. For details on the communication settings, refer to 10 CONNECTION AND COMMUNICATION of the *Analytical Balance Instruction Manual* (321-78327).

#### UPX/UPY/UW/UX series

Item	PLC (Serial Communications Unit)	UPX/UPY/UW/UX series
Unit number	0	—
Communications port (communications type)	Port 2 (RS-232C)	—
Serial communications mode	Protocol macro	—
Data (bit) length	8 bits	8 (default)
Stop bit (length)	1 bit	1 (default)
Parity	None	None (default)
Baud rate (communication speed)	1200 bps	1200 bps (default)
Protocol macro transmission method (Full-duplex / Half-duplex)	Full-duplex	—
Handshake	—	OFF
Data format	—	EB type (default)
Delimiter	—	CR (default)



#### Precautions for Correct Use

The following Serial Communications Unit, unit number and communications (connection) port are assumed to be used in this guide.

Model: CJ1W-SCU42, Unit number: 0, Communications (connection) port: Port 2

If you connect the devices under different conditions, change the CIO area and control data of the PMCR instruction by referring to 9. Program.

## 6.2. Cable Wiring

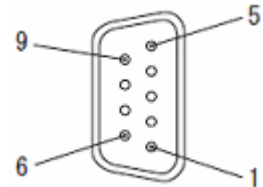
For details on cable wiring, refer to *SECTION 3 Installation and Wiring* of the *CJ Series Serial Communications Units OPERATION MANUAL* (Cat. No. W336).

Check the shapes and pin layouts of the connectors before wiring.

Shape and pin layout of the connector

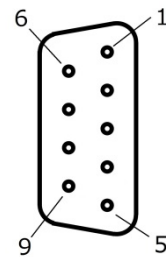
Serial Communications Unit (CJ1W-SCU42) applicable connector: D-SUB 9-pin female

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

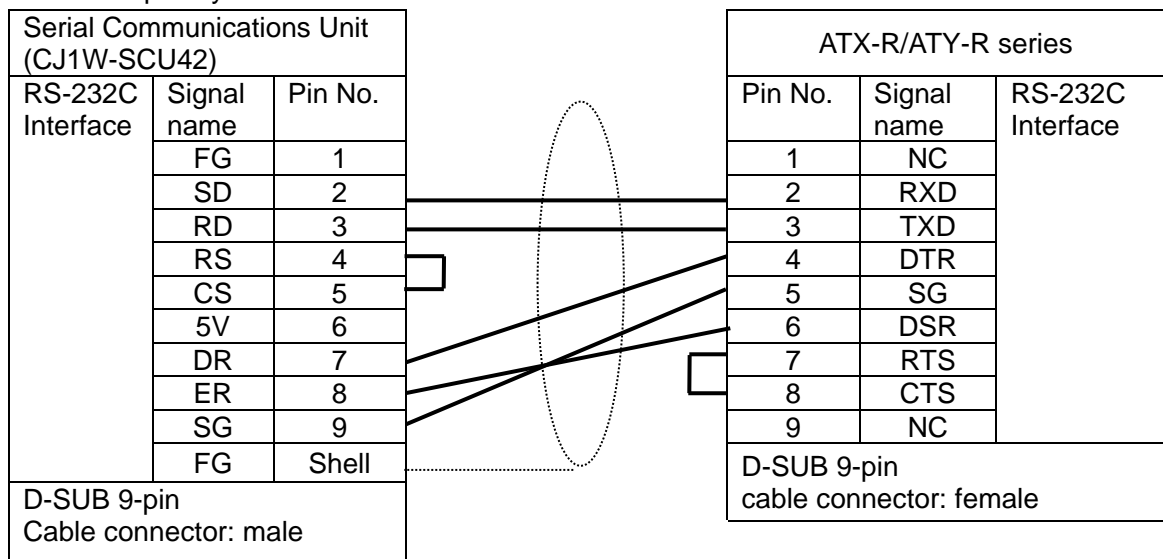


ATX-R/ATY-R series applicable connector: D-SUB 9-pin male

Use	Pin No.	Abbreviation	Signal name
RS-232C	1	—	—
	2	RXD	Data input
	3	TXD	Data output
	4	DTR	Handshake (send)
	5	SG	Signal ground
	6	DSR	Handshake (receive)
	7	RTS	Request to send (RS-232C)
	8	CTS	Clear to send (RS-232C)
	9	—	—

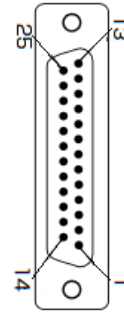


Cable and pin layout

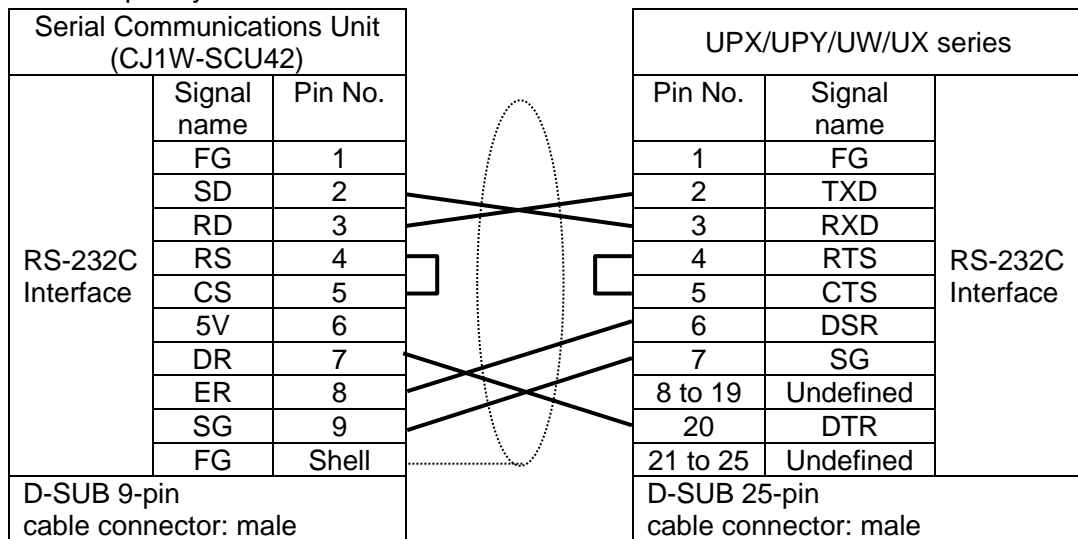


UPX/UPY/UW/UX series applicable connector: D-SUB 25-pin female

Use	Pin No.	Terminal name	Function
RS-232C	1	FG	Protective ground or earth
	2	TXD	Data output
	3	RXD	Data input
	4	RTS	Internal connection to CTS
	5	CTS	Internal connection to RTS
	6	DSR	Handshake (receive)
	7	SG	Signal ground
	8 to 19	Undefined	—
	20	DTR	Handshake (send)
	21 to 25	Undefined	—



Cable and pin layout



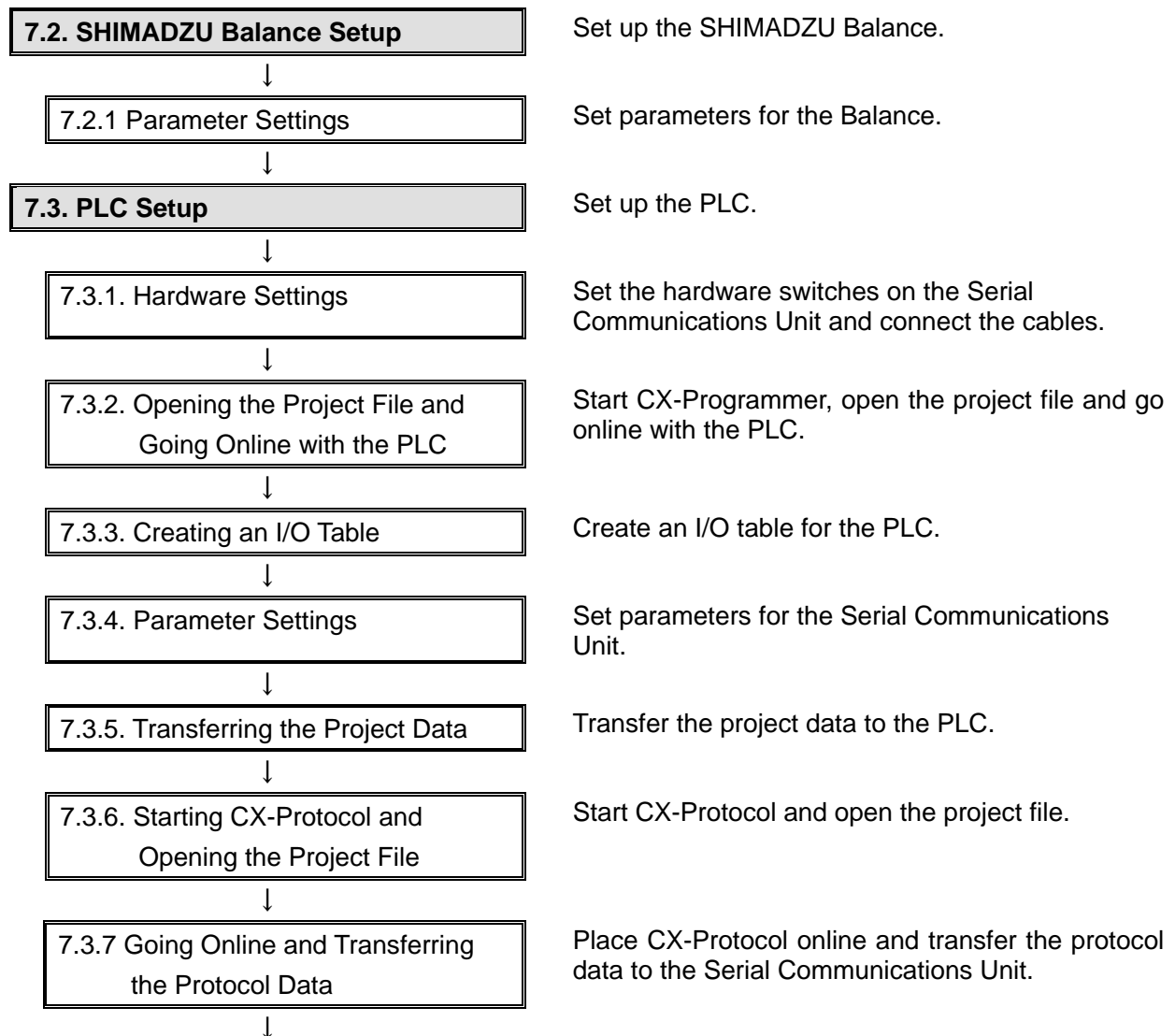
## 7. Serial Communications Connection Procedure

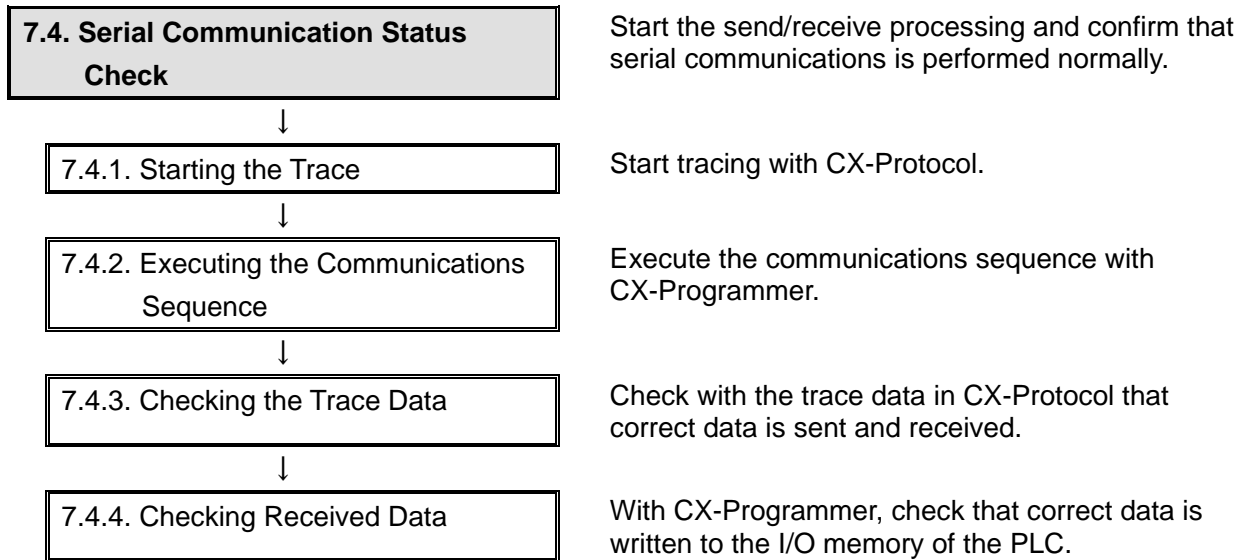
This section describes the procedures for connecting the Balance and the PLC via serial communications. The procedures for setting up the Balance and the PLC in this guide are based on the factory default settings.

For information on initialization, refer to *Section 8. Initialization Method*.

### 7.1. Work Flow

Take the following steps to connect the Balance and the PLC via serial communications and send and receive a message.





## 7.2. SHIMADZU Balance Setup

Set up the SHIMADZU Balance.

### 7.2.1. Parameter Settings

Set parameters for the Balance.

The parameter settings vary depending on the model used.

Use one of the following parameter setting procedures appropriate for your Balance's model.

Model	Procedure to be followed
ATX-R/ATY-R series	1) Parameter settings for ATX-R/ATY-R series
UPX/UPY/UW/UX series	2) Parameter settings for UPX/UPY/UW/UX series

#### 1) Parameter settings for ATX-R/ATY-R series

Set parameters for ATX-R/ATY-R series.



### Precautions for Correct Use

Make sure the power supply is OFF before setting up.

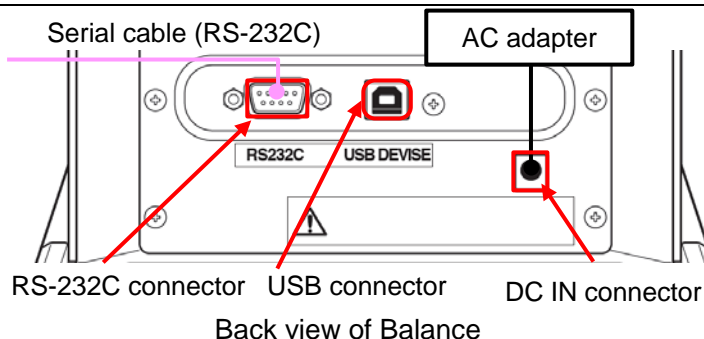
If it is ON, the settings described in the following steps and subsequent procedures may not be applicable.

- 1 Make sure AC Adapter is powered OFF.

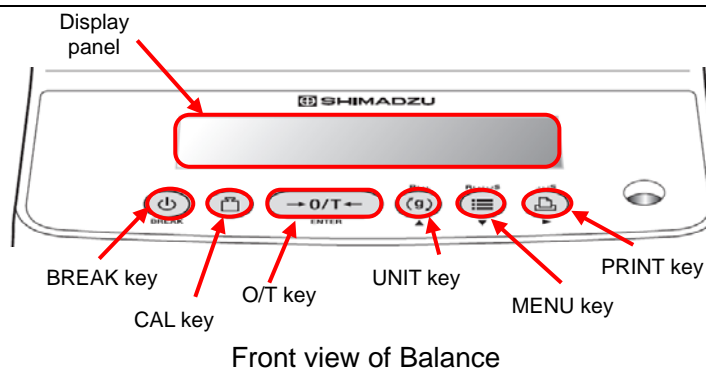
- 2 Check the position of the connectors on Balance.

Connect a Serial cable (RS-232C) to RS-232C connector.

Connect AC Adapter to DC IN connector.





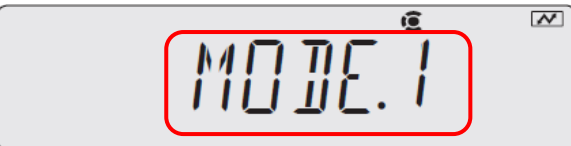

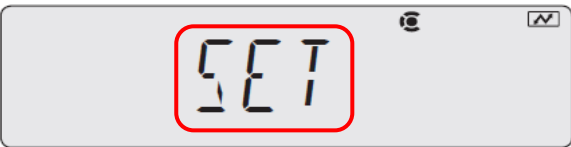



- 3 Check the position of the operation keys by referring to the figure on the right.


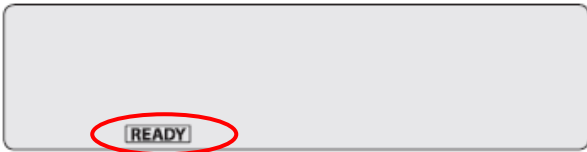


- 4 Turn ON AC Adapter.



5	Display panel shows "OFF". Press <b>BREAK</b> key.	
6	Display panel shows gram units. Press and hold <b>PRINT</b> key for about 3 seconds.	
7	Display panel shows "APL.PRN". Press <b>MENU</b> key once.	
	Display panel shows "COMM.SET". Press <b>PRINT</b> key once.	
	Display panel shows "MODE.1". Press <b>UNIT</b> key once.	
	Display panel shows "MODE.2". Press <b>O/T</b> key once.	
	*In this guide, the communication specifications of Balance are set to "MODE.2" (standard settings 2), in order to send command data from PLC to Balance and check response data received from Balance.	
	Check that Display panel shows "SET".	
	Once the setting is confirmed, Display panel shows "MODE.2". Press and hold <b>BREAK</b> key for about 3 seconds.	
	*For more information on the menu operations, refer to 10 CONNECTION AND COMMUNICATION WITH PERIPHERAL DEVICES of the Analytical Balance Instruction Manual (321-78327).	

## 7. Serial Communications Connection Procedure

8	Display panel shows gram units. Press <b>BREAK</b> key.	
9	Display panel shows "READY".  *Balance is in the standby mode.	
10	Turn OFF AC Adapter.	

### 2) Parameter settings for UPX/UPY/UW/UX series

Set parameters for UPX/UPY/UW/UX series.



#### Precautions for Correct Use

Make sure the power supply is OFF before setting up.

If it is ON, the settings described in the following steps and subsequent procedures may not be applicable.


1	Make sure AC Adapter is powered OFF.
2	<p>Check the position of the connectors on Balance.</p> <p>Connect a Serial cable (RS-232C) to RS-232C connector.</p> <p>Connect AC Adapter to DC IN connector.</p> <div data-bbox="716 607 1434 1077"> <p>Serial cable (RS-232C)</p> <p>AC adapter</p> <p>KEY connector</p> <p>RS-232C connector</p> <p>DATA I/O connector</p> <p>AUX connector</p> <p>DC IN connector</p> <p>Back view of Balance</p> </div>
3	<p>Check the position of the operation keys by referring to the figure on the right.</p> <div data-bbox="716 1077 1434 1422"> <p>Display panel</p> <p>POWER key</p> <p>CAL key</p> <p>O/T key</p> <p>UNIT key</p> <p>PRINT key</p> <p>Front view of UPX/UPY series</p> </div> <div data-bbox="716 1467 1434 1870"> <p>Display panel</p> <p>POWER key</p> <p>CAL key</p> <p>O/T key</p> <p>UNIT key</p> <p>PRINT key</p> <p>Front view of UW/UX series</p> </div>
4	Turn ON AC Adapter.

