

# **SYSMAC CP Series**

**CP1L-EL20D□-□**

**CP1L-EM30D□-□**

**CP1L-EM40D□-□**

## **CP1L-EL/EM CPU Unit**

# **OPERATION MANUAL**

# **OMRON**

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**CP1L-EL20D□-□**

**CP1L-EM30D□-□**

**CP1L-EM40D□-□**

# **CP1L-EL/EM CPU Unit**

## **Operation Manual**

*Produced July 2017*








## Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

-  **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Additionally, there may be severe property damage.
-  **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
-  **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

## OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PLC” means Programmable Controller. “PC” is used, however, in some CX-Programmer displays to mean Programmable Controller.

## Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

**Note** Indicates information of particular interest for efficient and convenient operation of the product.

**1,2,3...** 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

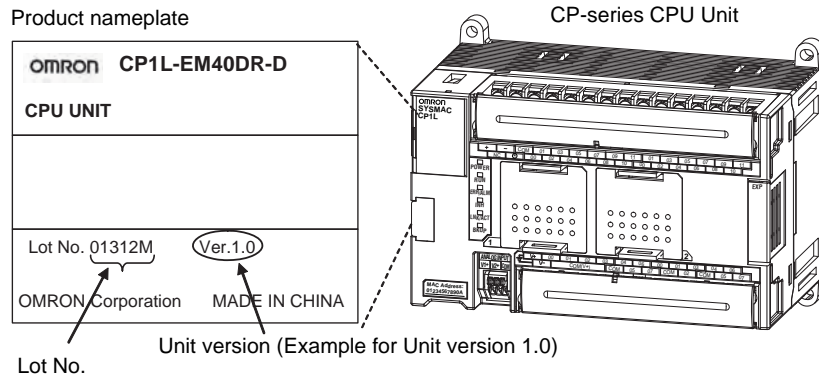
# Unit Versions of CP-series CPU Units

## Unit Versions

### Notation of Unit Versions on Products

A “unit version” has been introduced to manage CPU Units in the CP Series according to differences in functionality accompanying Unit upgrades.

The unit version is given to the right of the lot number on the nameplate of the products for which unit versions are being managed, as shown below.



### Confirming Unit Versions with Support Software

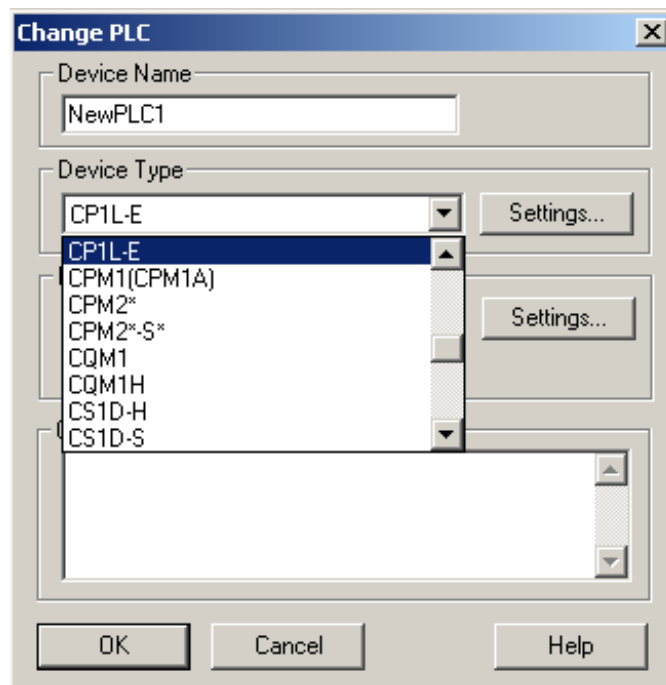
CX-Programmer version 9.4 or higher can be used to confirm the unit version of the CP1L-EL/EM CPU Unit.