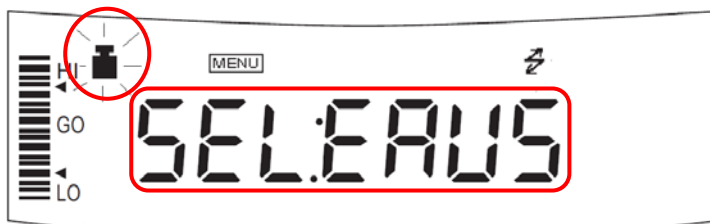
- 5 Display panel shows "OFF".  
Press **POWER** key.




- 6 Display panel shows gram units.  
Press **CAL** key on UPX/UPY series twice or on UW/UX series three times.




- 7 Display panel shows "SEL:EAUS".  
Check that  is blinking.  
Press **CAL** key six times.




\*The blinking of  indicates the menu group 1.

\*Press **CAL** key to move to the next menu group.  
The analog display blinks.




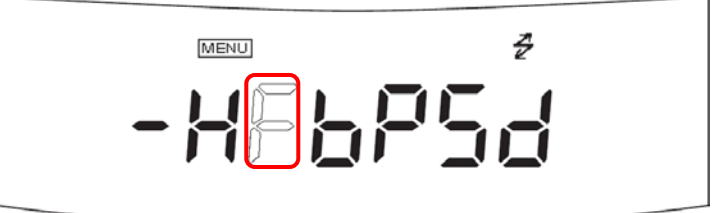

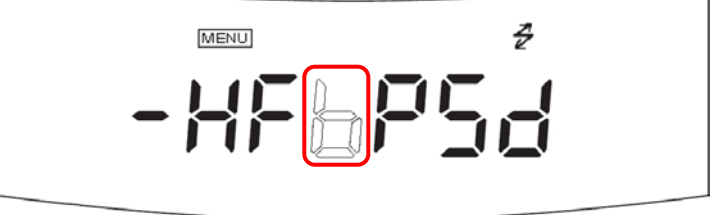


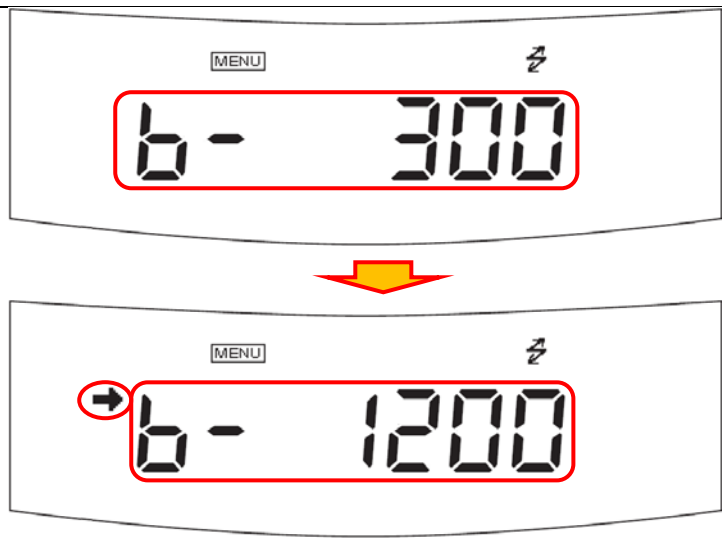
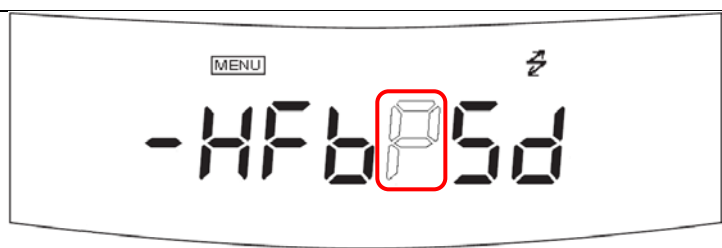
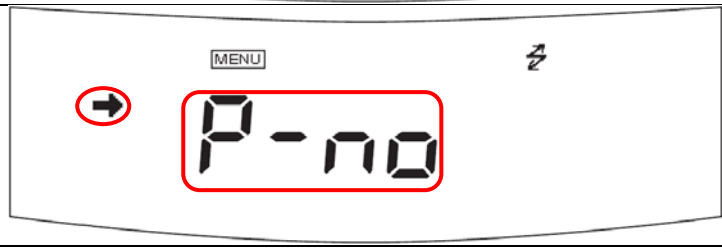

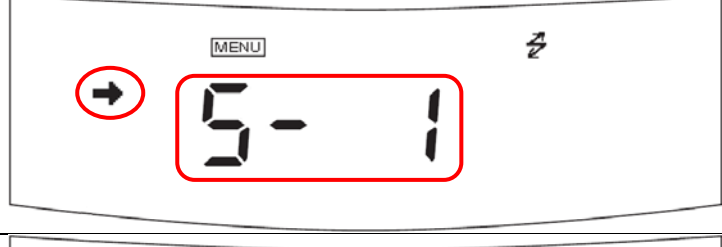

Check that  is blinking.  
Press **O/T** key.  
Set the communication specifications by following the next steps.

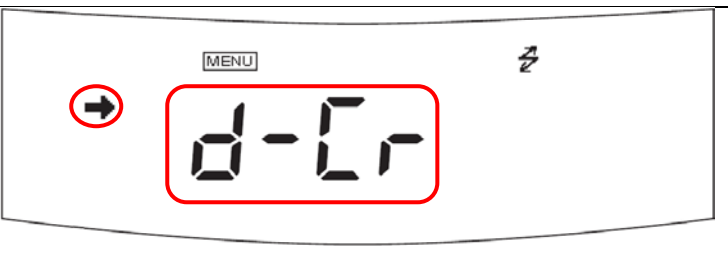




\*The blinking of  indicates the menu group 7 (communication with computer and external devices).

\*For more information on the menu operations, refer to *Appendices* of the *Top-loading Balance Instruction Manual* (321-78282) and *Electronic Balance Instruction Manual* (321-78048).

8	<p>Set handshake as follows. Display panel shows "-HFbPSd". Check that "H" is blinking. Press <b>O/T</b> key.</p>	
9	<p>Display panel shows "H-oFF". Press <b>O/T</b> key.</p> <p>*It allows you to set handshake to OFF.</p>	
10	<p>Check that the stability mark "→" is displayed to the left of "H-oFF". Press <b>POWER</b> key.</p> <p>*The handshake is set to OFF.</p>	
11	<p>Display panel shows "-HFbPSd". Press <b>CAL</b> key.</p> <p>Check that "F" is blinking. Press <b>O/T</b> key.</p>	
12	<p>Check that the stability mark "→" is displayed to the left of "F-Eb". Press <b>POWER</b> key.</p> <p>*The data format is set to EB type.</p>	
13	<p>Display panel shows "-HFbPSd". Press <b>CAL</b> key.</p> <p>Check that "b" is blinking. Press <b>O/T</b> key.</p>	

<p>14</p>	<p>Display panel shows "b-300". Press <b>CAL</b> key twice.</p> <p>Check that the stability mark "→" is displayed to the left of "b-1200". Press <b>POWER</b> key.</p> <p>*The baud rate (communication speed) is set to 1200 (bps).</p>	
<p>15</p>	<p>Display panel shows "-HFbPSd". Press <b>CAL</b> key.</p> <p>Check that "P" is blinking. Press <b>O/T</b> key.</p>	
<p>16</p>	<p>Check that the stability mark "→" is displayed to the left of "P-no". Press <b>POWER</b> key.</p> <p>*The parity (bit length) is set to none (8 bits).</p>	
<p>17</p>	<p>Display panel shows "-HFbPSd". Press <b>CAL</b> key.</p> <p>Check that "S" is blinking. Press <b>O/T</b> key.</p>	
<p>18</p>	<p>Check that the stability mark "→" is displayed to the left of "S-1". Press <b>POWER</b> key.</p> <p>*The stop bit is set to 1 bit.</p>	
<p>19</p>	<p>Display panel shows "-HFbPSd". Press <b>CAL</b> key.</p> <p>Check that "d" is blinking. Press <b>O/T</b> key.</p>	

20	<p>Check that the stability mark "→" is displayed to the left of "d-Cr". Press and hold <b>POWER</b> key for about 3 seconds.</p> <p>*The delimiter is set to CR.</p>	
21	<p>Display panel shows gram units. Press <b>POWER</b> key.</p>	
22	<p>Display panel shows "STAND-BY".</p>	
23	<p>Turn OFF AC Adapter.</p>	

## 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.



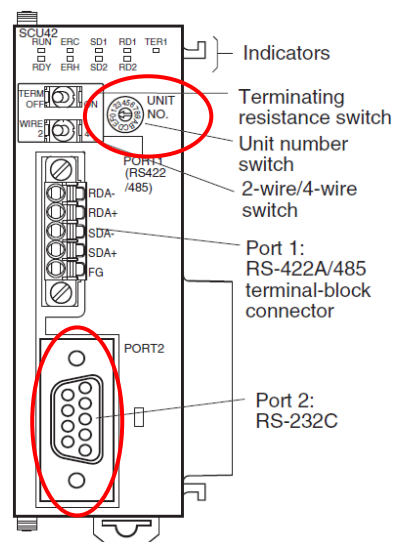
#### Precautions for Correct Use

Make sure the power supply is OFF before setting up.

If it is ON, the settings described in the following steps and subsequent procedures may not be applicable.

1 Make sure PLC is powered OFF.

2 Check the positions of the hardware switches and Port 2 on the front panel of Serial Communications Unit by referring to the figure on the right.



3 Set Unit number switch to 0.

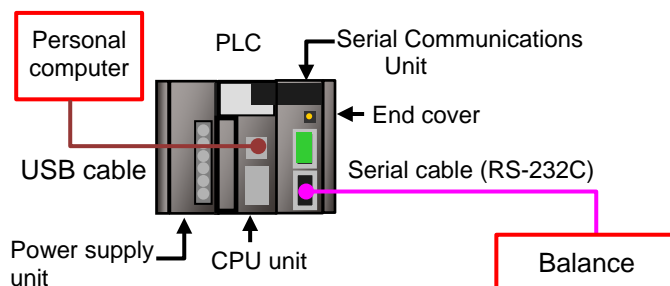
\*The factory default value of the unit number is 0.



4 Connect Serial Communications Unit to PLC as shown on the right.

Connect Balance and Port 2 on Serial Communications Unit with the serial cable (RS-232C).

Connect Personal computer and PLC with a USB cable.


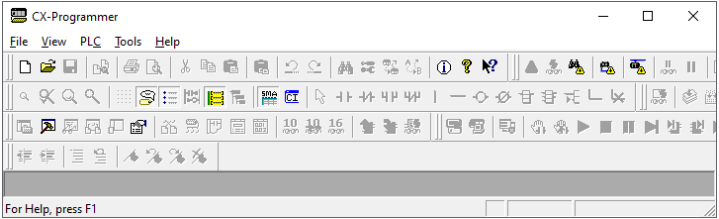
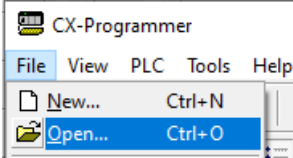
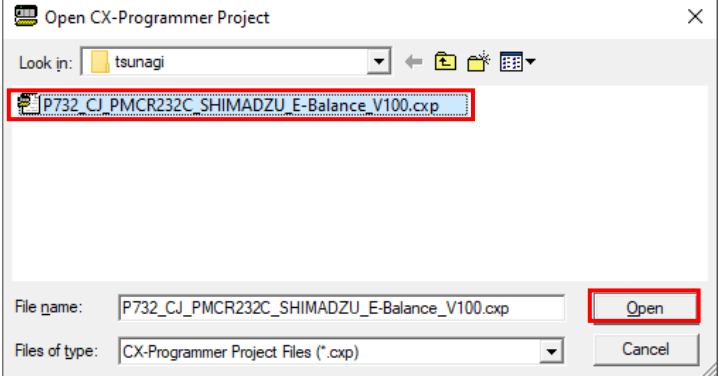
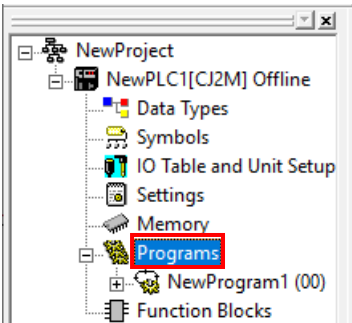




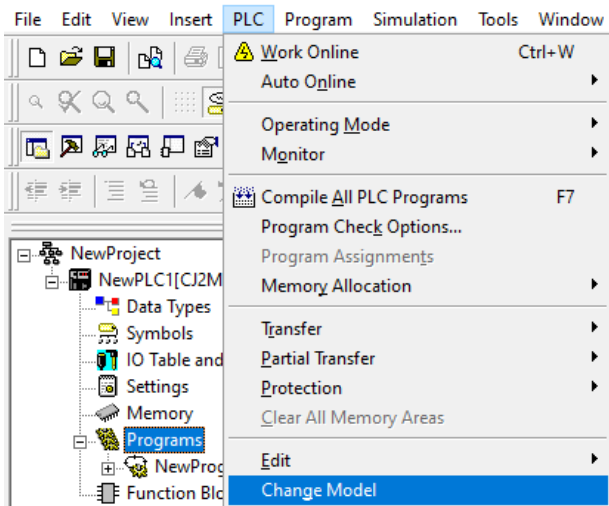
### 7.3.2. Opening the Project File and Going Online with the PLC

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

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

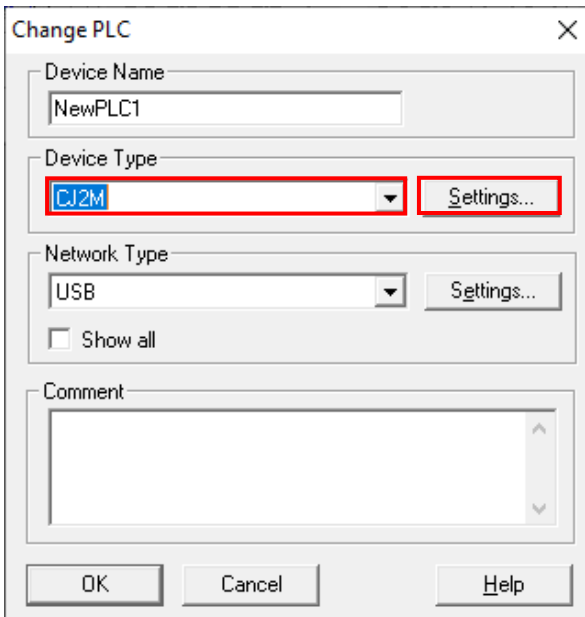
1	Turn ON PLC and AC Adapter on Balance.	
2	Start CX-Programmer.  *If the User Account Control Dialog Box is displayed at start, make a selection to start CX-Programmer.	
3	CX-Programmer starts up.	
4	Select <b>Open</b> from the File Menu.	
5	The Open CX-Programmer Project Dialog Box is displayed. Select <i>P732_CJ_PMCR232C_SHIMADZU_E-Balance_V100.cxp</i> and click <b>Open</b> .  *Obtain the project file from OMRON.	
6	After you open the project file, select <b>Programs</b> in the project workspace.	

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



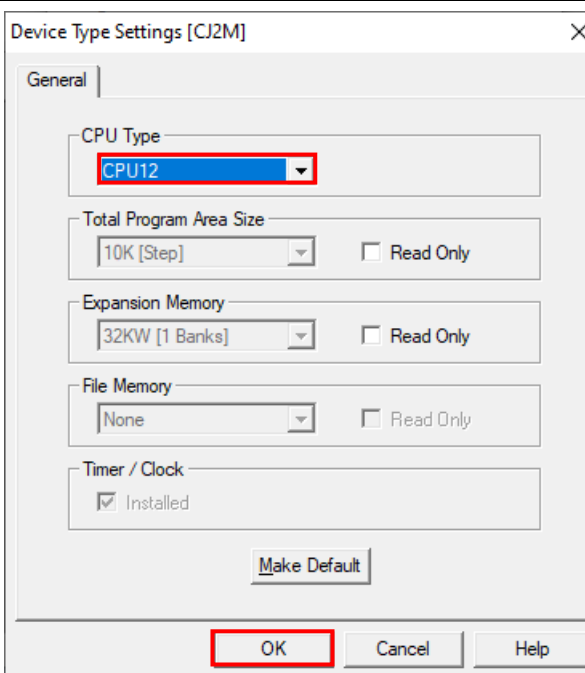
- 8 The Change PLC Dialog Box is displayed. Select the device type of PLC from the pull-down list in the *Device Type* Field. Click **Settings**.

\*CJ2M is selected in this guide.



- 9 The Device Type Settings Dialog Box is displayed. Select the CPU type from the pull-down list in the *CPU Type* Field. Click **OK**.

\*CPU12 is selected in this guide.

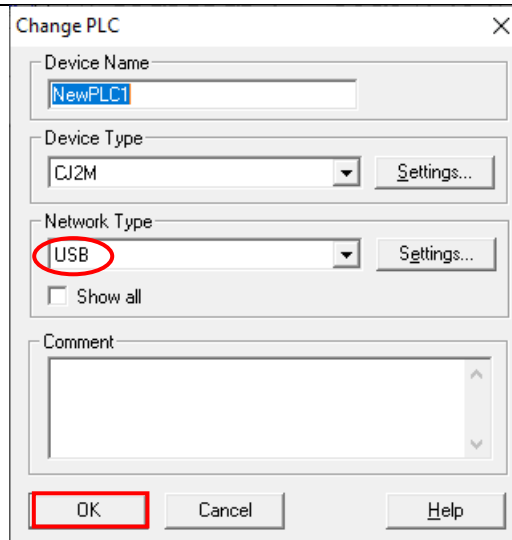


- 10 Check that the network type is set to USB in the Change PLC Dialog Box. Click **OK**.

\*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 the program is converted normally. ("0 errors" must be shown.)

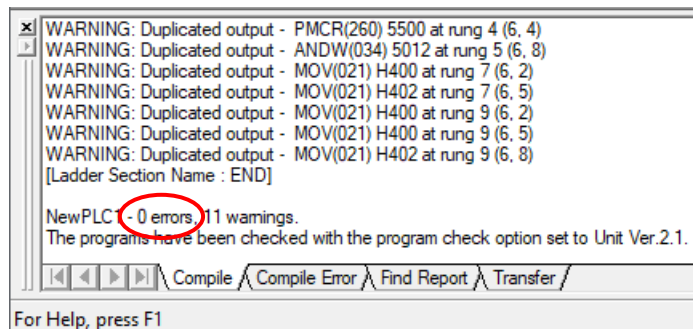
(Although the duplicated output warnings are detected as shown on the right, they are not problems.)



The program(s) and the PLC Settings need to be converted for the new PLC type. Since the behaviour of the program(s) and the PLC Settings may change after conversion, please confirm the program and the PLC Settings functionality before downloading. Do you wish to continue?

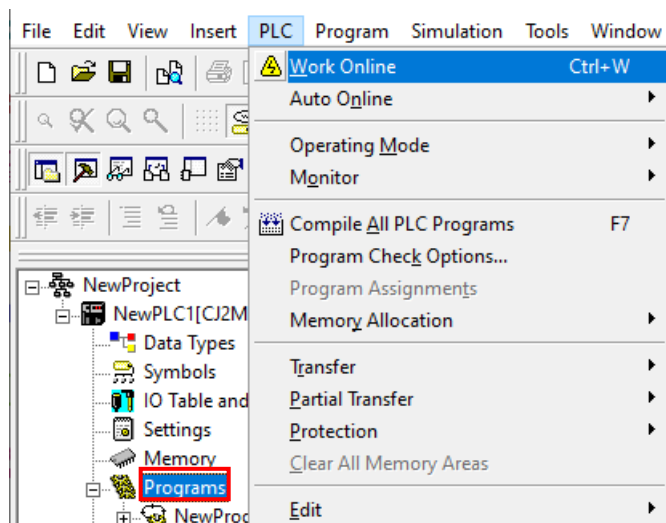
**Yes**

No

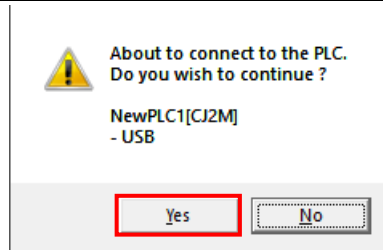


- 11 Select **Programs** in the project workspace.

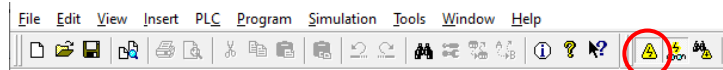
Select **Work Online** from the PLC Menu.




- 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 6, check the settings such as the connection type described in steps 7 through to 9 and then try online again.

For more information, 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. Refer to *Options and Preferences* in *CHAPTER 3 Project Reference* of the *CX-Programmer OPERATION MANUAL* (Cat. No. W446) for information on the environmental settings.

The procedures in this guide assume that "Confirm all operations affecting the PLC" is selected.

## 7.3.3. Creating an I/O Table

Create an I/O table for the PLC.

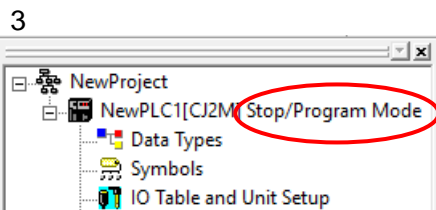
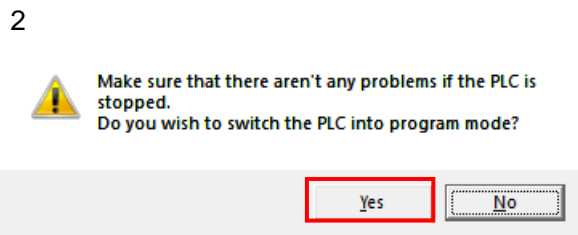
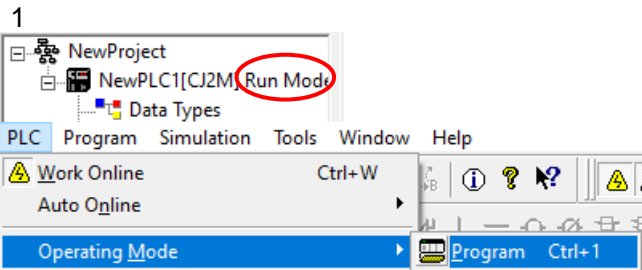
- 1 If the operating mode of PLC is Run Mode or Monitor Mode, change it to Program Mode by following the steps below.

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.

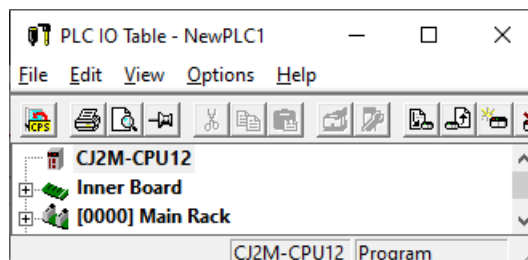
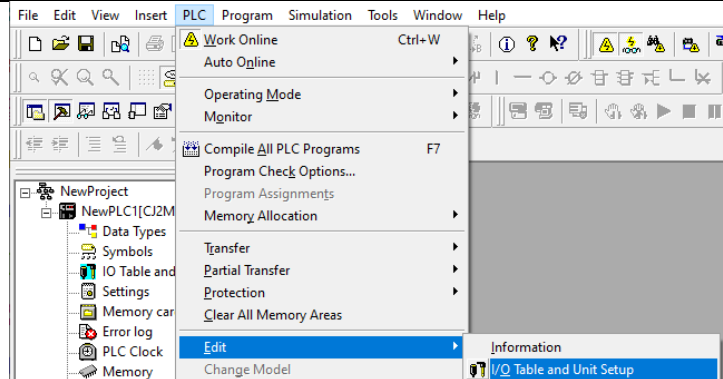
3. Check that Stop/Program Mode is displayed to the right of the PLC model in the project workspace.



(project workspace)

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

The PLC IO Table Window is displayed.





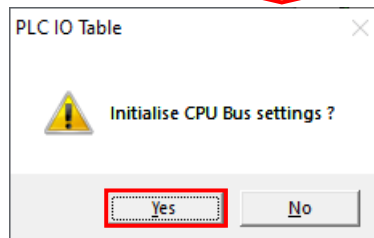
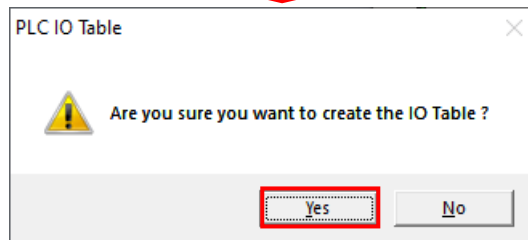
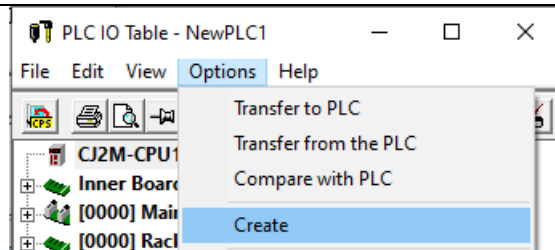
### Precautions for Correct Use

The PLC will be reset after creating and transferring an I/O table in steps 3 and 4.  
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 complete, the Transfer Results Dialog Box is displayed.

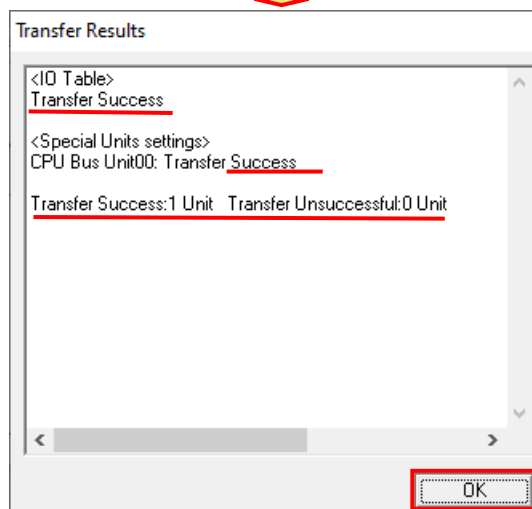
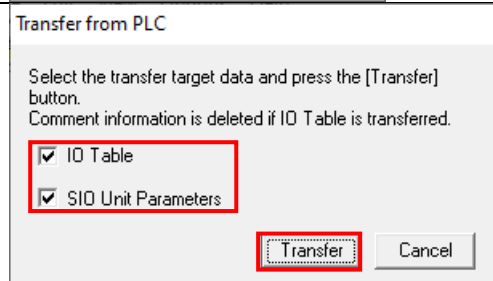
Check that the transfer is succeeded by referring to the message in the dialog box.

When an I/O table is created successfully, the dialog box displays as follows:

Transfer Success: 1 Unit

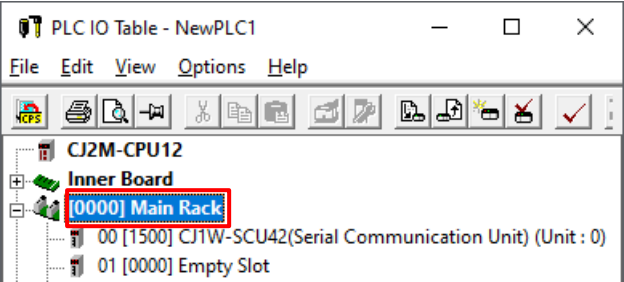
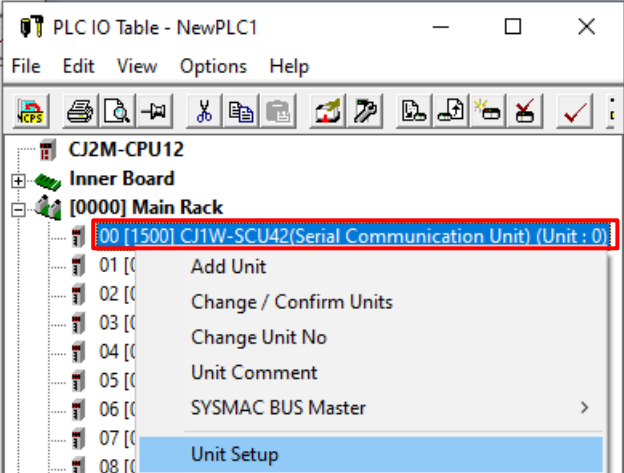
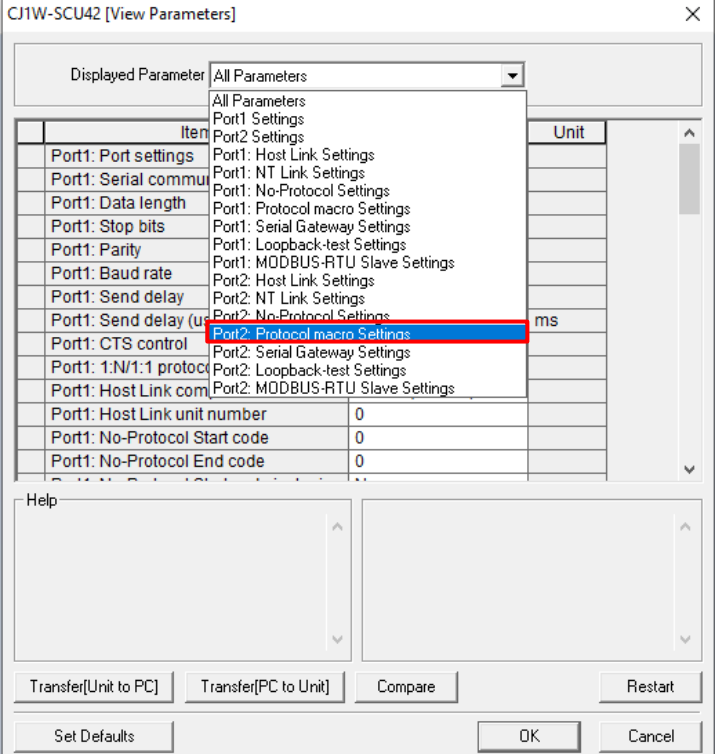
Transfer Unsuccessful: 0 Unit

Click **OK**.



## 7.3.4. Parameter Settings

Set parameters for the Serial Communications Unit.

<p>1</p>	<p>Double-click <b>[0000] Main Rack</b> in the PLC IO Table Window to expand the tree.</p>	
<p>2</p>	<p>Right-click <b>00 [1500] CJ1W-SCU42</b> and select <b>Unit Setup</b> from the menu.</p>	
<p>3</p>	<p>The View Parameters Dialog Box is displayed. Select <b>Port2: Protocol macro Settings</b> from the pull-down list in the <i>Displayed Parameter</i> Field.</p> <p>*The parameters are set assuming that Port 2 of Serial Communications Unit is used.</p>	

- 4 The setting items of "Port2: Protocol macro Settings" are listed as shown in the figure on the right.  
(The figure shows the default values.)

Item	Set Value	Unit
Port2: Port settings	Defaults	
Port2: Serial communications mode	Host Link(default)	
Port2: Data length	7 bits	
Port2: Stop bits	2 bits	
Port2: Parity	Even	
Port2: Baud rate	Default(9600bps)	
Port2: Serial Gateway Response timeo	0	ms
Port2: Serial Gateway send start timeo	0	ms
Port2: Protocol macro Transmission m	Half-duplex	
Port2: Clearing/holding the contents of	Clear	
Port2: Link word specification data exc	On-request I/O refre	
Port2: Maximum number of bytes in pro	0	Byte

Buttons: Transfer[Unit to PC], Transfer[PC to Unit], Compare, Restart, Set Defaults, OK, Cancel.

- 5 Select **User settings** from the pull-down list in the *Port2: Port settings* Field.

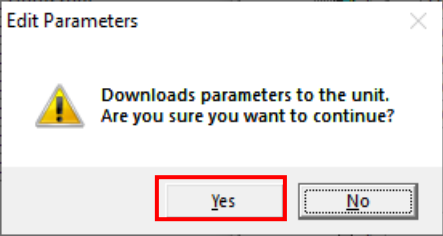

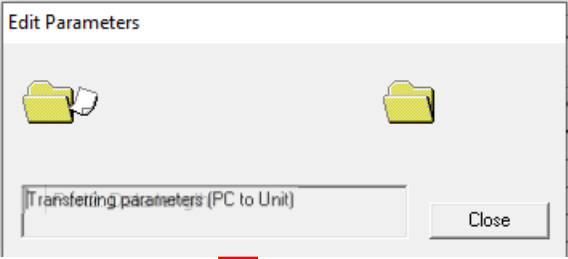

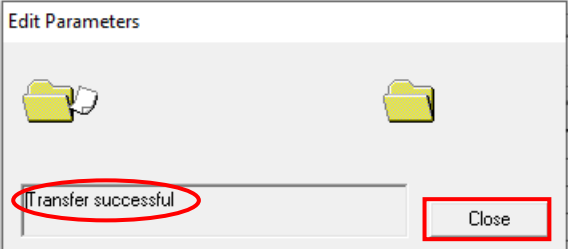
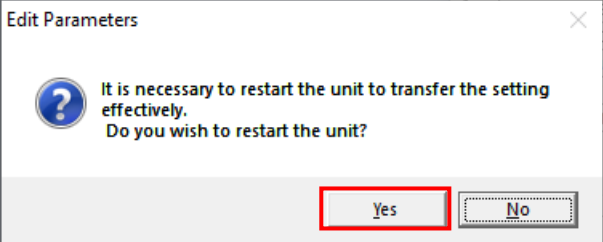
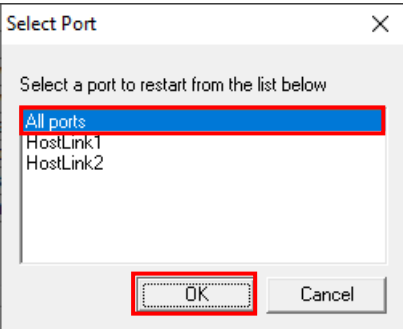
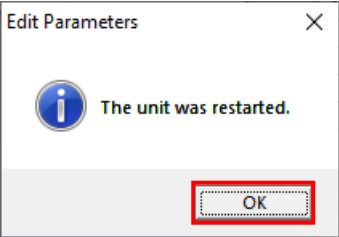
Item	Set Value	Unit
Port2: Port settings	User settings	
Port2: Serial communications mode	Defaults	
Port2: Data length	User settings	
Port2: Stop bits	2 bits	
Port2: Parity	Even	
Port2: Baud rate	Default(9600bps)	
Port2: Serial Gateway Response timeo	0	ms
Port2: Serial Gateway send start timeo	0	ms
Port2: Protocol macro Transmission m	Half-duplex	

- 6 Set the following parameters in the same way as step 5.
- Serial communications mode: *Protocol macro*
  - Data length: *8 bits*
  - Stop bits: *1 bit*
  - Parity: *None*
  - Baud rate: *1200bps*
  - Protocol macro Transmission method: *Full-duplex*
- \*Use the default values for other parameters.
- Click **Transfer[PC to Unit]**.

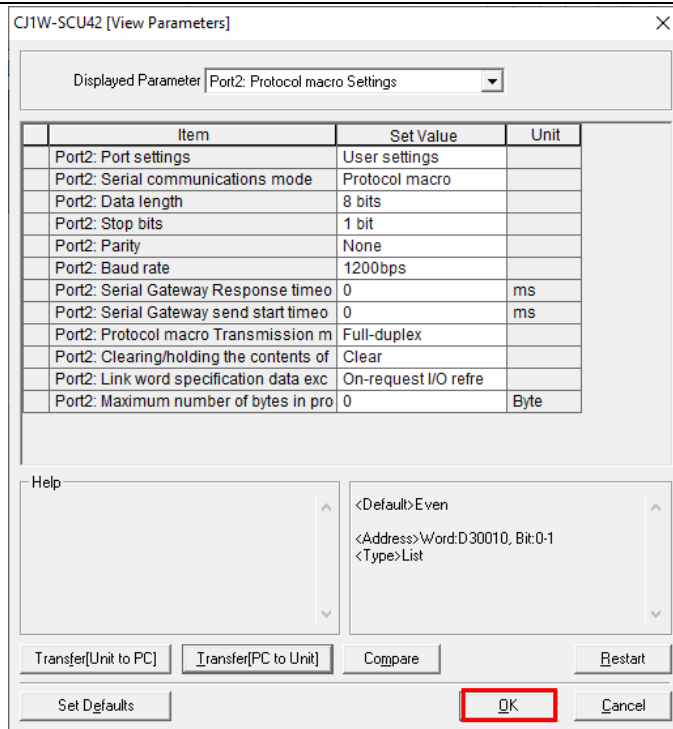
Item	Set Value	Unit
Port2: Port settings	User settings	
Port2: Serial communications mode	Protocol macro	
Port2: Data length	8 bits	
Port2: Stop bits	1 bit	
Port2: Parity	None	
Port2: Baud rate	1200bps	
Port2: Serial Gateway Response timeo	0	ms
Port2: Serial Gateway send start timeo	0	ms
Port2: Protocol macro Transmission m	Full-duplex	
Port2: Clearing/holding the contents of	Clear	
Port2: Link word specification data exc	On-request I/O refre	
Port2: Maximum number of bytes in pro	0	Byte

Buttons: Transfer[Unit to PC], Transfer[PC to Unit], Compare, Restart, Set Defaults, OK, Cancel.



<p>7 The dialog box on the right is displayed. Confirm that there is no problem, and click <b>Yes</b>.</p> <p>Check that the transfer is complete as shown on the right. Click <b>Close</b>.</p>	    
<p>8 The dialog box on the right is displayed. Check the contents and click <b>Yes</b>.</p> <p>The Select Port Dialog Box is displayed. Select <i>All ports</i> and click <b>OK</b>.</p>	 
<p>9 The dialog box on the right is displayed. Check the contents and click <b>OK</b>.</p>	

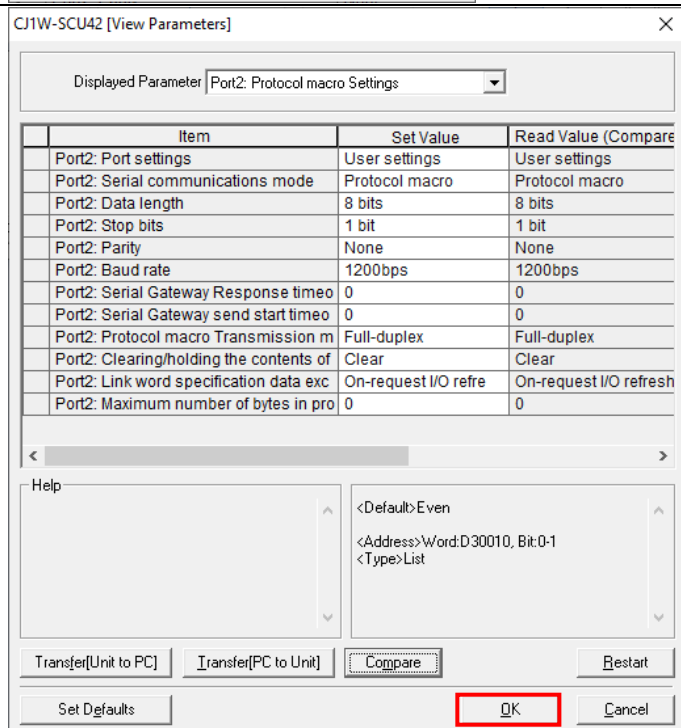
- 10 Click **Compare** in the View Parameters Dialog Box.