**Note** CX-Programmer version 9.3 or lower cannot be used to confirm unit versions for CP1L-EL/EM CPU Units.

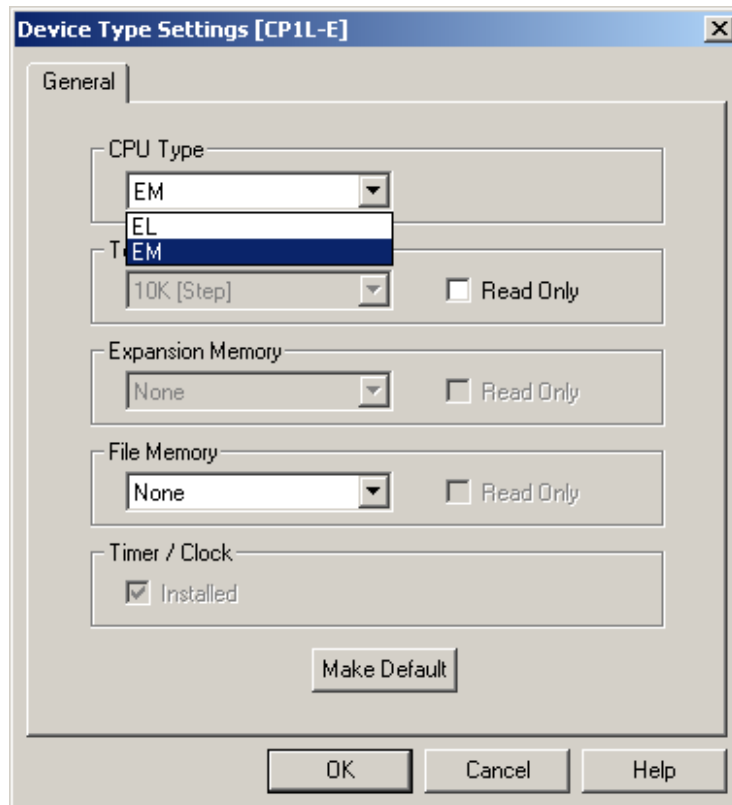
#### ■ Confirmation Procedure

##### Procedure When the Device Type and CPU Type Are Known

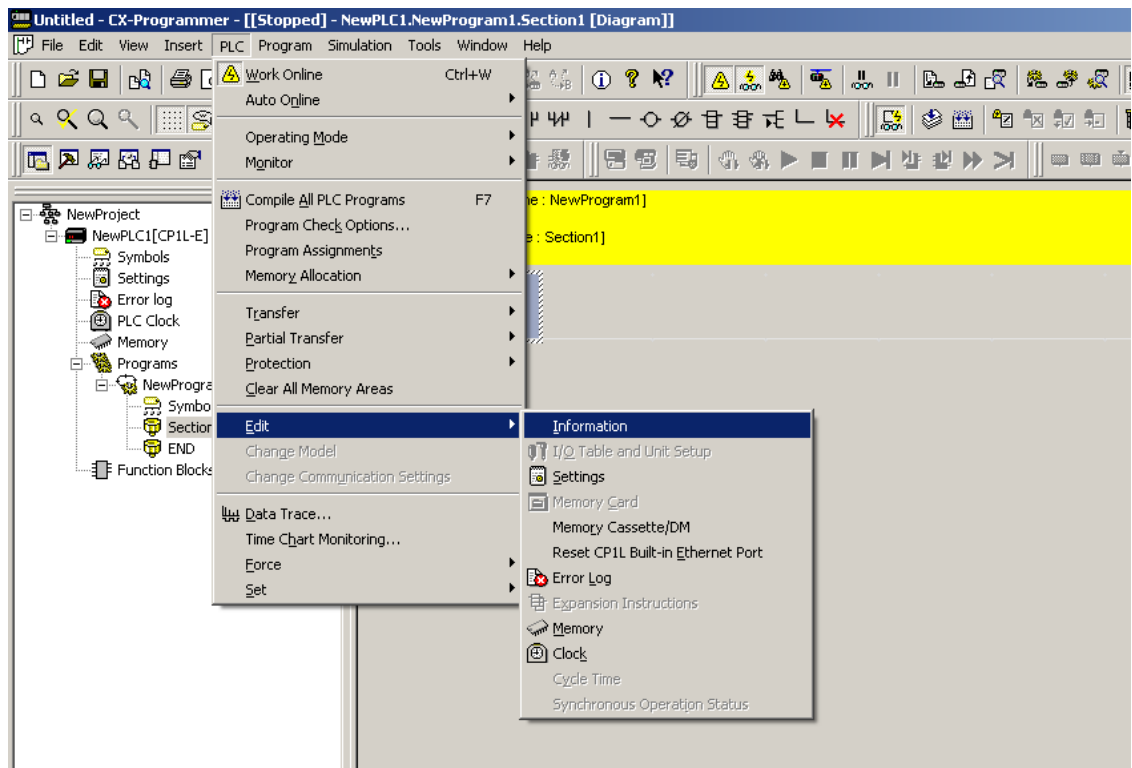
- 1,2,3... 1. Set the *Device Type* Field in the Change PLC Dialog Box to *CP1L-E*.



- Click the **Settings** Button by the *Device Type* Field and, when the Device Type Settings Dialog Box is displayed, set the *CPU Type* Field to *EL* or *EM*.



- Go online and select **PLC - Edit - Information**.  
(Refer to 5-1 Connecting the CX-Programmer)



The PLC Information Dialog Box will be displayed.



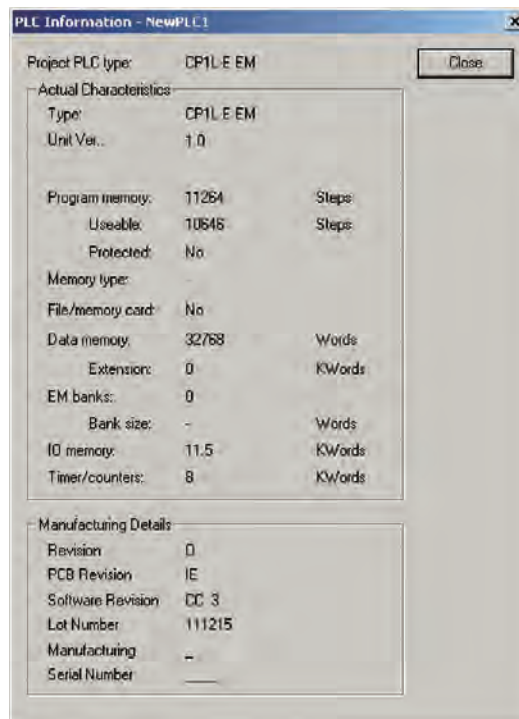
Use the above display to confirm the unit version of the CPU Unit.

### **Procedure When the Device Type and CPU Type Are Not Known**

This procedure is possible only when connected directly to the CPU Unit with a serial connection.

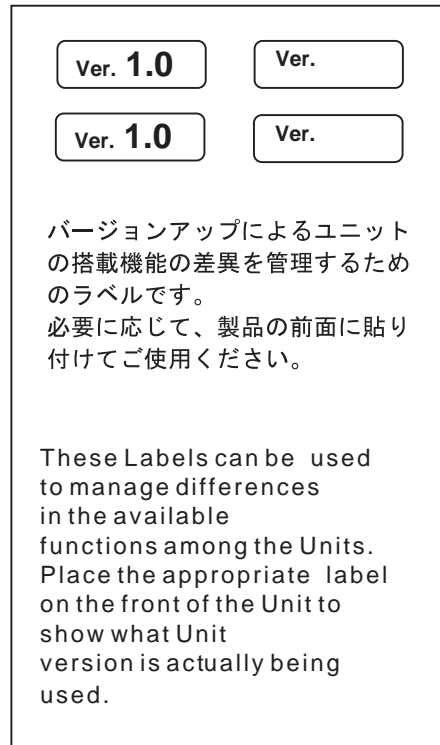
If you don't know the device type and CPU type that are connected directly to the CPU Unit on a serial line, select **PLC - Auto Online** to go online, and then select **PLC - Edit - Information** from the menus.

The PLC Information Dialog Box will be displayed and can be used to confirm the unit version of the CPU Unit.



## Using the Unit Version Labels

The following unit version labels are provided with the CPU Unit.



These labels can be attached to the front of previous CPU Units to differentiate between CPU Units of different unit versions.



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## About this Manual:

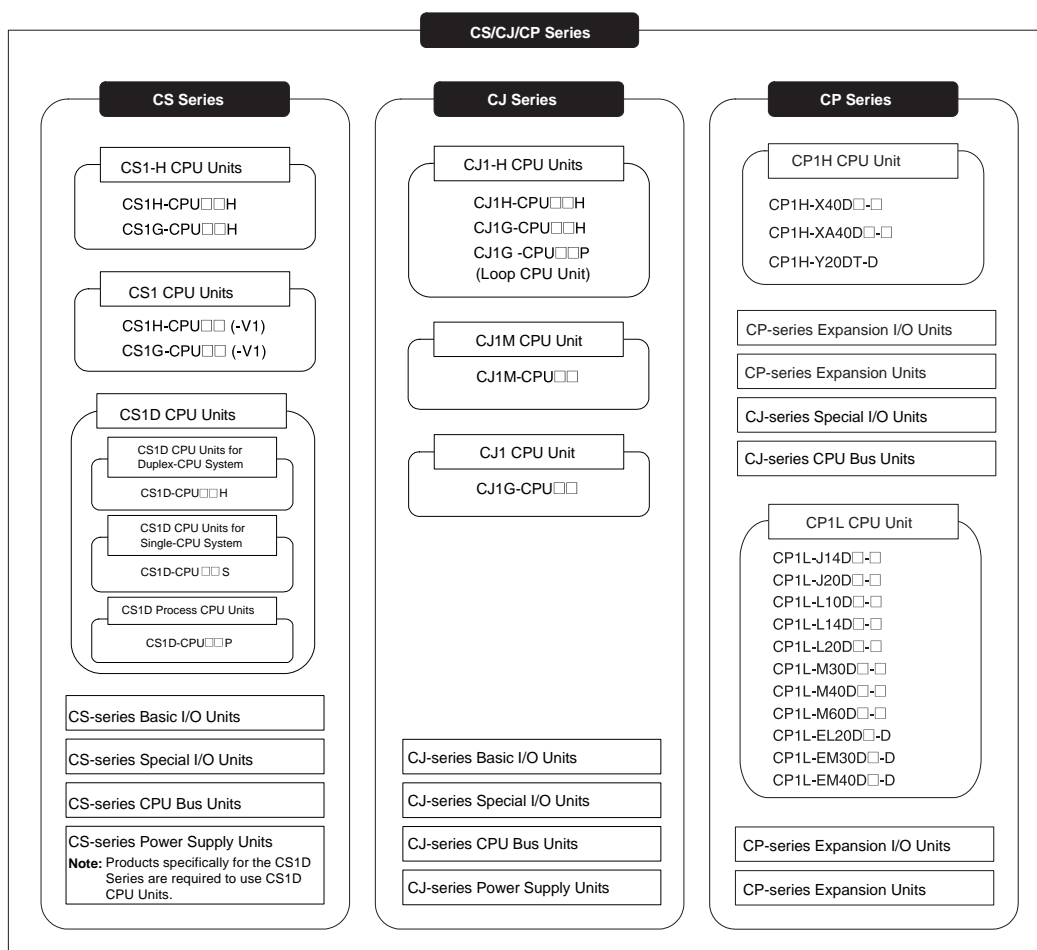
This manual describes installation and operation of the CP-series Programmable Controllers (PLCs) and includes the sections described below. The CP Series provides advanced package-type PLCs based on OMRON's advanced control technologies and vast experience in automated control.

Please read this manual carefully and be sure you understand the information provided before attempting to install or operate a CP-series PLC. Be sure to read the precautions provided in the following section.

### Definition of the CP Series

The CP Series is centered around the CP1H and CP1L CPU Units and is designed with the same basic architecture as the CS and CJ Series. Always use CP-series Expansion Units and CP-series Expansion I/O Units when expanding I/O capacity.

I/O words are allocated in the same way as the CPM1A/CPM2A PLCs, i.e., using fixed areas for inputs and outputs.



**Precautions** provides general precautions for using the Programmable Controller and related devices.

**Section 1** introduces the features of the CP1L-EL/EM and describes its configuration. It also describes the Units that are available and connection methods for Programming Devices and other peripheral devices.

**Section 2** describes the names and functions of CP1L-EL/EM parts and provides CP1L-EL/EM specifications.

**Section 3** describes how to install and wire the CP1L-EL/EM.

**Section 4** describes the structure and functions of the I/O Memory Areas and Parameter Areas.

**Section 5** describes the methods for CX-Programmer connection, the processes used to transfer the program to the CPU Unit and the functions that can be used to test and debug the program.

**Section 6** gives an outline of the built-in Ethernet function, explains its specification and how to make the settings required for operation.

**Section 7** describes the CP1L-EL/EM's interrupt and high-speed counter functions.

**Section 8** describes all of the advanced functions of the CP1L-EL/EM that can be used to achieve specific application needs.

**Section 9** describes how to use CP-series Expansion Units and Expansion I/O Units.

**Section 10** describes how to use Analog Input/Output Option Board.

**Section 11** gives an outline of the LCD Option Board, explains how to install and remove the LCD Option Board, and describes the functions including how to monitor and make settings for the PLC. It also lists the errors during operation and provides probable causes and countermeasures for troubleshooting.

**Section 12** provides information on hardware and software errors that occur during CP1L-EL/EM operation.

**Section 13** provides inspection and maintenance information.

**Appendices** provide product lists, dimensions, tables of Auxiliary Area allocations, and a memory map.

## Related Manuals

The following manuals are used for the CP1L-EL/EM CPU Units. Refer to these manuals as required.

| Cat. No. | Model numbers   | Manual name   | Description  |
|----------|---|---|--|
| W516     | CP1L-EL20D□-□<br>CP1L-EM30D□-□<br>CP1L-EM40D□-□   | SYSMAC CP Series<br>CP1L-EL/EM CPU<br>Unit Operation Manual (this manual) | Provides the following information on the CP Series:<br><ul style="list-style-type: none"> <li>• Overview, design, installation, maintenance, and other basic specifications</li> <li>• Features</li> <li>• System configuration</li> <li>• Mounting and wiring</li> <li>• I/O memory allocation</li> <li>• Troubleshooting</li> </ul> Use this manual together with the <i>CP1L Programmable Controllers Programming Manual</i> (W451). |
| W451     | CP1H-X40D□-□<br>CP1H-XA40D□-□<br>CP1H-Y20DT-D<br>CP1L-L10D□-□<br>CP1L-L14D□-□<br>CP1L-L20D□-□<br>CP1L-M30D□-□<br>CP1L-M40D□-□<br>CP1L-M60D□-□ | SYSMAC CP Series<br>CP1H/CP1L CPU<br>Unit Programming Manual              | Provides the following information on programming the CP Series:<br><ul style="list-style-type: none"> <li>• Programming methods</li> <li>• Tasks</li> <li>• Programming instructions</li> </ul>   |
| W461     | CP1L-L10D□-□<br>CP1L-L14D□-□<br>CP1L-L20D□-□<br>CP1L-M30D□-□<br>CP1L-M40D□-□<br>CP1L-M60D□-□  | SYSMAC CP Series<br>CP1L CPU Unit Introduction Manual                     | Describes basic setup methods of CP1L PLCs:<br><ul style="list-style-type: none"> <li>• Basic configuration and component names</li> <li>• Mounting and wiring</li> <li>• Programming, data transfer, and debugging using the CX-Programmer</li> <li>• Application program examples</li> </ul>   |
| W446     | CXONE-AL□□C-V4<br>CXONE-AL□□D-V4  | SYSMAC CX-Programmer Operation Manual                                     | Provides information on how to use the CX-Programmer for all functionality except for function blocks.   |
| W447     | CXONE-AL□□C-V4<br>CXONE-AL□□D-V4  | CX-Programmer Operation Manual<br>Function Blocks/<br>Structured Text     | Explains how to use the CX-Programmer software's function block and structured text functions. For explanations of other shared CX-Programmer functions, refer to the CX-Programmer Operation Manual (W446).   |
| W463     | CXONE-AL□□C-V4<br>CXONE-AL□□D-V4  | CX-One Setup Manual   | Installation and overview of CX-One FA Integrated Tool Package.  |
| W464     | CXONE-AL□□C-V4<br>CXONE-AL□□D-V4  | CX-Integrator Operation Manual  | Describes CX-Integrator operating methods, e.g., for setting up and monitoring networks.   |
| W344     | WS02-PSTC1-E  | CX-Protocol Operation Manual  | Provides operating procedures for creating protocol macros (i.e., communications sequences) with the CX-Protocol and other information on protocol macros.<br><br>The CX-Protocol is required to create protocol macros for user-specific serial communications or to customize the standard system protocols.   |