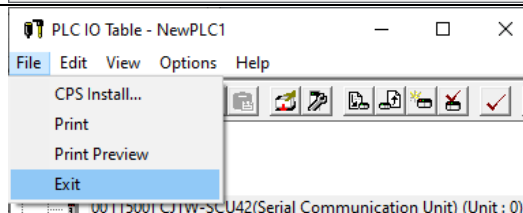
- 11 Check that a message is displayed stating "Compare successful" as shown in the figure on the right. Click **Close**.



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

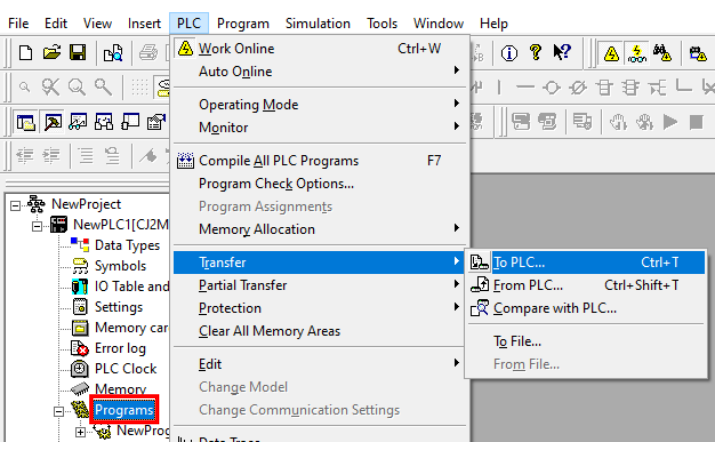
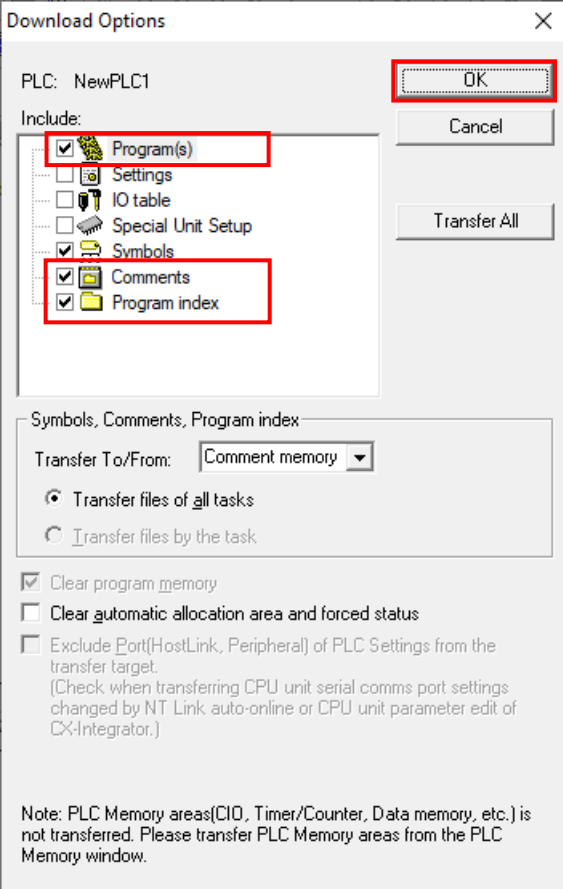
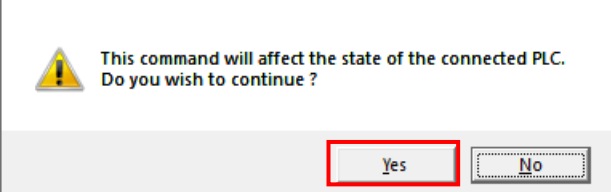


- 13 Select **Exit** from the File Menu to exit the PLC IO Table Window.

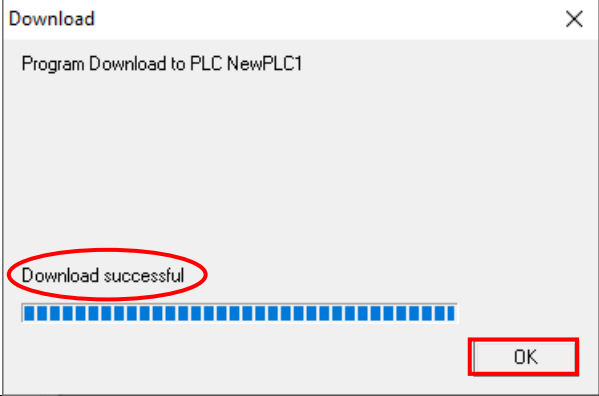
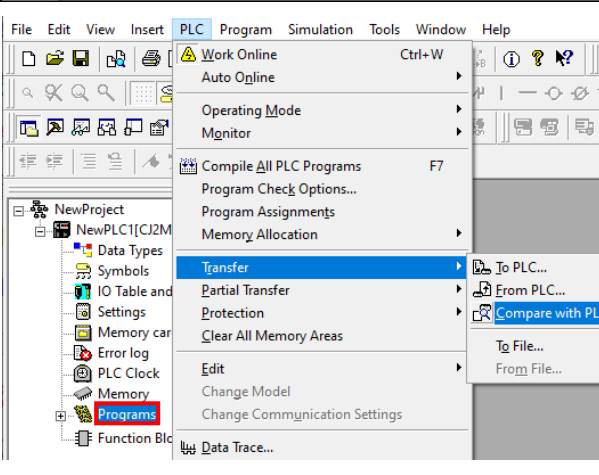
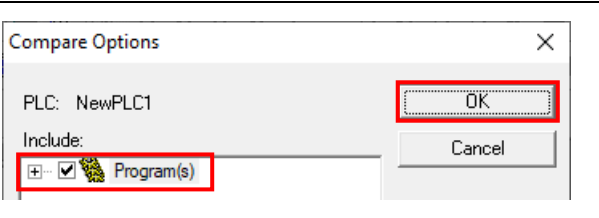
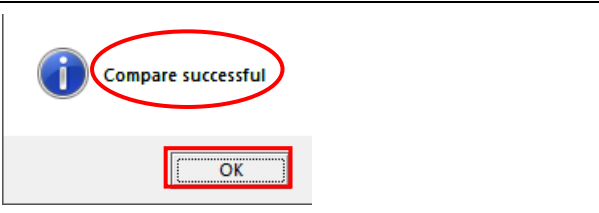


## 7.3.5. Transferring the Project Data

Transfer the project data to the PLC.


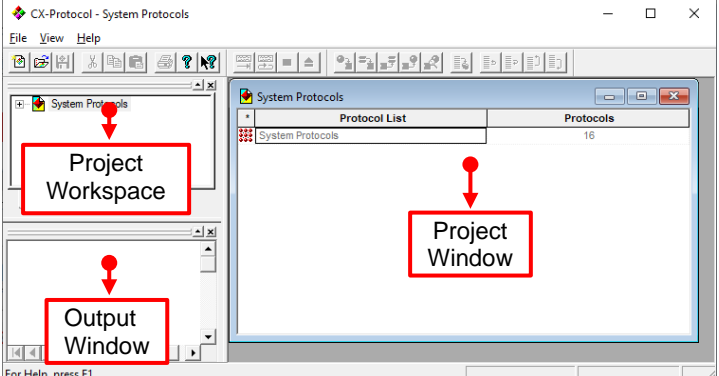
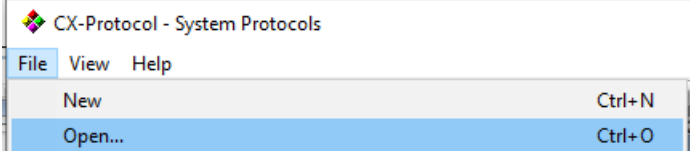
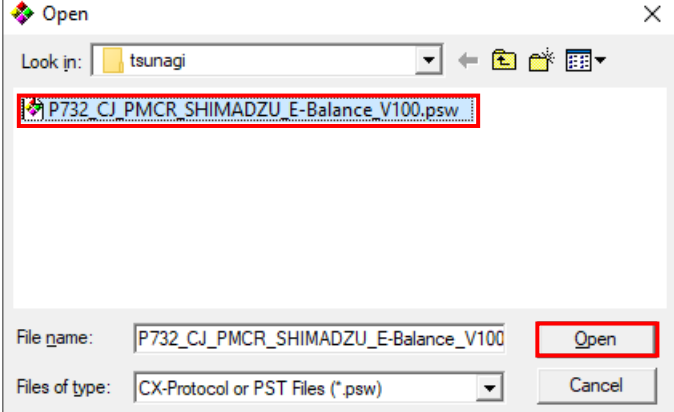
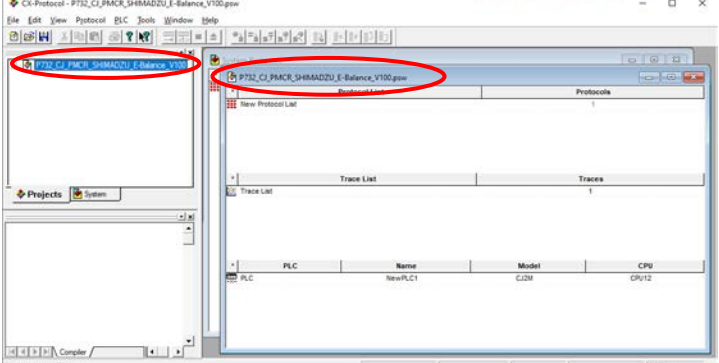
<p>1 Select <b>Programs</b> in the project workspace of CX-programmer. Select <b>Transfer – To PLC</b> from the PLC Menu.</p>	
<p>2 Select <i>Program(s)</i>, <i>Comments</i> and <i>Program index</i>. Click <b>OK</b>.</p> <p>*You do not need to transfer I/O table and Special Unit Setup because they are already set in 7.3.3. <i>Creating an I/O Table</i> and 7.3.4. <i>Parameter Settings</i>.</p> <p>*The <i>Comments</i> and <i>Program index</i> Check Boxes may not be displayed depending on the PLC type. In that case, select <i>Program(s)</i> only and transfer the project data.</p>	
<p>3 The dialog box on the right is displayed. Confirm that there is no problem, and click <b>Yes</b>.</p>	

## 7. Serial Communications Connection Procedure

<p>4 The dialog box on the right is displayed. Check that "Download successful" is displayed after the transfer is complete. Click <b>OK</b>.</p>		
<p>5 Select <b>Programs</b> in the project workspace. Select <b>Transfer – Compare with PLC</b> from the PLC Menu.</p>		
<p>6 Select <b>Program(s)</b> and click <b>OK</b>.</p>		
<p>7 Check that a message is displayed stating "Compare successful" as shown in the figure on the right. Click <b>OK</b>.</p>		

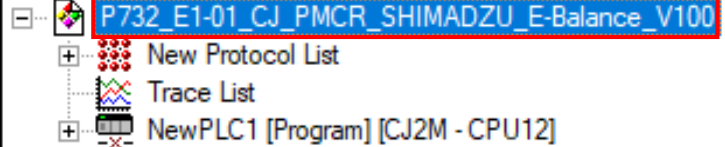
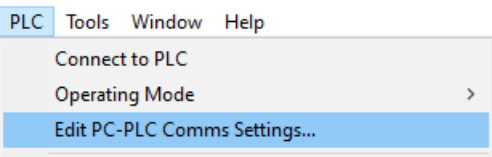
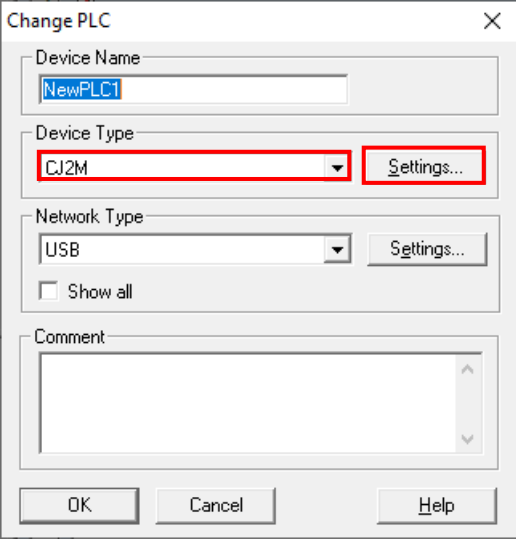
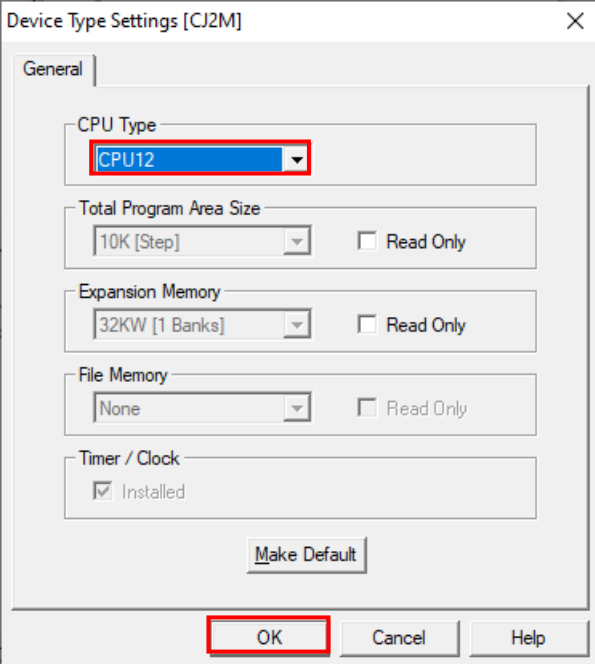
## 7.3.6. Starting CX-Protocol and Opening the Project File

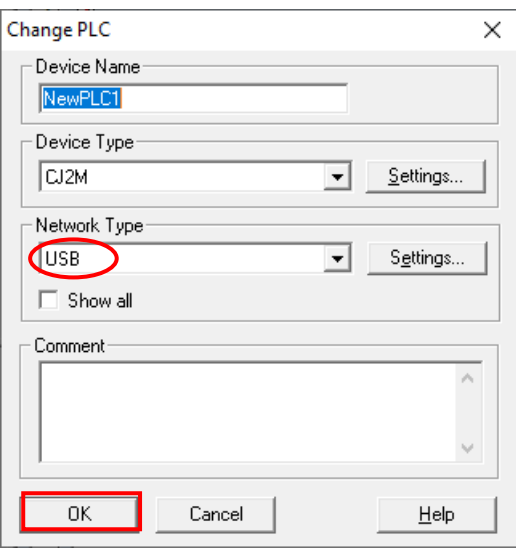
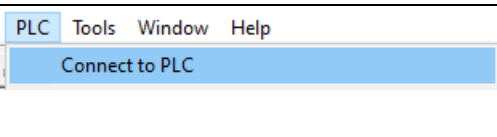
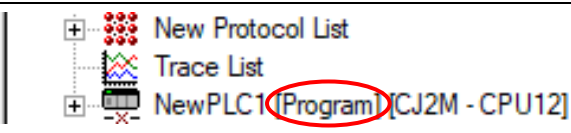
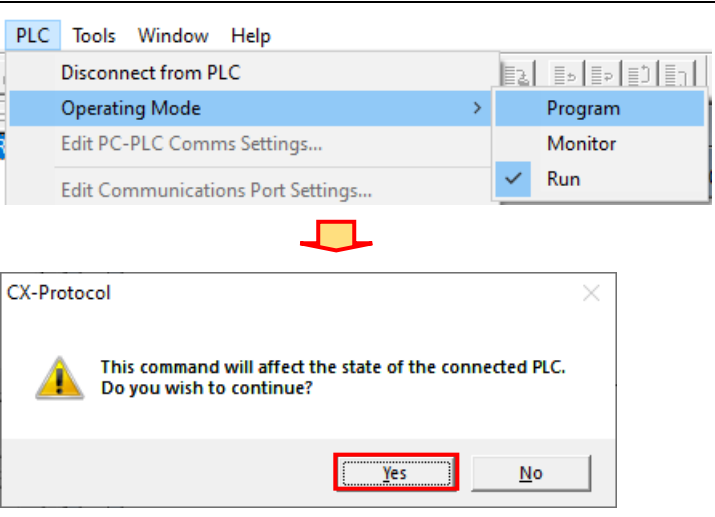
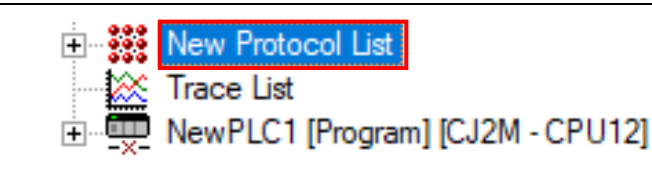
Start CX-Protocol and open the project file.

1	<p>Start CX-Protocol.</p> <p>*If the User Account Control Dialog Box is displayed at start, make a selection to start CX-Protocol.</p>	
2	<p>Start CX-Protocol.</p> <p>The following panes are displayed in the window. Upper left: Project Workspace Lower left: Output Window Right: Project Window</p>	
3	<p>Select <b>Open</b> from the File Menu.</p>	
4	<p>The Open Dialog Box is displayed.</p> <p>Select <i>P732_CJ_PMCR_SHIMADZU_E-Balance_V100.psw</i> and click <b>Open</b>.</p> <p>*Obtain the project file from OMRON.</p>	
5	<p>The opened project is displayed in both the Project Workspace and the Project Window.</p>	

## 7.3.7. Going Online and Transferring the Protocol Data

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

1	<p>Double-click <b>P732_CJ_PMCR_SHIMADZU_E-Balance_V100</b> in the Project Workspace to expand the tree.</p>	
2	<p>Select <b>Edit PC-PLC Comms Settings</b> from the PLC Menu.</p>	
3	<p>The Change PLC Dialog Box is displayed. Select the PLC type from the pull-down list in the <i>Device Type</i> Field. Click <b>Settings</b>.</p> <p>*CJ2M is selected in this guide.</p>	
4	<p>The Device Type Settings Dialog Box is displayed. Select the CPU type from the pull-down list in the <i>CPU Type</i> Field. Click <b>OK</b>.</p> <p>*CPU12 is selected in this guide.</p>	

<p>5</p>	<p>Check that the network type is set to USB in the Change PLC Dialog Box. Click <b>OK</b>.</p> <p>*If not, select <b>USB</b> from the pull-down list.</p>	 <p>The 'Change PLC' dialog box is shown. The 'Device Name' field contains 'NewPLC1'. The 'Device Type' is set to 'CJ2M'. The 'Network Type' is set to 'USB', which is circled in red. The 'OK' button is also circled in red.</p>
<p>6</p>	<p>Select Connect to PLC from the PLC Menu.</p>	 <p>The 'PLC' menu is open, showing the 'Connect to PLC' option highlighted in blue.</p>
<p>7</p>	<p>Check that the PLC status displayed next to the PLC Icon changes from Offline to the Program in the Project Workspace.</p> <p>It means that PLC is online.</p> <p>*If the other operating mode such as Monitor or Run is displayed, change it to Program by following step 8.</p>	 <p>The Project Workspace shows the 'New Protocol List' and 'Trace List'. The 'NewPLC1 (Program) [CJ2M - CPU12]' is circled in red.</p>
<p>8</p>	<p>If the operating mode is Monitor or Run in step 7, select <b>Operating Mode – Program</b> from the PLC Menu.</p> <p>The dialog box on the right is displayed. Confirm that there is no problem, and click <b>Yes</b>. Check that the operating mode changes to Program as shown in step 7.</p>	 <p>The 'PLC' menu is open, showing the 'Operating Mode' sub-menu. The 'Program' option is highlighted. Below the menu, a yellow arrow points to the 'CX-Protocol' dialog box. The dialog box contains a warning icon and the text: 'This command will affect the state of the connected PLC. Do you wish to continue?'. The 'Yes' button is circled in red.</p>
<p>9</p>	<p>Double-click <b>New Protocol List</b> in the Project Workspace to expand the tree.</p>	 <p>The Project Workspace shows the 'New Protocol List' and 'Trace List'. The 'NewPLC1 [Program] [CJ2M - CPU12]' is circled in red.</p>

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

* Protocol Name	Start Sequence	End Sequence	Type	Target
New Protocol	900	999	USER	SCU [0]

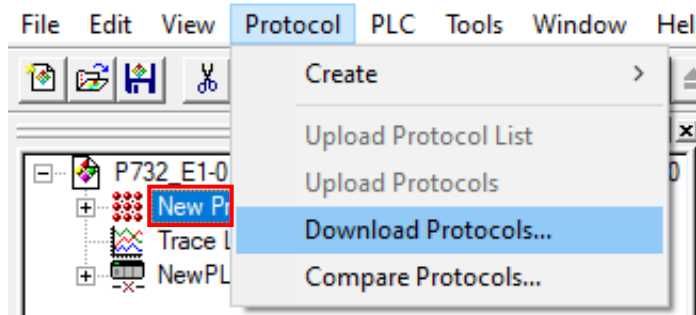
  

* Protocol Name	Start Sequence	End Sequence	Type	N/A [1]
New Protocol	900	999	USER	Communication Unit

SCB (Not Fitted)  
 SCU [0]  
 N/A [1]

\*If not, select **SCU [0]** from the pull-down list 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**.

Protocol Compile / Download
 X

☒ Protocol password protection
 

Password

Confirm

Close

☒ Include Source Information

Target	Compiled %	Downloaded %
SCU [0]	000%	000%

- 13 The compile is complete when 100% is displayed in the *Compiled %* Column.  
Click **Download** after checking that the compile is complete.

Protocol Compile / Download
 X

☒ Protocol password protection
 

Password

Confirm

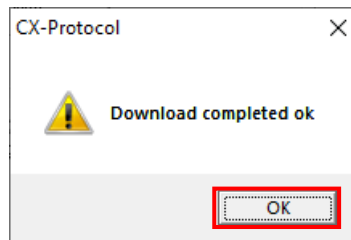
Close

☒ Include Source Information

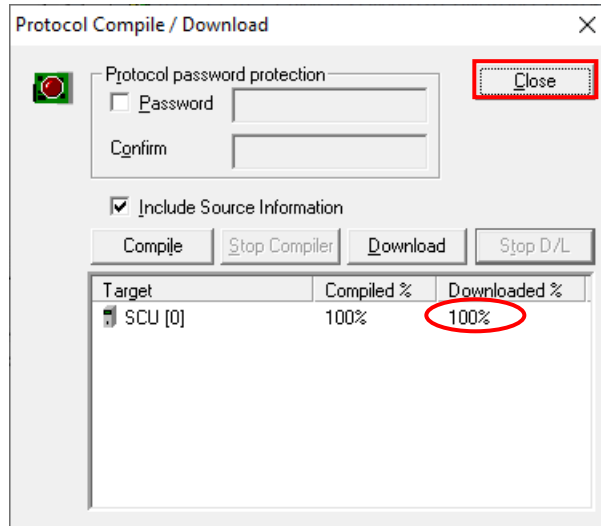
Target	Compiled %	Downloaded %
SCU [0]	100%	000%



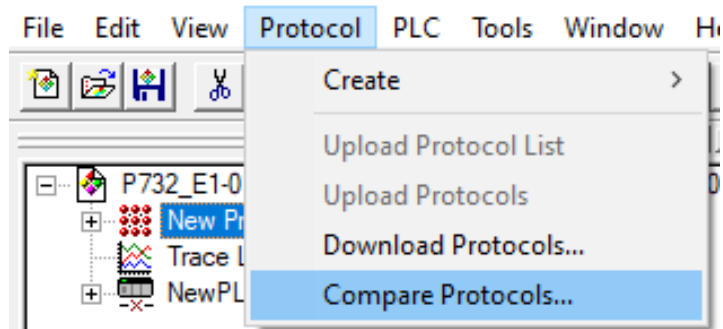
- 14 The dialog box on the right is displayed. Confirm that there is no problem, and click **OK**.



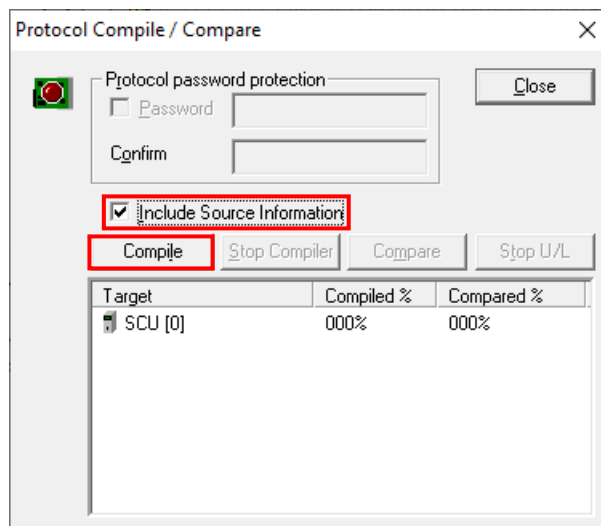
- 15 Check that 100% is displayed in the *Downloaded %* Column, as shown in the figure on the right. Click **Close**.



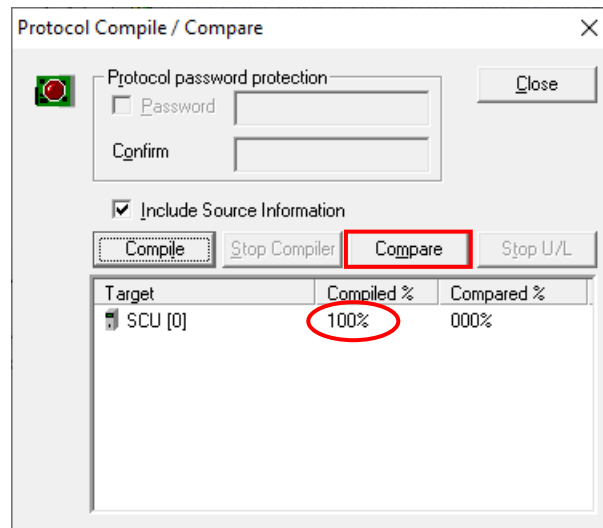
- 16 Select **Compare Protocols** from the Protocol Menu.



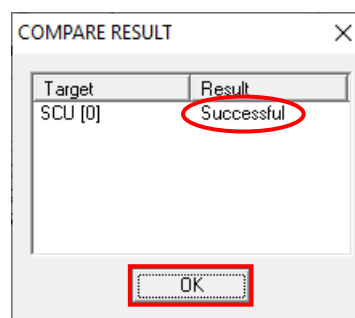
- 17 The dialog box on the right is displayed. Select *Include Source Information* and click **Compile**.



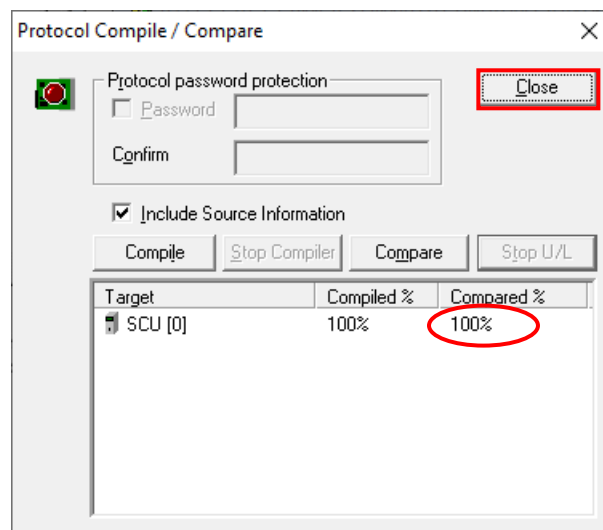
- 18 The compile is complete when 100% is displayed in the *Complied %* Column. Click **Compare** after checking that the compile is complete.



- 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 in the figure on the right. Click **Close**.



### 7.4. Serial Communication Status Check

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

## WARNING

If the PLC memory is changed by malfunction during the process of monitoring power flow and present values 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 values in the Ladder Section Window or in the Watch Window.



### Precautions for Correct Use

Make sure the serial cable is connected before following the procedures described hereafter (7.4.1 through to 7.4.4). If not, turn OFF the devices, and then connect the serial cable.

#### 7.4.1. Starting the Trace

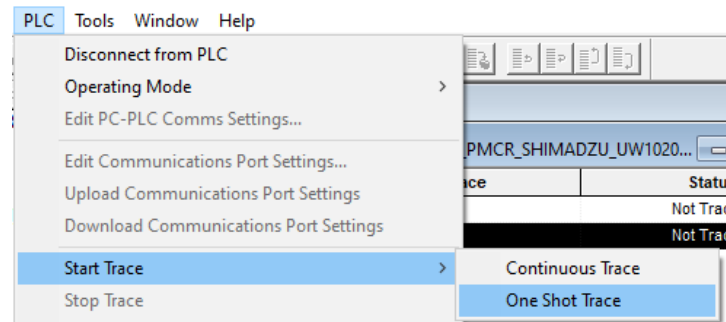
Start tracing with CX-Protocol.

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

## 7. Serial Communications Connection Procedure

- 5 Select the Trace 2 Icon (🔍) in the Project Window.  
(Check that Trace 2 is highlighted as shown in the figure on the right.)
- \*Trace 2 corresponds to Port 2 of Serial Communications Unit.
- 6 Select **Start Trace – One Shot Trace** from the PLC Menu.
- 7 Check that the status of Trace 2 in the Project Window changes to One-shot Trace Running.

*	Trace	Status
Trace 1		Not Tracing
Trace 2		Not Tracing

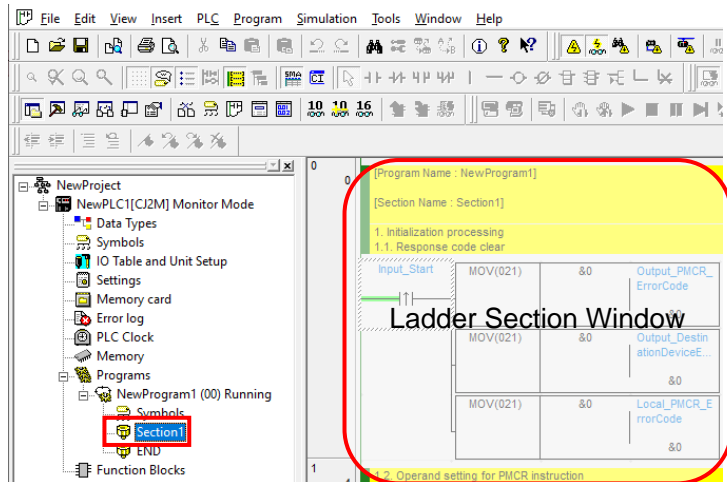


*	Trace	Status
Trace 1		Not Tracing
Trace 2		One-shot Trace Running

### 7.4.2. Executing the Communications Sequence

Execute the communications sequence with CX-Programmer.

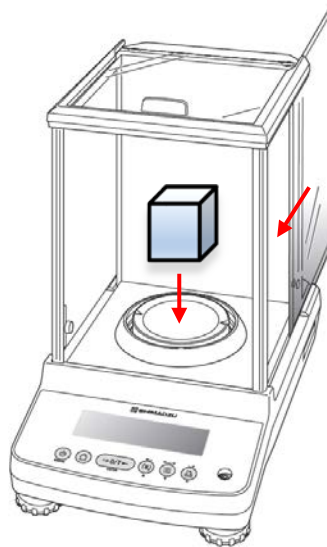
- 1 Expand the Programs tree in the project workspace of CX-Programmer and double-click **Section1**.  
The Ladder Section Window shows the Section1 ladder program.



- 2 Press **POWER** key to show gram units on Display panel on Balance. Check that 0.0000 g is displayed.



- 3 Place a sample (substance to be measured) on the pan.



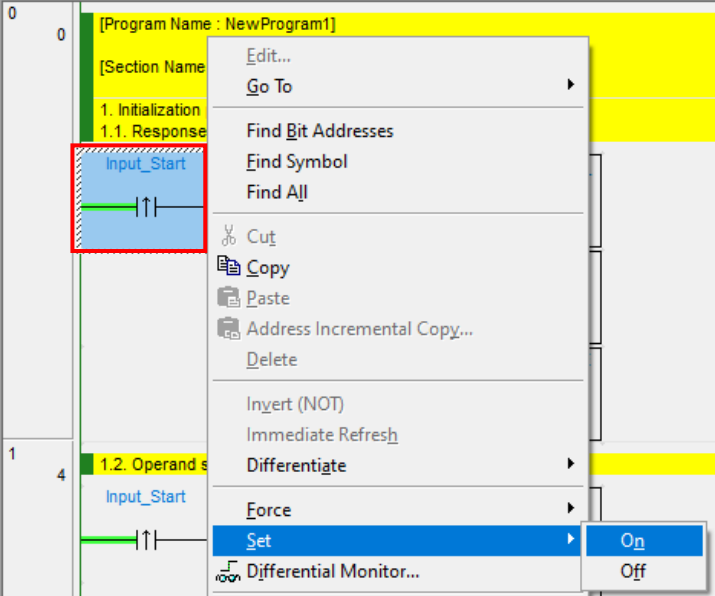
- 4 Check the measurement value displayed on Balance.

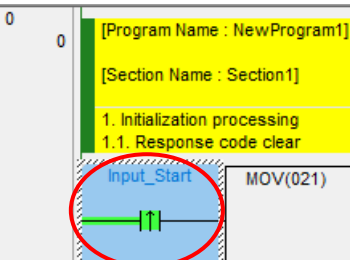
\*The figure on the right shows as follows:  
Measurement status:  
Stability mark "→" (stable)  
Measurement value:  
126.5947g



\*The display varies depending on the sample to be measured.

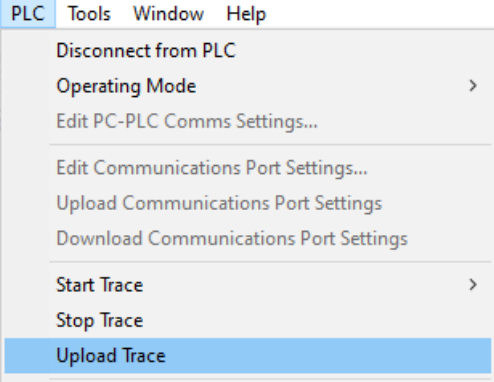
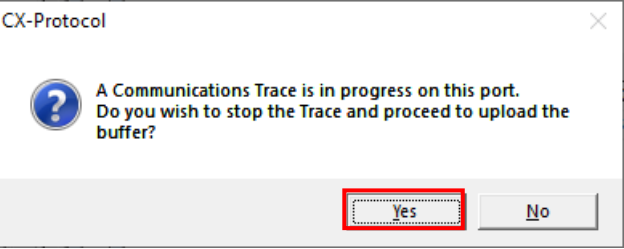
- 5 In the Ladder Section Window, right-click **Input\_Start** and select **Set – On** from the menu.


- 6 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 with the trace data in CX-Protocol that correct data is sent and received.

1	<p>Select <b>Upload Trace</b> from the PLC Menu in CX-Protocol.</p> <p>*Once the trace data is stored, the menu item "Upload Trace" becomes selectable.</p>	 <p>The screenshot shows the 'PLC' menu in the CX-Protocol software. The menu is open, displaying several options: 'Disconnect from PLC', 'Operating Mode', 'Edit PC-PLC Comms Settings...', 'Edit Communications Port Settings...', 'Upload Communications Port Settings', 'Download Communications Port Settings', 'Start Trace', 'Stop Trace', and 'Upload Trace'. The 'Upload Trace' option at the bottom is highlighted with a blue selection bar.</p>
2	<p>The dialog box on the right is displayed. Check the contents and click <b>Yes</b>.</p>	 <p>The screenshot shows a dialog box titled 'CX-Protocol' with a question mark icon. The text inside reads: 'A Communications Trace is in progress on this port. Do you wish to stop the Trace and proceed to upload the buffer?'. At the bottom, there are two buttons: 'Yes' and 'No'. The 'Yes' button is highlighted with a red rectangular box.</p>

- 3 Check the send and receive messages in the trace data file as shown in the figure on the right.

(In the example on the right, Balance's command "D07" 0Dh(CR) (single output with stability information) is sent and the response "S 126.5947g " 0Dh(CR) (13 bytes) is received.)

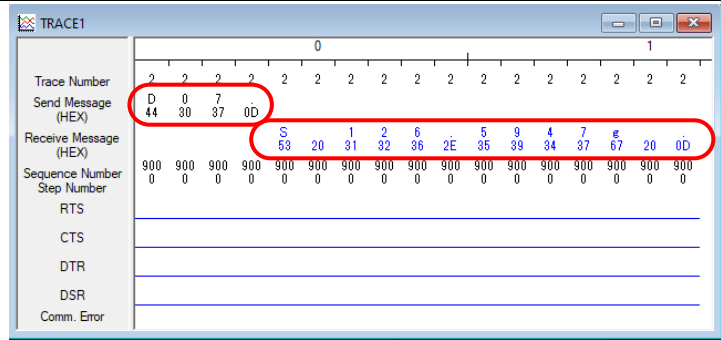
Check that the response matches the value measured by Balance in step 4 of 7.4.2.

*Executing the Communications Sequence.*

\*The above mentioned " " indicates a space

\*The contents of the response data and parameters are shown on the right.  
For more information, refer to *10 CONNECTION AND COMMUNICATION WITH PERIPHERAL DEVICES* of the *Analytical Balance Instruction Manual* (321-78327).

\*The receive message varies depending on Balance you use.