| Cat. No. | Model numbers   | Manual name   | Description  |
|----------|---|---|--|
| W342     | CS1G/H-CPU□□H<br>CS1G/H-CPU□□-V1<br>CS1D-CPU□□H<br>CS1D-CPU□□S<br>CS1W-SCU□□-V1<br>CS1W-SCB□□-V1<br>CJ1G/H-CPU□□H<br>CJ1G-CPU□□P<br>CJ1M-CPU□□<br>CJ1G-CPU□□<br>CJ1W-SCU□□-V1 | SYSMAC CS/CJ/CP/<br>NSJ-series Communi-<br>cations Commands<br>Reference Manual | Describes commands addressed to CS-series, CJ-series, and CP-series CPU Units, including C-mode commands and FINS commands.<br><br><b>Note</b> This manual describes on commands address to CPU Units regardless of the communications path. (CPU Unit serial ports, Serial Communications Unit/Board ports, and Communications Unit ports can be used.) Refer to the relevant operation manuals for information on commands addresses to Special I/O Units and CPU Bus Units. |
| W420     | CS1W-ETN21<br>CJ1W-ETN21  | Ethernet Units Operation Manual Construction of Networks                        | Provides information on operating and installing 100Base-TX Ethernet Units, including details on basic settings and FINS communications. Refer to the <i>Communications Commands Reference Manual</i> (W342) for details on FINS commands that can be sent to CS-series and CJ-series CPU Units when using the FINS communications service.  |
| W421     | CS1W-ETN21<br>CJ1W-ETN21  | Ethernet Units Operation Manual Construction of Applications                    | Provides information on constructing host applications for 100Base-TX Ethernet Units, including functions for sending/receiving mail, socket service, automatic clock adjustment, FTP server functions, and FINS communications.   |

# ***Terms and Conditions Agreement***

## ***Warranty and Limitations of Liability***

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### ***SUITABILITY OF USE***

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NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

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### ***CHANGE IN SPECIFICATIONS***

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

### ***ERRORS AND OMISSIONS***

Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.



# PRECAUTIONS

This section provides general precautions for using the CP-series Programmable Controllers (PLCs) and related devices. The information contained in this section is important for the safe and reliable application of Programmable Controllers. You must read this section and understand the information contained before attempting to set up or operate a PLC system.

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## 1 Intended Audience

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

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


## 2 General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.


Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.


Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.


This manual provides information for programming and operating the Unit. Be sure to read this manual before attempting to use the Unit and keep this manual close at hand for reference during operation.


 **WARNING** It is extremely important that a PLC and all PLC Units be used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before applying a PLC System to the above-mentioned applications.

## 3 Safety Precautions

 **WARNING** Do not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.

 **WARNING** Do not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

 **WARNING** Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

 **WARNING** Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, to ensure safety in the system if an abnormality occurs due to malfunction of the PLC or another external factor affecting the PLC operation. Not doing so may result in serious accidents.

- Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.

- The PLC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. Unexpected operation, however, may still occur for errors in the I/O control section, errors in I/O memory, and errors that cannot be detected by the self-diagnosis function. As a countermeasure for all these errors, external safety measures must be provided to ensure safety in the system.
- The PLC or outputs may remain ON or OFF due to deposits on or burning of the output relays, or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
- When the 24-V DC output (service power supply to the PLC) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned OFF. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

**⚠ WARNING** Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes. Not doing so may result in serious accidents.

**⚠ WARNING** Do not apply the voltage/current outside the specified range to this unit. It may cause a malfunction or fire.

**⚠ Caution** Execute online edit only after confirming that no adverse effects will be caused by extending the cycle time. Otherwise, the input signals may not be readable.

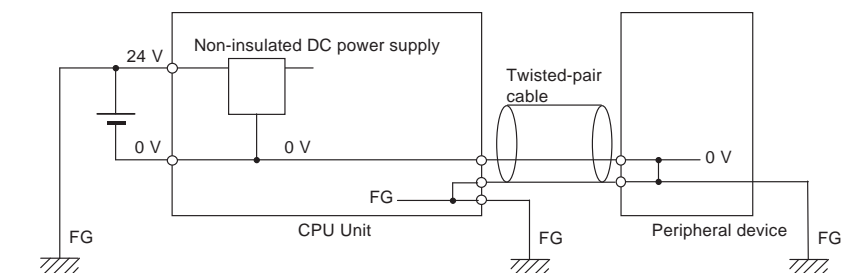
**⚠ Caution** Confirm safety at the destination node before transferring a program to another node or editing the I/O area. Doing either of these without confirming safety may result in injury.


**⚠ Caution** Tighten the screws on the terminal block of the AC power supply to the torque specified in this manual. The loose screws may result in burning or malfunction.


**⚠ Caution** Do not touch anywhere near the power supply parts or I/O terminals while the power is ON, and immediately after turning OFF the power. The hot surface may cause burn injury.

**⚠ Caution** Pay careful attention to the polarities (+/-) when wiring the DC power supply. A wrong connection may cause malfunction of the system.


**⚠ Caution** When connecting the PLC to a computer or other peripheral device, either ground the 0 V side of the external power supply or do not ground the external power supply at all. Otherwise the external power supply may be shorted depending on the connection methods of the peripheral device. DO NOT ground the 24 V side of the external power supply, as shown in the following diagram.




 **Caution** After programming (or reprogramming) using the IOWR instruction, confirm that correct operation is possible with the new ladder program and data before starting actual operation. Any irregularities may cause the product to stop operating, resulting in unexpected operation in machinery or equipment.