VRGT response data

Stability information "S" (stable) (1 byte)	Sign " " (+) (1 byte)	Absolute value " 126.5947" (8 bytes)	Unit "g " (2 bytes)
---	-----------------------------	--	---------------------------

VRGT response parameters

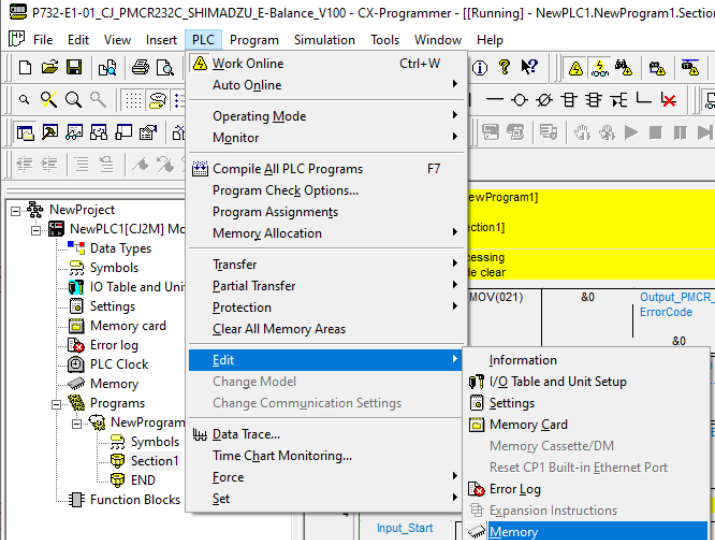
Item	Size
Stability information	1 byte
Sign	1 byte
Absolute value	8 bytes
Unit	2 bytes

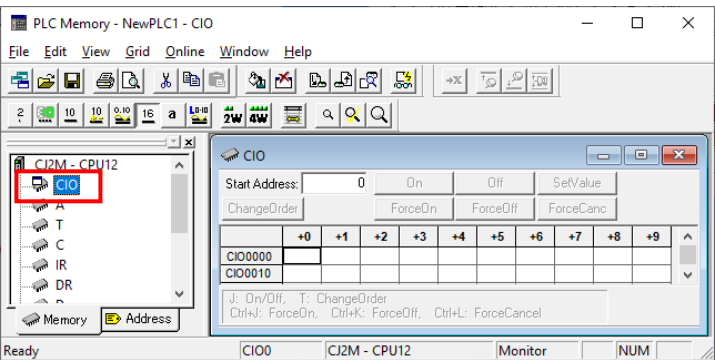


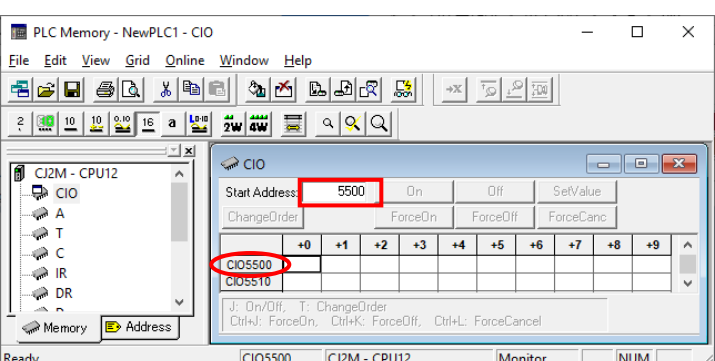
## 7.4.4. Checking Received Data

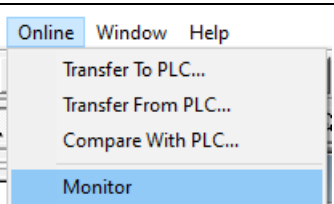
With CX-Programmer, check that correct data is written to the I/O memory of the PLC.

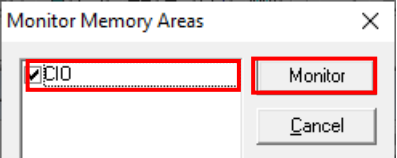
- 1 Select **Edit – Memory** from the PLC Menu in CX-Programmer.


- 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**.



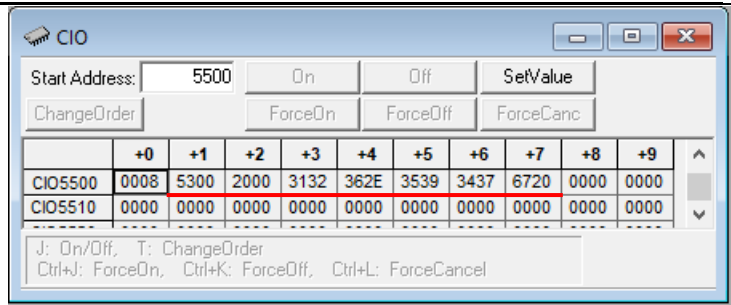
- 6 Check the received data displayed in the CIO Area as shown in the figure on the right.

\*In the example on the right, the data stored in words from CIO 5501 is 5300 2000 3132 362E 3539 3437 6720 in hexadecimal, which equates to S\_126.5947g\_ in string. This is the same as the value measured by Balance in step 4 of 7.4.2. *Executing the Communications Sequence* and the same as the trace data displayed in step 3 of 7.4.3. *Checking the Trace Data*. The above mentioned " " indicates a space (20 in hexadecimal).

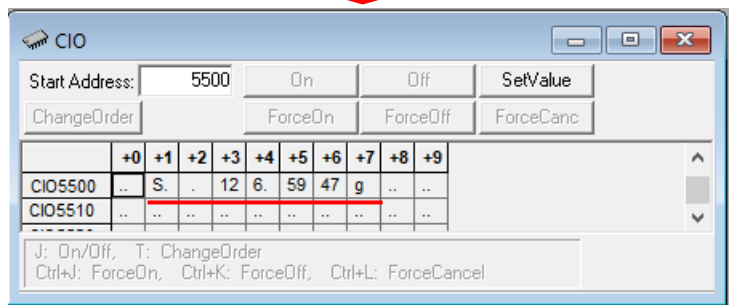
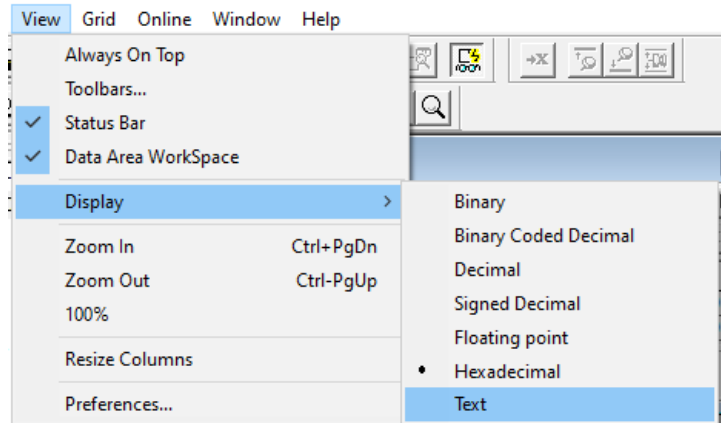
\*The number of words being used (0008 in hexadecimal) is stored in word CIO5500. The receive data read is stored in words from CIO5501 to CIO5507.

\*The content of the received data is given in the table below. Refer to *10 CONNECTION AND COMMUNICATION WITH PERIPHERAL DEVICES* of the *Analytical Balance Instruction Manual* (321-78327) for details.

Data	Item
S (stable)	Stability information
_	Sign
_126.5947	Absolute value
g_	Unit



\*You can convert hexadecimal to string by selecting **Display – Text** from the View Menu.



## 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.

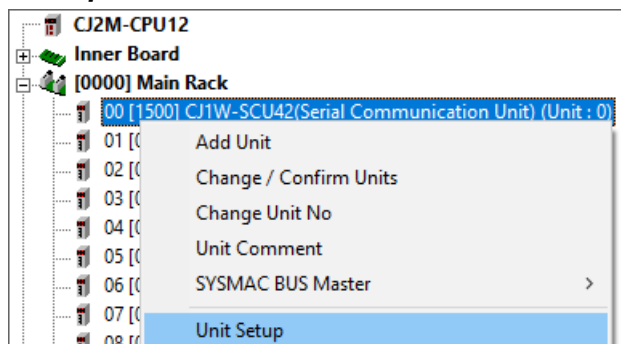
### 8.1. Initializing a PLC

To initialize 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.

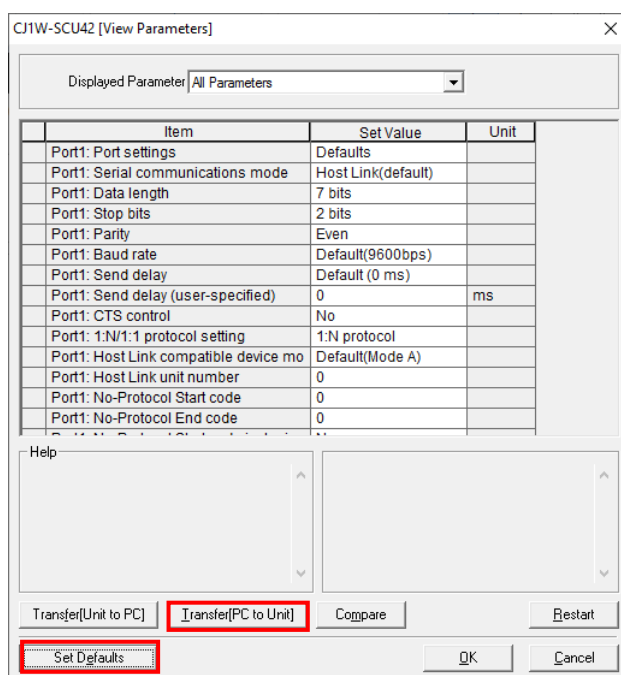
#### 8.1.1. Serial Communications Unit

To initialize 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.



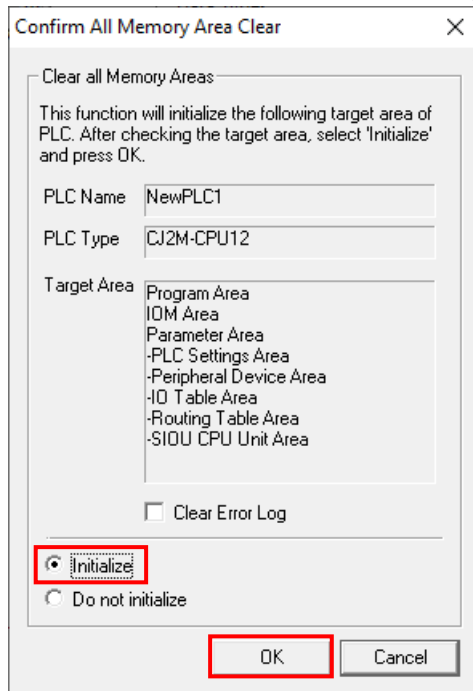
2. In the CJ1W-SCU42 [View Parameters] Dialog Box, click **Set Defaults** first, then click **Transfer[PC to Unit]**.



### 8.1.2. CPU Unit

To initialize 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 SHIMADZU Balance

For information on how to initialize a SHIMADZU Balance, refer to the following manuals.

- UW/UX series:

7.5.2. *Returning to the Default Settings (menu reset) of the Electronic Balance Instruction Manual (321-78048)*

- UPX/UPY series:

4.5.2. *Returning to the Default Settings (menu reset) of the Top-loading Balance Instruction Manual (321-78282)*

- ATX-R/ATY-R series:

3. *MENU SETTINGS of the Analytical Balance Instruction Manual (321-78327)*

## 9. Program

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

### 9.1. Overview

---

The specifications and functional components of the program are explained in this section, which are used to check the connection status between the SHIMADZU Balance (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, which sends the command "single output with stability information" to and receives a response from the Destination Device and then detects a normal or error end of the send/receive processing.

The normal end of the send/receive processing means a normal end of the communications sequence.

The error end means an error end of the communications sequence and an error of the Destination Device (detected 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

---

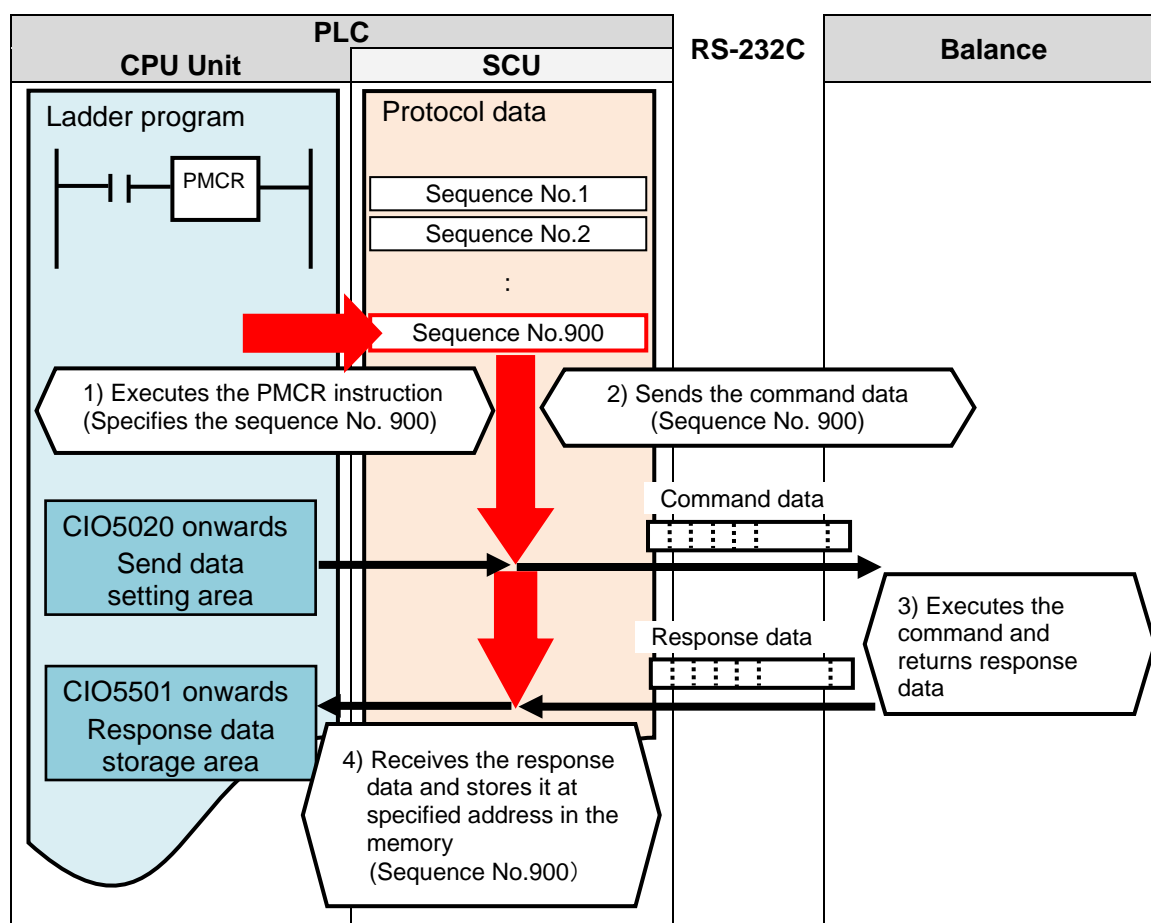
OMRON has confirmed that normal communications can be performed using this program under the conditions of 5.2. *Device Configuration*. However, we do not guarantee normal operation under disturbances such as electrical noise or device performance variation.

---

### 9.1.1. Outline of Processing

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

- 1) The ladder program specifies the communications sequence No. 900 and executes the PMCR instruction.
- 2) The PLC reads the parameters set in the send data setting area and sends the command data to the Balance according to the send message defined by the communications sequence No. 900.
- 3) The Balance 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 the Balance according to the receive message defined by the communications sequence No. 900, and stores the data in the response data storage area.



### 9.1.2. PMCR Instruction and Send/Receive Messages

The basic operations of the PMCR instruction and send/receive messages are given below.



#### 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 operand data

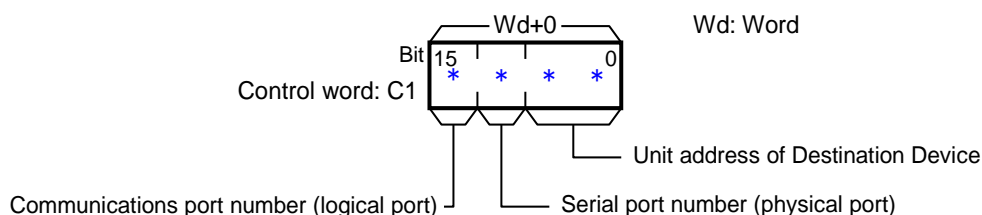
Instruction	Mnemonic	Variations	Function code	Function
PROTOCOL MACRO	PMCR	@PMCR	260	Starts a communications sequence (protocol data) that is registered in a Serial Communications Board (CS Series only) or Serial Communications Unit.

Symbol	PMCR	
	C1	C1: Control word 1
	C2	C2: Control word 2
	S	S: First send word
	R	R: First receive word

## C1: Control word 1

The following information on the SCU are set.

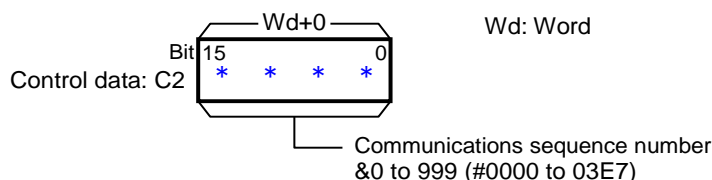
- Communications port number (logical port): #0 to 7
- Serial port number (physical port): #1 and 2 (#1: PORT1, #2: PORT2)
- Unit address of Destination Device: # unit number + #10



## C2: Control word 2

The communications sequence number registered in protocol data is set.

Refer to 9.2.1 *Communications Sequence Number* for information on the communications sequence number registered in the protocol data used in this guide.



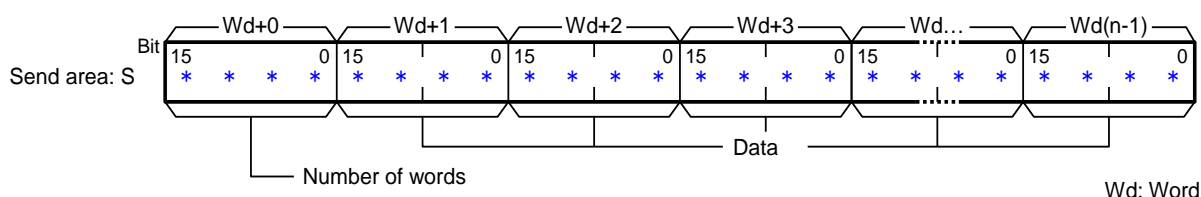
## S: First send word (send area specification)

The first word of the words required to send data is specified. S contains the number of words (n) to be sent +1 (i.e., including the S word).

From #0000 to #00FA (n=&0 to &250) words can be sent.

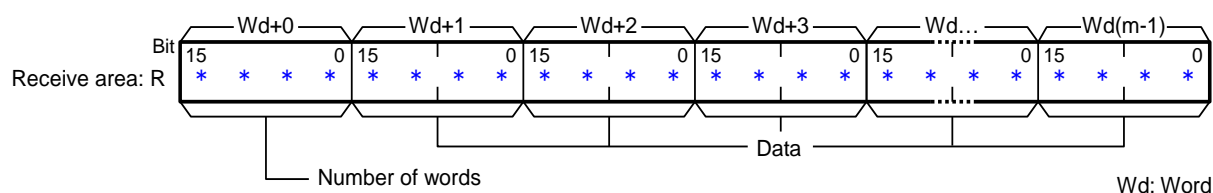
The send data (variable data) is stored in the words from S+1 to S+(n-1).