 **Caution** The CP1L-EL/EM CPU Units automatically back up the user program and parameter data to flash memory when these are written to the CPU Unit. I/O memory (including the DM Area, counter present values and Completion Flags, and HR Area), however, is not written to flash memory. The DM Area, counter present values and Completion Flags, and HR Area can be held during power interruptions with a battery. If there is a battery error, the contents of these areas may not be accurate after a power interruption. If the contents of the DM Area, counter present values and Completion Flags, and HR Area are used to control external outputs, prevent inappropriate outputs from being made whenever the Battery Error Flag (A402.04) is ON.


## 4 Operating Environment Precautions


 **Caution** Do not operate and keep the control system in the following locations:

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.
- Locations subject to direct rain fall.
- Locations subject to direct strong UV.

 **Caution** Take appropriate and sufficient countermeasures when installing systems in the following locations:


- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

 **Caution** The operating environment of the PLC System can have a large effect on the longevity and reliability of the system. Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the PLC System. Make sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.


 **Caution** Please fit it as foreign matter such as chips or wiring rubbish inside the unit. It becomes a cause of damage by fire, failure and malfunction. Especially during construction, please take measures.

## 5 Application Precautions

Observe the following precautions when using the PLC System.

 **WARNING** Always heed these precautions. Failure to abide by the following precautions could lead to serious or possibly fatal injury.

- Always connect to 100  $\Omega$  or less when installing the Units. Not connecting to a ground of 100  $\Omega$  or less may result in electric shock.
- Always turn OFF the power supply to the PLC before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
  - Mounting or dismounting Expansion Units or any other Units
  - Connecting or removing the Memory Cassette or Option Board
  - Setting DIP switches or rotary switches
  - Connecting or wiring the cables
  - Connecting or disconnecting the connectors

 **Caution** Failure to abide by the following precautions could lead to faulty operation of the PLC or the system, or could damage the PLC or PLC Units. Always heed these precautions.

- When unpacking the Unit, check carefully for any external scratches or other damages. Also, shake the Unit gently and check for any abnormal sound.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
- Mount the Unit only after checking the connectors and terminal blocks completely.
- Be sure that all the terminal screws and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.
- Wire all connections correctly according to instructions in this manual.
- Keep the wire cuttings out of the Unit when wiring.
- Always use the power supply voltage specified in the operation manuals. An incorrect voltage may result in malfunction or burning.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
- Leave the label attached to the Unit when wiring. Removing the label may result in malfunction.
- Remove the label after the completion of wiring to ensure proper heat dissipation. Leaving the label attached may result in malfunction.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.
- Do not apply voltages to the input terminals in excess of the rated input voltage. Excess voltages may result in burning.

- Do not apply voltages or connect loads to the output terminals in excess of the maximum switching capacity. Excess voltage or loads may result in burning.
- Be sure that the terminal blocks, connectors, Option Boards, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.
- Disconnect the functional ground terminal when performing withstand voltage tests. Not disconnecting the functional ground terminal may result in burning.
- Wire correctly and double-check all the wiring or the setting switches before turning ON the power supply. Incorrect wiring may result in burning.
- Check that the DIP switches and data memory (DM) are properly set before starting operation.
- Check the user program for proper execution before actually running it on the Unit. Not checking the program may result in an unexpected operation.
- Resume operation only after transferring to the new CPU Unit the contents of the DM, HR, and CNT Areas required for resuming operation. Not doing so may result in an unexpected operation.
- Confirm that no adverse effect will occur in the system before attempting any of the following. Not doing so may result in an unexpected operation.
  - Changing the operating mode of the PLC (including the setting of the startup operating mode).
  - Force-setting/force-resetting any bit in memory.
  - Changing the present value of any word or any set value in memory.
- Do not pull on the cables or bend the cables beyond their natural limit. Doing either of these may break the cables.
- Do not place objects on top of the cables. Doing so may break the cables.
- When replacing parts, be sure to confirm that the rating of a new part is correct. Not doing so may result in malfunction or burning.
- Before touching the Unit, be sure to first touch a grounded metallic object in order to discharge any static buildup. Not doing so may result in malfunction or damage.
- Install the Unit properly as specified in the operation manual. Improper installation of the Unit may result in malfunction.
- Do not touch the Expansion I/O Unit Connecting Cable while the power is being supplied in order to prevent malfunction due to static electricity.
- Do not turn OFF the power supply to the Unit while data is being transferred.
- When transporting or storing the product, cover the PCBs and the Units or put there in the antistatic bag with electrically conductive materials to prevent LSIs and ICs from being damaged by static electricity, and also keep the product within the specified storage temperature range.
- Do not touch the mounted parts or the rear surface of PCBs because PCBs have sharp edges such as electrical leads.
- Double-check the pin numbers when assembling and wiring the connectors.
- Wire correctly according to specified procedures.



- Do not connect pin 6 (+5V) on the RS-232C Option Board (CP1W-CIF01) on the CPU Unit to any external device other than the NT-AL001 or CJ1W-CIF11 Conversion Adapter. The external device and the CPU Unit may be damaged.
- Use the dedicated connecting cables specified in this manual to connect the Units. Using commercially available RS-232C computer cables may cause failures in external devices or the CPU Unit.
- The user program and parameter area data in the CPU Unit is backed up in the built-in flash memory. The BKUP indicator will light on the front of the CPU Unit when the backup operation is in progress. Do not turn OFF the power supply to the CPU Unit when the BKUP indicator is lit. The data will not be backed up if power is turned OFF.
- Do not turn OFF the power supply to the PLC while the Memory Cassette is being written. Doing so may corrupt the data in the Memory Cassette. The BKUP indicator will light while the Memory Cassette is being written. Wait for the BKUP indicator to go out before turning OFF the power supply to the PLC.
- Before replacing the battery, supply power to the CPU Unit for at least 5 minutes and then complete battery replacement within 5 minutes of turn OFF the power supply. Memory data may be corrupted if this precaution is not observed.
- Always use the following size wire when connecting I/O terminals: AWG22 to AWG18 (0.32 to 0.82 mm<sup>2</sup>).
- Dispose of the product and batteries according to local ordinances as they apply.  
Have qualified specialists properly dispose of used batteries as industrial waste.



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- UL standards required that batteries be replaced only by experienced technicians. Do not allow unqualified persons to replace batteries. Also, always follow the replacement procedure provided in the manual.
- Never short-circuit the positive and negative terminals of a battery or charge, disassemble, heat, or incinerate the battery. Do not subject the battery to strong shocks or deform the battery by applying pressure. Doing any of these may result in leakage, rupture, heat generation, or ignition of the battery. Dispose of any battery that has been dropped on the floor or otherwise subjected to excessive shock. Batteries that have been subjected to shock may leak if they are used.
- Always construct external circuits so that the power to the PLC is turned ON before the power to the control system is turned ON. If the PLC power supply is turned ON after the control power supply, temporary errors may result in control system signals because the output terminals on DC Output Units and other Units will momentarily turn ON when power is turned ON to the PLC.
- Fail-safe measures must be taken by the customer to ensure safety in the event that outputs from Output Units remain ON as a result of internal circuit failures, which can occur in relays, transistors, and other elements.