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)

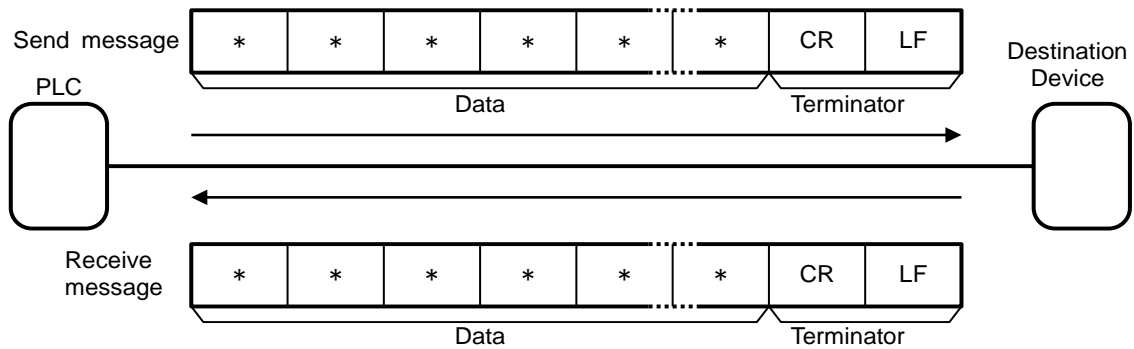
Received data is automatically stored in words starting with R+1 and the number of words (m) received plus R (i.e., including the R word) is automatically written to R from #0000 to 00FA hex (m=&0 to &250).



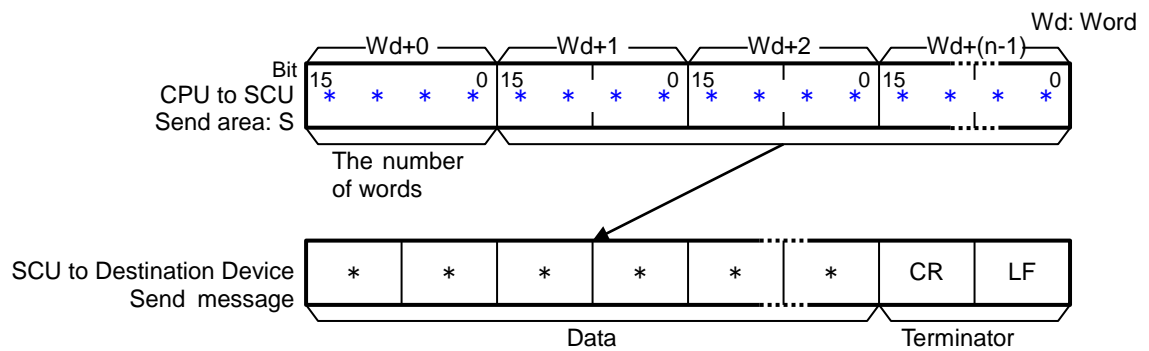


## Send/Receive messages

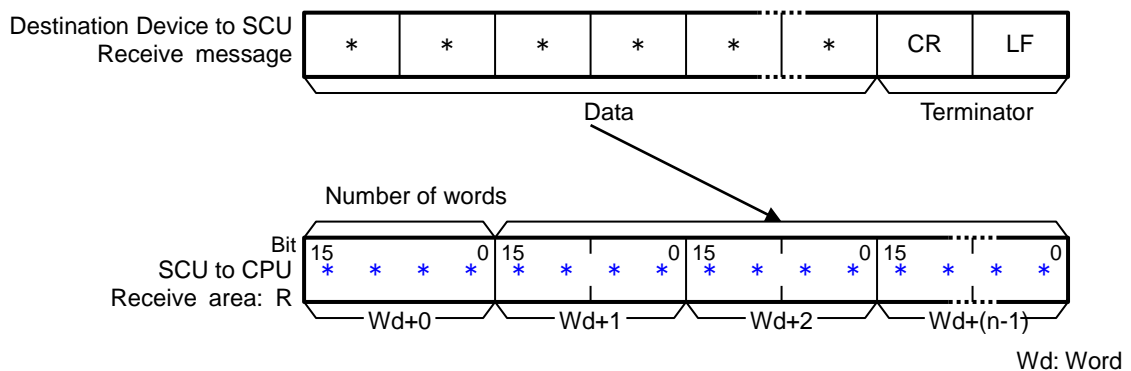
### Image of send/receive messages



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



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



## 9.2. Communications Sequence

The communications sequence that is used for the PMCR instruction in this program is described below.

### 9.2.1. Communications Sequence No.

The communications sequence that is registered in the SCU is identified by a communications sequence number. The command corresponding to the communications sequence number specified in the PMCR instruction is executed on the Destination Device.

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

No.	Command name	Description
900	Single output with stability information	Acquires the displayed value of the Destination Device.

### 9.2.2. PMCR Instruction Operand Settings

The PMCR instruction operands of the communications sequence No. 900 (#0384) "single output with stability information" are shown below.

Control word C1 setting (C1: CIO 5010)

Word	Contents (data type)	Data (description)
C1	Communications port No. (1-digit hex)	#7210 (Communications port No. 7, Serial port No.2, #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	Contents (data type)	Data (description)
C2	Communications sequence No.	&900 (single output with stability information)

First send word S setting (S: CIO 5020)

Word	Contents (data type)	Data (description)
S	The number of send data words (4-digit hex)	#0000 (no variable in the send message of protocol data)

First receive word R setting (R: CIO 5500)

Word	Contents (data type)	Data (description)
R	The number of receive data words (4-digit hex)	Stores the number of words used, including the R word.
R+1	Receive data [0] (4-digit hex)	Stores the acquired value.
R+2	Receive data [1] (4-digit hex)	
:	:	
R+10	Receive data [49] (4-digit hex)	

**9.2.3. Receive Data Format**

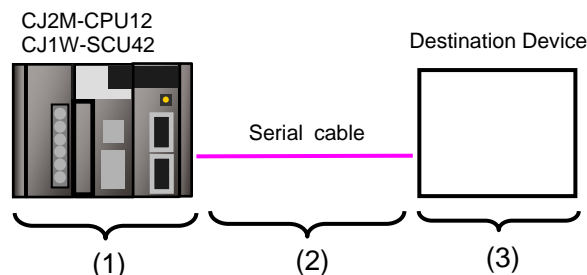
The receive data format is given below, which is used for receiving the value acquired from the Destination Device by using the command "single output with stability information".

The following items are stored in order from R+1. (R: CIO 5500)

Item	Size
Stability information	1 byte
Sign	1 byte
Absolute value	8 bytes
Unit	2 bytes

### 9.3. Error Detection Processing

With this program, the error detection processing is performed according to the following descriptions (1), (2) and (3). For information on error codes, refer to 9.8. *Error Processing*.



(1) Errors when executing the PMCR instruction (PMCR instruction error)

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 is detected, 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 when communicating 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 Destination Device (Destination Device errors)

Errors such as an execution failure on the Destination Device are detected as Destination Device errors. 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 formats 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"). For more information, refer to 9.6.6. *Receive Message Settings*.

	" * "	" * "	" * * * * * * * * "	" * * "	#0D
Normal message	Stability information	Sign	Absolute value	Unit	End code CR
Error message	Other than the above				



#### Additional Information

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

## 9.4. Memory Maps

The memory maps of this program are shown below.

### 9.4.1. List 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

When you change the addresses, make sure there is no duplication.

#### Input memory

The below address is used to operate this program.

Address	Data type	Variable name	Description
5000.00	BOOL	Input_Start	Starts the send/receive processing when this flag is turned ON.

#### Output memory

The program execution results 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 occurs. (1) PMCR instruction error (2) Communications error (3) Destination Device error
5501	WORD	ReceiveData[0] (4-digit hex)	Stores the 1st and 2nd bytes of the data received from the Destination Device.
5502	WORD	ReceiveData[1] (4-digit hex)	Stores the 3rd and 4th bytes of the data received from the Destination Device.
:	:	:	:
5510	WORD	ReceiveData[49] (4-digit hex)	Stores the 19th and 20th bytes of the data received from the Destination Device.
H400	UINT	Output_PMCR_ErrorCode	Stores an error code when a PMCR instruction error or a communications error occurs.
H402	UINT	Output_DestinationDeviceErrorCode	Stores an error code when a Destination Device error occurs.

## 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 No. error (2) Data read/write area exceeded 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 an 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.

### 9.4.2. List of Allocations

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

#### CIO area

These addresses are allocated in the CIO area according to the unit number (unit address) setting for the SCU.

The unit number 0 is used in this program.

Address	Data type	Variable name
1519.10	BOOL	SequenceAbortCompletion_SCU_0_P2
1519.11	BOOL	SequenceEndCompletion_SCU_0_P2
1519.15	BOOL	ProtocolMacroExecuting_SCU_0_P2
1519	UINT	ProtocolMacroErrorCode_SCU_0_P2



#### Additional Information

For details on the CIO area allocated to 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 in the related auxiliary area according to the communications port number (logical port) 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 *Serial Communications Instructions — PMCR — Related Auxiliary Area Words and Bits* 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 given below.

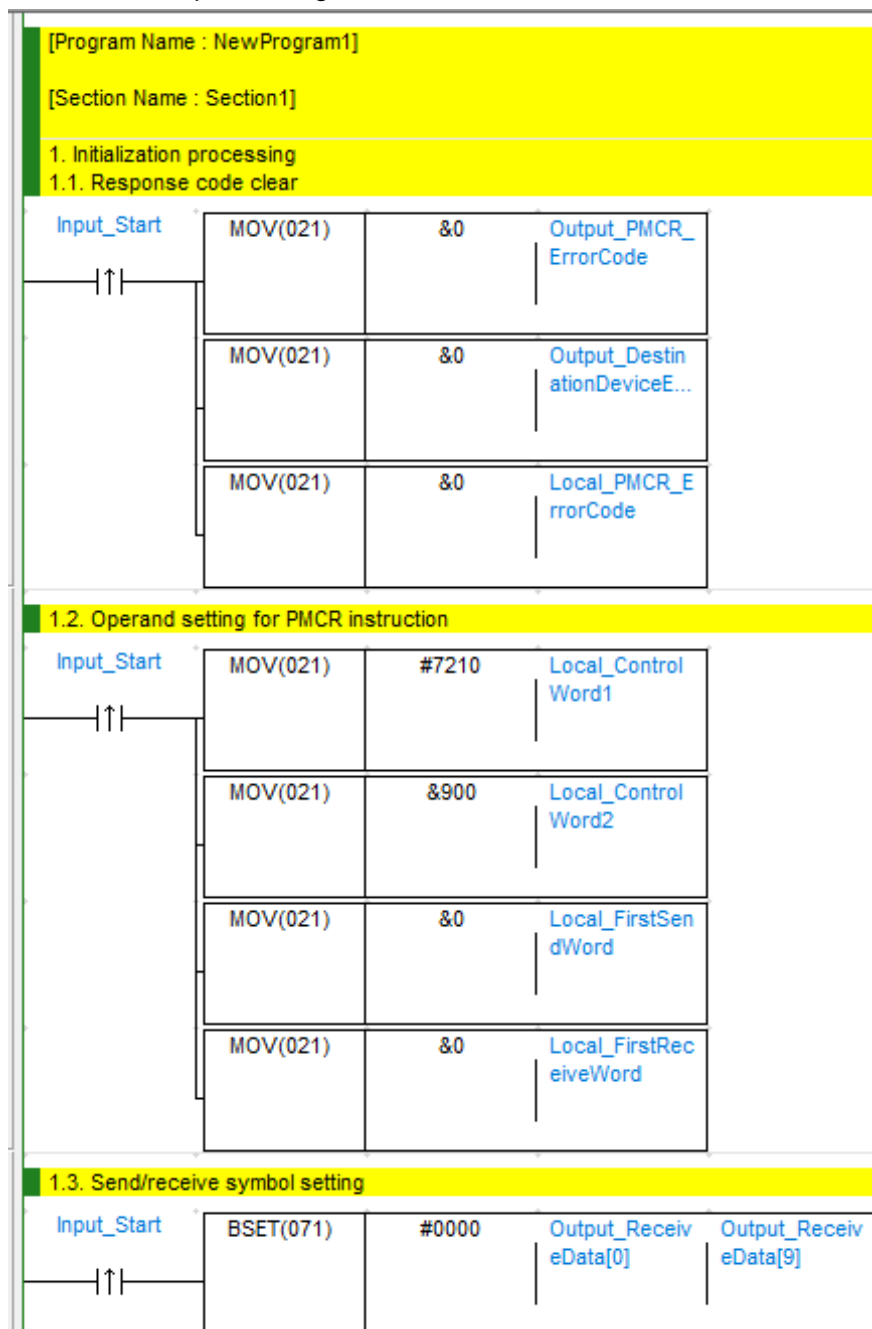
Major classification	Minor classification	Description
1. Initialization processing	1.1. Response code clear 1.2. Operand setting for PMCR instruction 1.3. Send/receive symbol setting	The area of use is cleared, and the initialization setting is performed as a preparation for communications.
2. PMCR instruction execution management	2.1. PMCR instruction executing 2.2. PMCR instruction execution processing 2.3. Normal/error judgement processing	The communications sequence registered in SCU is identified and executed. A normal end or an error end of the processing is detected based on the related flags and 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

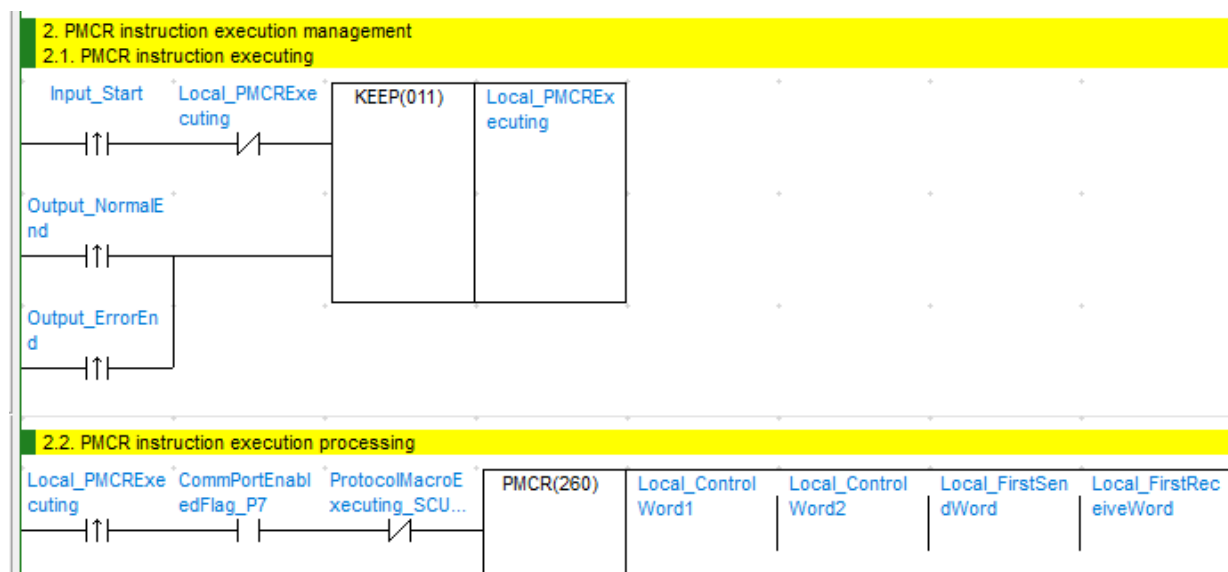
The program used in this guide is shown below.

#### 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.

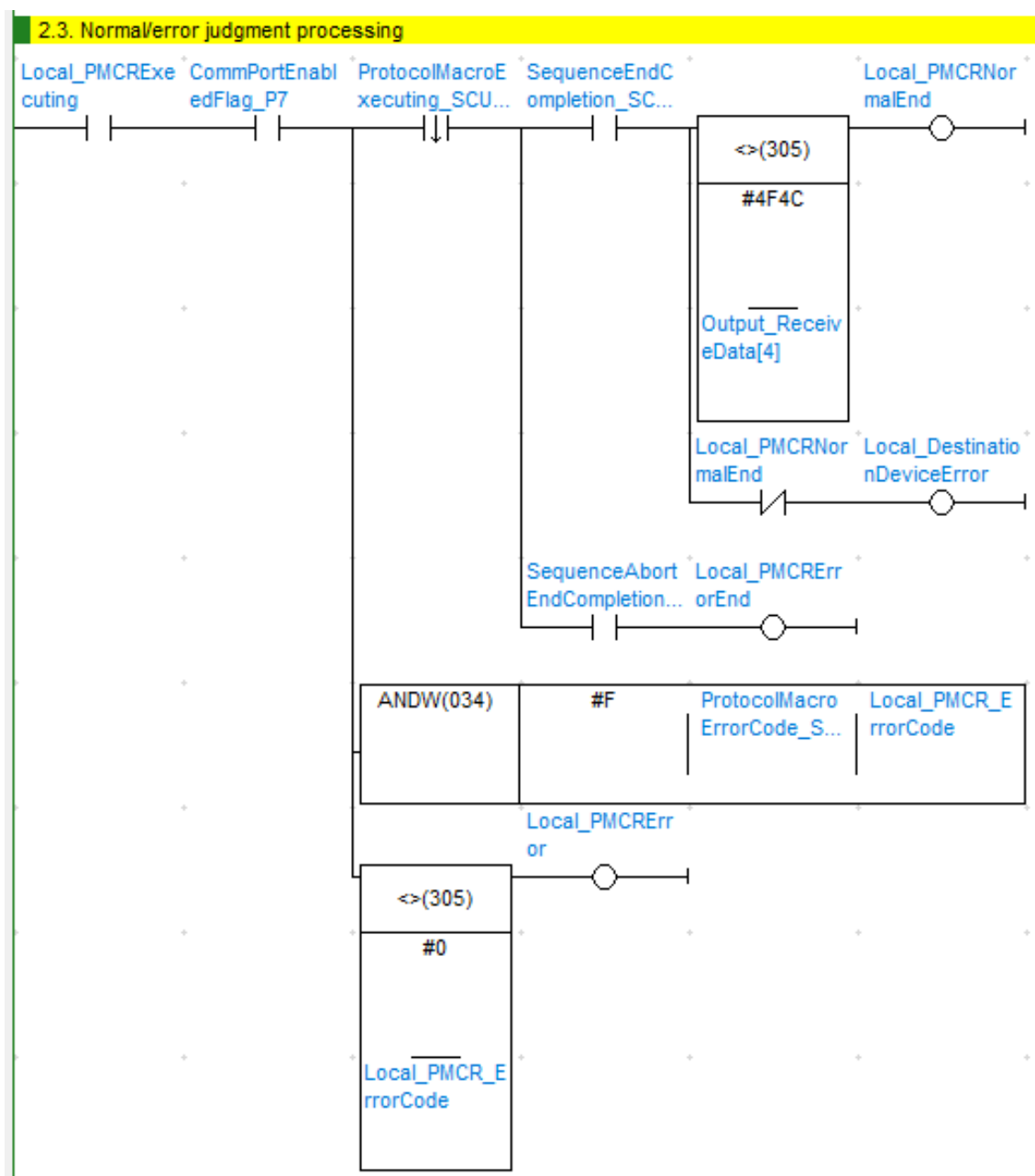
**Precautions for Safe Use**

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**

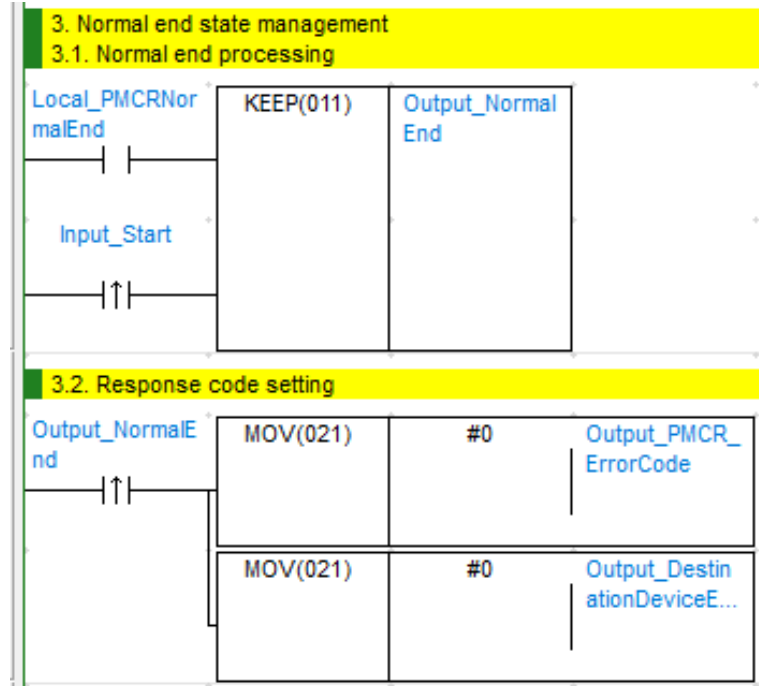
The communications port No. 7 is used in this program.

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.



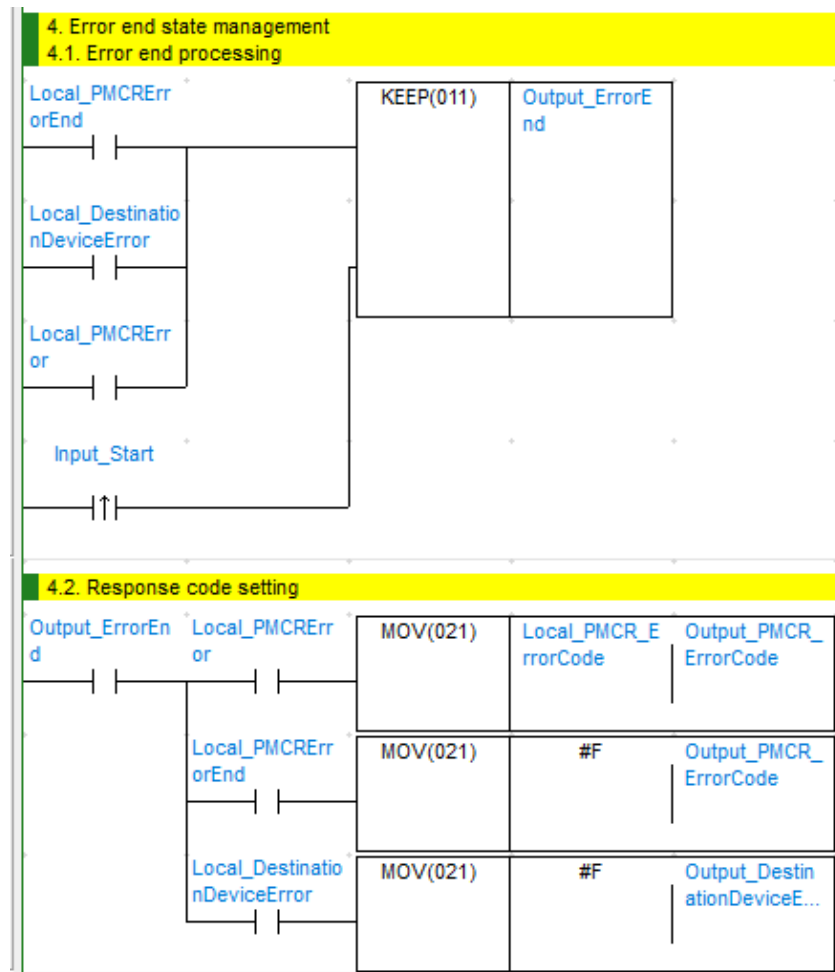
No.	Name	Description
2.3.	Normal/error judgement processing	<p>Detects a normal or error end of the send/receive processing.</p> <p>It is considered as a normal end when all the following conditions are met.</p> <p>(1) Normal end of the PMCR instruction (No PMCR instruction error)</p> <p>(2) Normal end of communications sequence (No communications error)</p> <p>(3) Normal messages received from the Destination Device (No Destination Device error)</p> <p>If any error occurs, the corresponding error flag is turned ON.</p>

## 3. Normal end state management



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

## 4. Error end state management



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

**Additional Information**

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

## 9.6. Protocol Data

The protocol data consists of a sequence, steps, send/receive messages and a receive matrix. The structure is described as follows:

- When there is only one receive message format for a step (send/receive once):

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

Sequence No. 900	Step No. 00	Send message 00	Receive message 00
⋮			
Sequence No. xxx	Step No. yy	Send message yy	Receive message yy

xxx: 999 max / yy: 15 max

- When there are several types of receive message formats for a step (send/receive once):

A send message and receive matrix are set for a step.

Several types of receive message formats are set in the case numbers 00 to 14 of receive matrix. ("Other" is automatically set in the case number 15.)

Sequence No. 900	Step No. 00	Send message 00	< Receive matrix >	
⋮			Case No. 00	Receive message 00
⋮	Step No. yy			
	yy: 15 max	zz: 14 max	Case No. zz	Receive message zz
Sequence No. xxx	xxx: 999 max	Automatically stores in the case No. 15	Case No. 15	Other

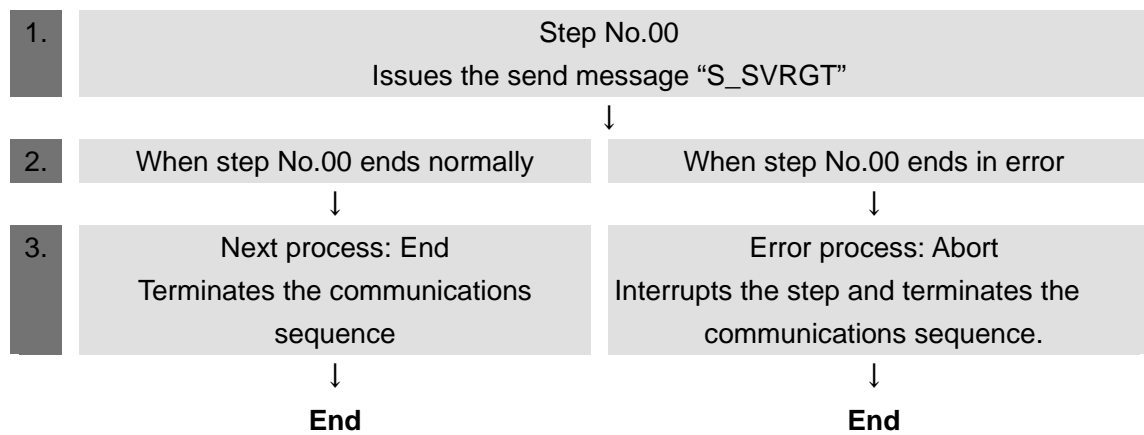
### 9.6.1. Protocol Data Structure

The receive message "R\_SVARGET" is used for the send message "S\_SVRGT" in the protocol data used in this guide. The structure is given below.

Sequence No. 900	Step No. 00	S_SVRGT	R_SVARGET
------------------	-------------	---------	-----------

### 9.6.2. Procedure for Protocol Data Processing

The procedure for protocol data processing is shown below.



### 9.6.3. Sequence Settings

The command "single output with stability information" is executed by using the communications sequence No. 900 in the protocol data used in this guide.

The time for monitoring the send and receive processing (monitoring time) is set for the communications sequence.



#### Additional Information

For details on the sequence settings, refer to *3-2 Sequence Attributes (Common to All Steps)* of the *CX-Protocol OPERATION MANUAL* (Cat. No. W344).

#### Timeout period setting

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

#### Screenshot of communications sequence setting

#	Communication Sequence	Link Word	Control	Response	Timer Tr	Timer Tfr	Timer Tfs
900	New Sequence	---	Set	Scan	3 sec	3 sec	3 sec

#### Settings

Item	Meaning	Explanation
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 settings for the communications sequence No. 900 are given below.

The settings include retry count, send/receive message names, next process, and error process. The sequence of the protocol data used in this guide is composed 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 setting

The retry count 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 Send&Receive command is set.

#### Screenshot of step settings

Step	Repeat	Command	Retry	Send Wait	Send Message	Recv Message	Response	Next	Error
00	RSET/001	Send & Receive	3	---	S_SVRGT	R_SVARGET	YES	End	Abort

#### Setting

Step No.	Retry count
00	3

#### Send/Receive message name setting

The send/receive message names set for the step are shown below, which must be the names created in the send message settings and the receive message settings.

#### Screenshot of step settings

Step	Repeat	Command	Retry	Send Wait	Send Message	Recv Message	Response	Next	Error
00	RSET/001	Send & Receive	3	---	S_SVRGT	R_SVARGET	YES	End	Abort

#### Setting

Step No.	Send message	Receive message
00	S_SVRGT	R_SVARGET

### Next process and error process settings

The next process and the error process set in the step are shown below.

The process set in the *Next* Column is executed when a previous step execution ends normally. If a communications error occurs, the process set in the *Error* Column is executed.

### Screenshot of step settings



Step	Repeat	Command	Retry	Send Wait	Send Message	Recv Message	Response	Next	Error
00	RSET/001	Send & Receive	3	---	S_SVRGT	R_SVARGET	YES	End	Abort

### Setting

Step No.	Next process	Error process
00	End	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	Uses the settings of the receive matrix.

### 9.6.5. Send Message Settings

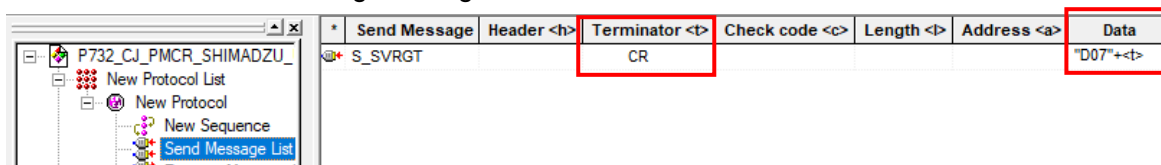
The send message settings are shown below.



#### Additional Information

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

Screenshot of send message settings



S\_SVRGT send message setting

Setting

"D07"+<t>  
(1) (2)

No.	Code	Description
(1)	"D07"	Constant ASCII (single output with stability information)
(2)	<t> (Terminator)	Type: Code, Data: CR

Send message command format

This is the command format of the message that is sent by the SCU to the Destination Device according to the S\_SVRGT send message setting.

"D07"	CR
-------	----

Command	The number of bytes	Remarks
"D07"	3	Fixed: "D07" (single output with stability information)
Terminator	1	CR(#0D) is used for the protocol data in this guide.

### 9.6.6. Receive Message Settings

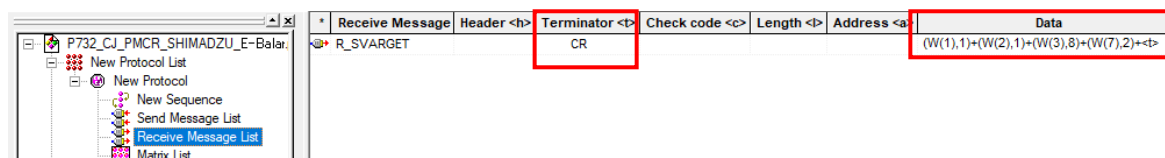
The receive message settings are shown below, which correspond to the response formats of normal and error messages.



#### 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 receive message settings



#### Normal and error message identification

In the protocol data used in this guide, the normal and error messages can be identified by receive message data.

Normal message: "(stability output) (sign) (absolute value) (unit)"

Error message: "U \_ \_ \_ \_ OL \_ \_ \_ \_" (" \_ ": space)

"U - \_ \_ \_ \_ OL \_ \_ \_ \_" (" \_ ": space)

#### R\_SVARGET receive message setting (normal message / error message)

Setting

(W(1),1)+(W(2),1)+(W(3),8)+(W(7),2)+<t>

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

No.	Code	Description
(1)	(W(1),1)	Stores 1 byte of data in the first receive word + 1 word that is specified in the PMCR instruction operand.
(2)	(W(2),1)	Stores 1 byte of data in the first receive word + 2 words that is specified in the PMCR instruction operand.
(3)	(W(3),8)	Stores 8 bytes of data in the first receive word + 8 words that is specified in the PMCR instruction operand.
(4)	(W(7),2)	Stores 2 bytes of data in the first receive word + 2 words that is specified in the PMCR instruction operand.
(5)	<t> (terminator)	Type: Code, Data: CR

## Response format of normal message

This is the response format of the normal message received by the SCU from the Destination Device according to the R\_SVARGET receive message setting.

Stability information	Sign	Absolute value	Unit	CR
-----------------------	------	----------------	------	----

Command	The number of bytes	Remarks
Stability information	1	Receives "S" when stable and "U" when unstable
Sign	1	Receives "_" when positive value and "-" when negative value
Absolute value	8	Variable: (displayed value)
Unit	2	Receives "g_" in this guide.
Terminator	1	Receives CR(#0D) used in the protocol data in this guide.

## Response format of error message

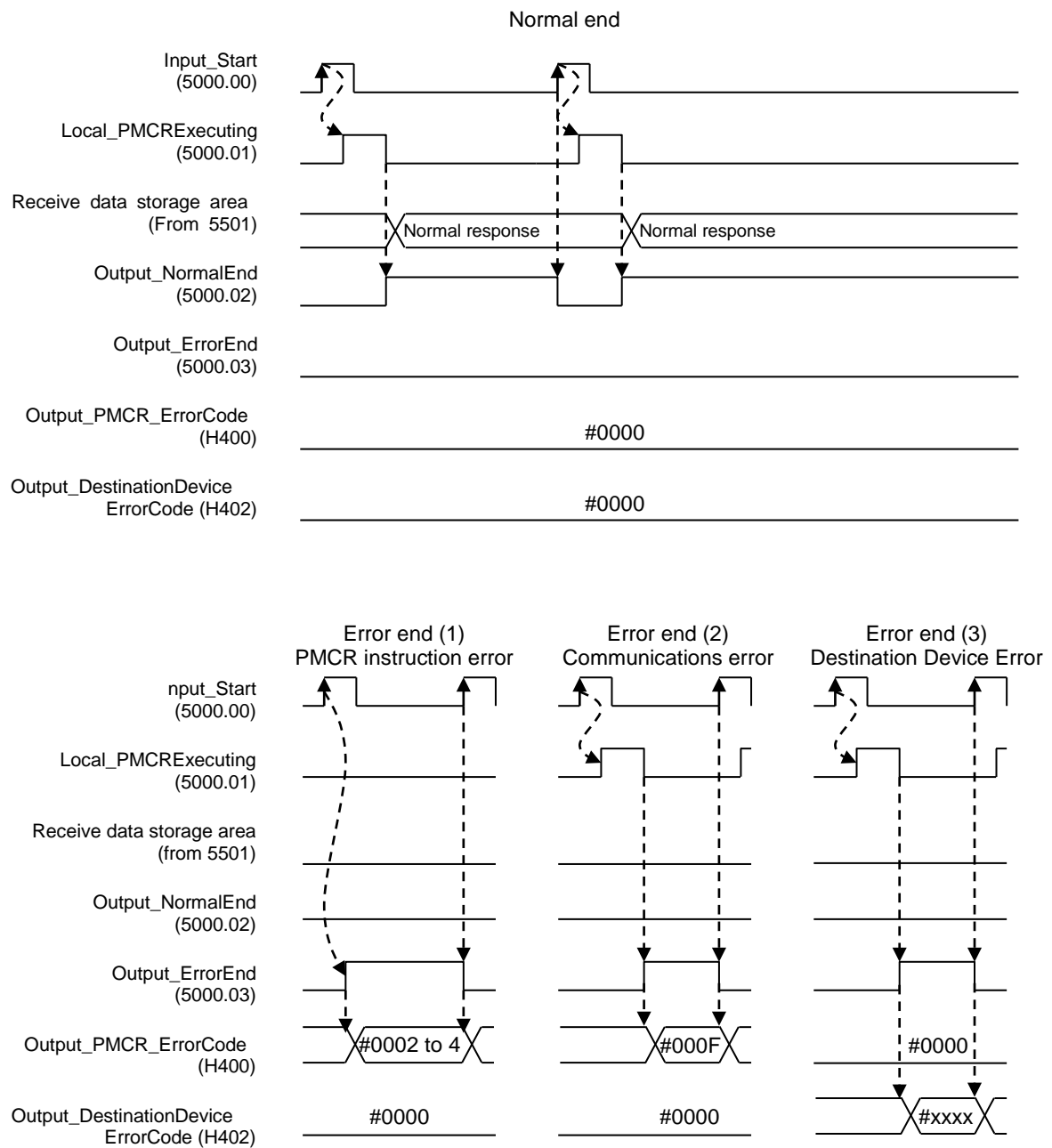
This is the response format of the message received by the SCU from the Destination Device according to the R\_SVARGET receive message setting.

"U"	Sign	"_ _ _ _ OL _ _ _ _"	CR
-----	------	----------------------	----

Command	The number of bytes	Remarks
Stability information	1	Stores "U" (unstable).
Sign	1	Stores "_" when overload and "-" when minus overload.
Overload	10	Fixed: stores "_ _ _ _ OL _ _ _ _" using the fields in the response format of normal message where the absolute value and unit are written.
Terminator	1	Stores CR(#0D) used in the protocol data in this guide.

9.7. Timing Chart

The timing charts are shown below.



## 9.8. Error processing

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

### 9.8.1. Protocol Macro Error Code

The SCU detects an error while monitoring the macro operation.

The error codes include either (1) PMCR instruction error or (2) Communications error (transmission error, etc.) 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 by the PMCR instruction does not exist in Unit.
#0003	Data Read/Write Area Exceeded Error	(1) PMCR instruction error	When data is written or read to CPU Unit, the specified area range was exceeded.
#0004	Protocol Data Syntax Error	(1) PMCR instruction error	A code that cannot be executed occurs while the protocol macro was executed. (e.g. 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 more information and troubleshooting tips 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 Code

The Destination Device detects an error while executing the command on Destination Device.  
The error code is stored in H402 Output\_DestinationDeviceErrorCode.

Error code list

Error code	Description
#000F	An error is detected in the Destination Device. (overload or minus overload)



#### Additional Information

For more information and troubleshooting tips on the Destination Device errors, refer to the following manuals.

- 17. *Troubleshooting of the Electronic Balance Instruction Manual (321-78048)*
- 14. *Troubleshooting of the Top-loading Balance Instruction Manual (321-78282)*
- 12. *TROUBLESHOOTING of the Analytical Balance Instruction Manual (321-78327)*



## 10. Revision History

Revision code	Date of revision	Description of revision
01	January 2020	First edition

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