- If the I/O Hold Bit is turned ON, the outputs from the PLC will not be turned OFF and will maintain their previous status when the PLC is switched from RUN or MONITOR mode to PROGRAM mode. Make sure that the external loads will not produce dangerous conditions when this occurs. (When operation stops for a fatal error, including those produced with the FALS(007) instruction, all outputs from Output Unit will be turned OFF and only the internal output status will be maintained.)

## 6 Conformance to EC Directives

### 6-1 Applicable Directives

- EMC Directives
- Low Voltage Directive

### 6-2 Concepts

#### EMC Directives

OMRON devices that comply with EC Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards (see the following note). Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer.

EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

**Note** The applicable EMC (Electromagnetic Compatibility) standard is EN61131-2.

#### Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 V AC and 75 to 1,500 V DC meet the required safety standards for the PLC (EN61131-2).

### 6-3 Conformance to EC Directives

The CP1L-EL/EM PLCs comply with EC Directives. To ensure that the machine or device in which the CP1L-EL/EM PLC is used complies with EC Directives, the PLC must be installed as follows:

- 1,2,3...**
1. The CP1L-EL/EM PLC must be installed within a control panel.
  2. You must use reinforced insulation or double insulation for the DC power supplies used for I/O Units and CPU Units requiring DC power. The output holding time must be 10 ms minimum for the DC power supply connected to the power supply terminals on Units requiring DC power.
  3. CP1L-EL/EM PLCs complying with EC Directives also conform to EN61131-2. Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions. You must therefore confirm that the overall machine or equipment complies with EC Directives.

## 6-4 Relay Output Noise Reduction Methods

The CP1L-EL/EM PLCs conforms to the Common Emission Standards (EN61131-2) of the EMC Directives. However, noise generated by relay output switching may not satisfy these Standards. In such a case, a noise filter must be connected to the load side or other appropriate countermeasures must be provided external to the PLC.

Countermeasures taken to satisfy the standards vary depending on the devices on the load side, wiring, configuration of machines, etc. Following are examples of countermeasures for reducing the generated noise.

### Countermeasures

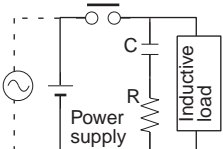
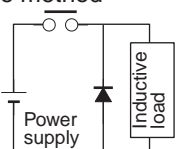
Countermeasures are not required if the frequency of load switching for the whole system with the PLC included is less than 5 times per minute.

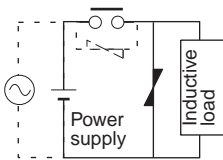
Countermeasures are required if the frequency of load switching for the whole system with the PLC included is more than 5 times per minute.

**Note** Refer to EN61131-2 for more details.

### Countermeasure Examples

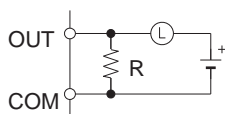
When switching an inductive load, connect an surge protector, diodes, etc., in parallel with the load or contact as shown below.

| Circuit  | Current |     | Characteristic  | Required element   |
|--|---------|-----|---|--|
|  | AC      | DC  |   |  |
| <b>CR method</b><br>    | Yes     | Yes | <p>If the load is a relay or solenoid, there is a time lag between the moment the circuit is opened and the moment the load is reset.</p> <p>If the supply voltage is 24 or 48 V, insert the surge protector in parallel with the load. If the supply voltage is 100 to 200 V, insert the surge protector between the contacts.</p>   | <p>The capacitance of the capacitor must be 1 to 0.5 <math>\mu\text{F}</math> per contact current of 1 A and resistance of the resistor must be 0.5 to 1 <math>\Omega</math> per contact voltage of 1 V. These values, however, vary with the load and the characteristics of the relay. Decide these values from experiments, and take into consideration that the capacitance suppresses spark discharge when the contacts are separated and the resistance limits the current that flows into the load when the circuit is closed again.</p> <p>The dielectric strength of the capacitor must be 200 to 300 V. If the circuit is an AC circuit, use a capacitor with no polarity.</p> |
| <b>Diode method</b><br> | No      | Yes | <p>The diode connected in parallel with the load changes energy accumulated by the coil into a current, which then flows into the coil so that the current will be converted into Joule heat by the resistance of the inductive load.</p> <p>This time lag, between the moment the circuit is opened and the moment the load is reset, caused by this method is longer than that caused by the CR method.</p> | <p>The reversed dielectric strength value of the diode must be at least 10 times as large as the circuit voltage value. The forward current of the diode must be the same as or larger than the load current.</p> <p>The reversed dielectric strength value of the diode may be two to three times larger than the supply voltage if the surge protector is applied to electronic circuits with low circuit voltages.</p>  |

| Circuit  | Current |     | Characteristic  | Required element |
|--|---------|-----|---|------------------|
|  | AC      | DC  |   |                  |
| Varistor method<br> | Yes     | Yes | The varistor method prevents the imposition of high voltage between the contacts by using the constant voltage characteristic of the varistor. There is time lag between the moment the circuit is opened and the moment the load is reset.<br><br>If the supply voltage is 24 or 48 V, insert the varistor in parallel with the load. If the supply voltage is 100 to 200 V, insert the varistor between the contacts. | ---              |

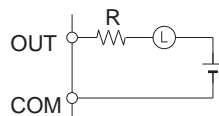
When switching a load with a high inrush current such as an incandescent lamp, suppress the inrush current as shown below.

Countermeasure 1



Providing a dark current of approx. one-third of the rated value through an incandescent lamp

Countermeasure 2



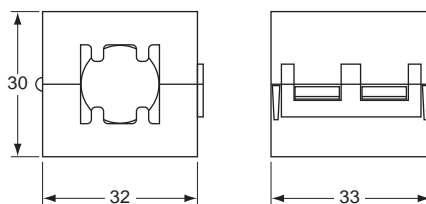
Providing a limiting resistor

## 6-5 Conditions for Meeting EMC Directives when Using CP-series Relay Expansion I/O Units

EN61131-2 immunity testing conditions when using the CP1W-40EDR, CP1W-32ER, or CP1W-16ER with a CP1W-CN811 I/O Connecting Cable are given below.

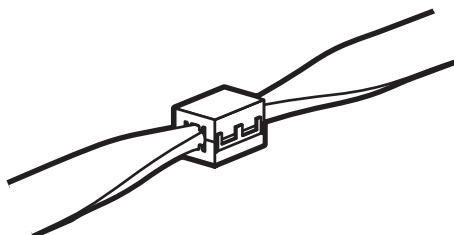
### Recommended Ferrite Core

Ferrite Core (Data Line Filter): 0443-164151 manufactured by Nisshin Electric  
Minimum impedance: 90  $\Omega$  at 25 MHz, 160  $\Omega$  at 100 MHz



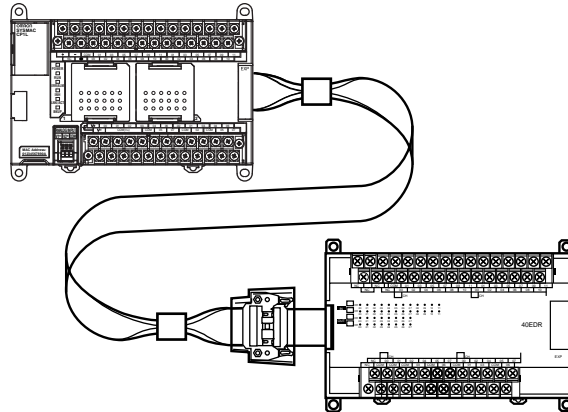
### Recommended Connection Method

- 1,2,3... 1. Cable Connection Method



## 2. Connection Method

As shown below, connect a ferrite core to each end of the CP1W-CN811 I/O Connecting Cable.



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# SECTION 1

## Features and System Configuration

This section introduces the features of the CPIL-EL/EM and describes its configuration. It also describes the Units that are available and connection methods for the CX-Programmer and other peripheral devices.

|       |  |    |
|-------|--|----|
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## 1-1 Features and Main Functions

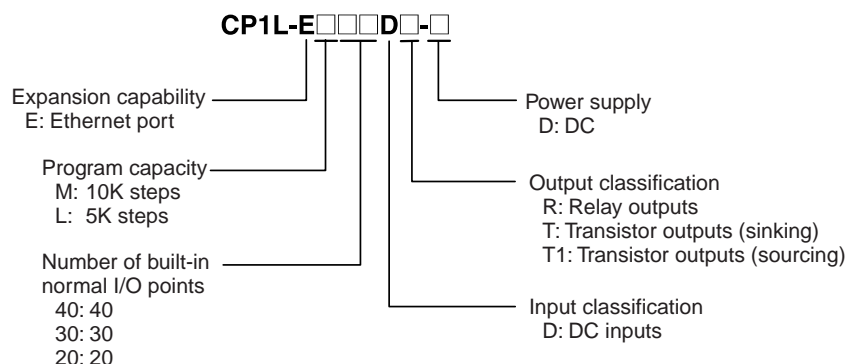
### 1-1-1 CP1L-EL/EM Overview

The SYSMAC CP1L-EL/EM PLCs are the low end PLCs in the SYSMAC CP Series of package-type Programmable Controllers. They have the same program and I/O capacity as the CP1L PLCs, but offer a built-in Ethernet port and independent FB capacity.

| Type                          |                                    | EM CPU Units  |  | EL CPU Units                                     |
|-------------------------------|------------------------------------|---|--|--|
| Model                         |                                    | CP1L-EM40DR-D<br>CP1L-EM40DT-D<br>CP1L-EM40DT1-D  | CP1L-EM30DR-D<br>CP1L-EM30DT-D<br>CP1L-EM30DT1-D | CP1L-EL20DR-D<br>CP1L-EL20DT-D<br>CP1L-EL20DT1-D |
| Power supply                  |                                    | 24 V DC   |  |  |
| Program capacity(See note 3.) |                                    | 10K steps   |  | 5K steps   |
| FB capacity                   |                                    | 10K steps   |  |  |
| DM Area capacity              |                                    | 32K words   |  | 10K words  |
| Maximum number of I/O points  |                                    | 160 (See note 1.)   | 150 (See note 1.)                                | 60 (See note 2.)                                 |
| Normal I/O                    | I/O points                         | 40  | 30   | 20   |
|                               | Input points                       | 24  | 18   | 12   |
|                               | Input specifications               | 24 VDC  |  |  |
|                               | Interrupt or quick-response inputs | 6 max   |  |  |
|                               | Output points                      | 16  | 12   | 8  |
|                               | Output specifications              | Relay outputs: Model numbers with "R" before the final suffix<br>Transistor outputs, sinking: Model numbers with "T" before the final suffix<br>Transistor outputs, sourcing: Model numbers with "T1" before the final suffix |  |  |
| High-speed counter inputs     |                                    | 4 counters/2 axes, 100 kHz (single-phase),<br>100 kHz for up/down pulses or pulse plus direction, 50 kHz for differential phases  |  |  |
| Pulse outputs                 |                                    | 2 axes, 100 kHz (transistor outputs)  |  |  |
| Built-in analog input         |                                    | 2 channels (10 bits)  |  |  |
| Built-in Ethernet port        |                                    | 1   |  |  |

- Note**
- (1) Three Expansion I/O Units connected to a CP-series CPU Unit with 40 or 30 I/O Points.
  - (2) One Expansion I/O Unit connected to a CP-series CPU Unit with 20 I/O Points.
  - (3) The function block capacity is not included in the program capacity.

#### Interpreting CP1L-EL/EM CPU Unit Model Numbers

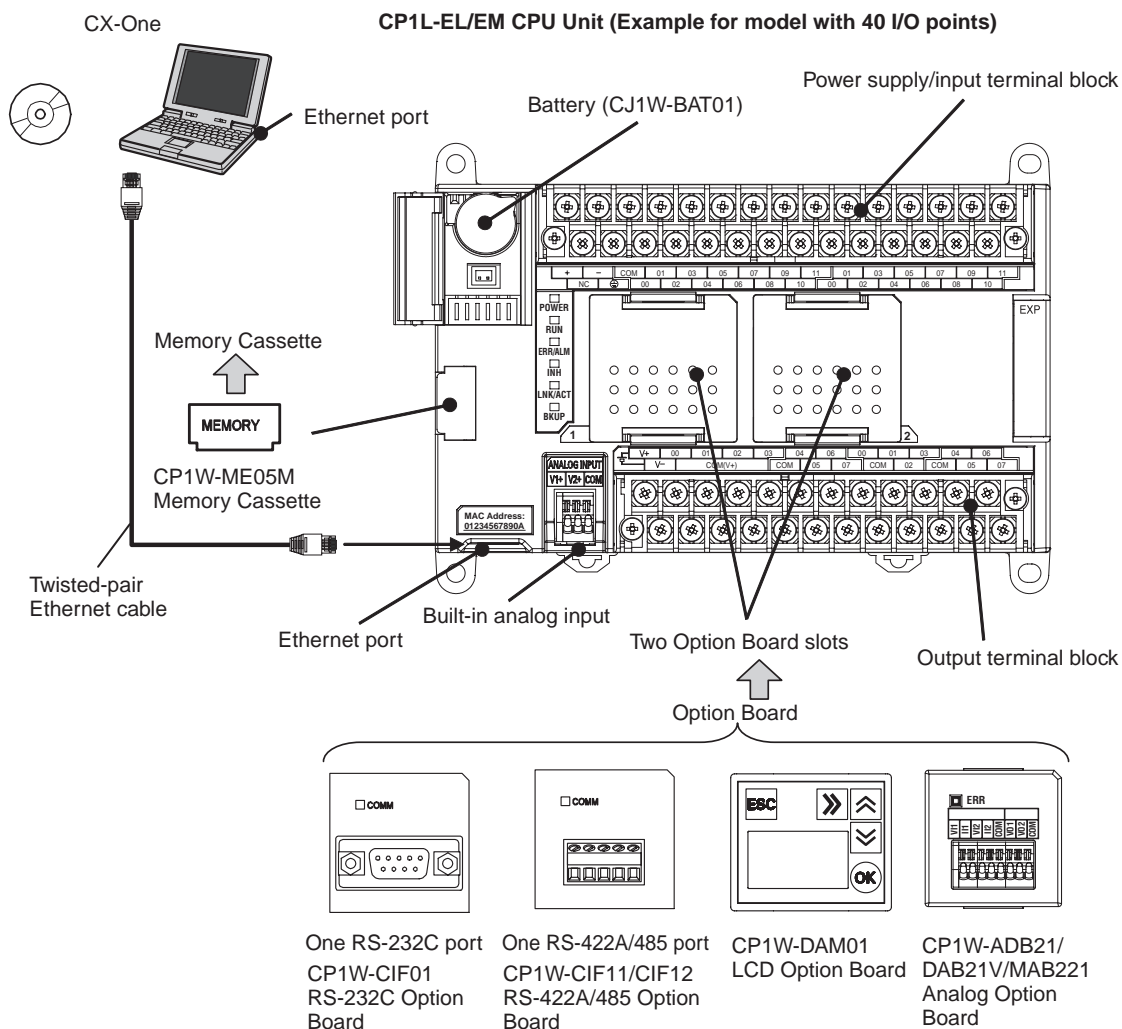




## 1-1-2 Features

This section describes the main features of the CP1L-EL/EM.

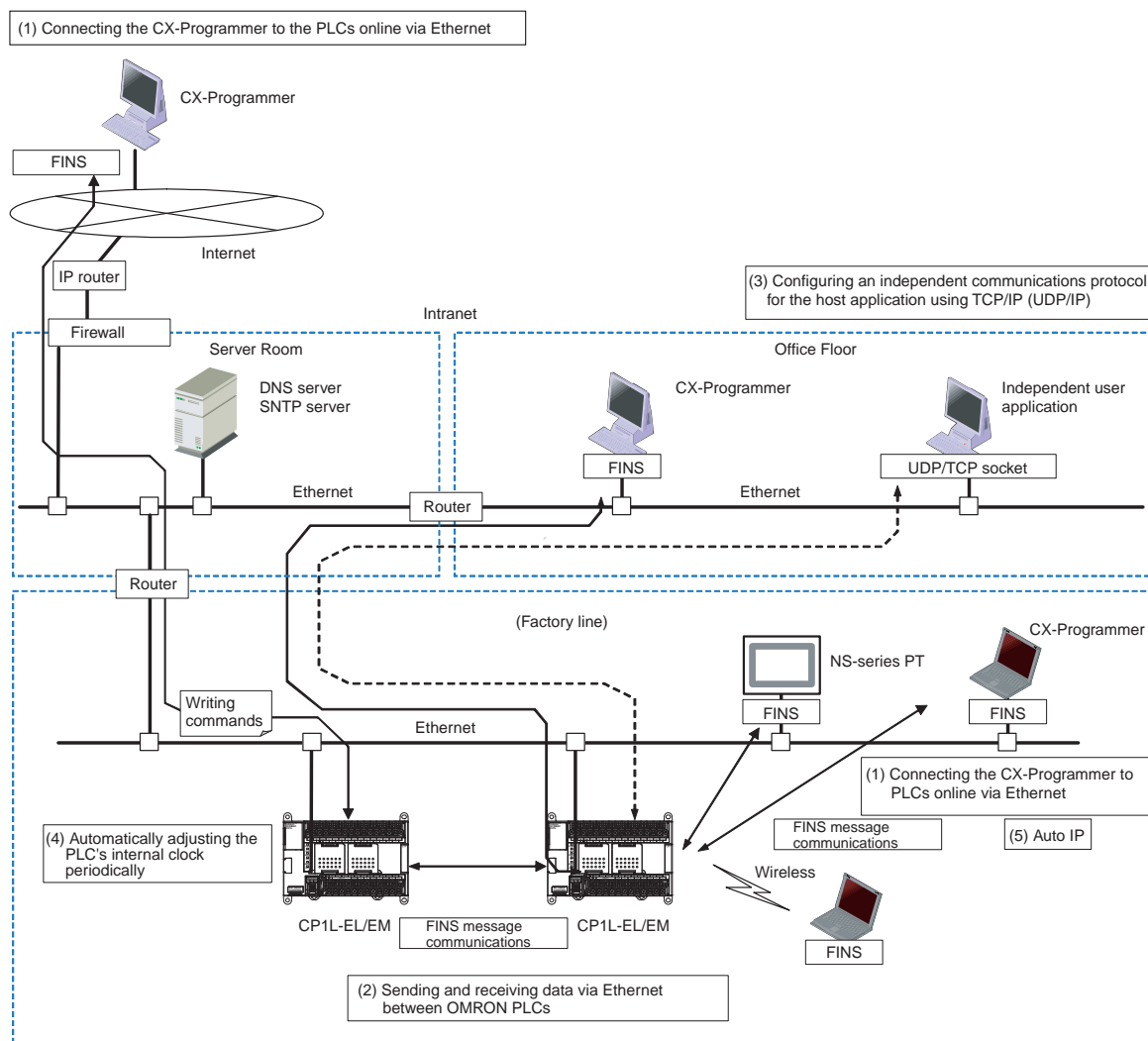
### Basic CP1L-EL/EM Configuration



**Note** In this manual, unless otherwise specified, "CP1W-CIF12" refers to the CP1W-CIF12 and CP1W-CIF12-V1 Option Boards.

## **Built-in Ethernet Port for Various Ethernet Application**

With the built-in Ethernet port, it is possible to connect the CX-Programmer to PLCs and exchange data between OMRON PLCs using Ethernet. It can also create an original communications procedure using TCP/IP or UDP/IP for the host application or communicate with PLCs from another manufacturer.



## **Independent FB Capacity**

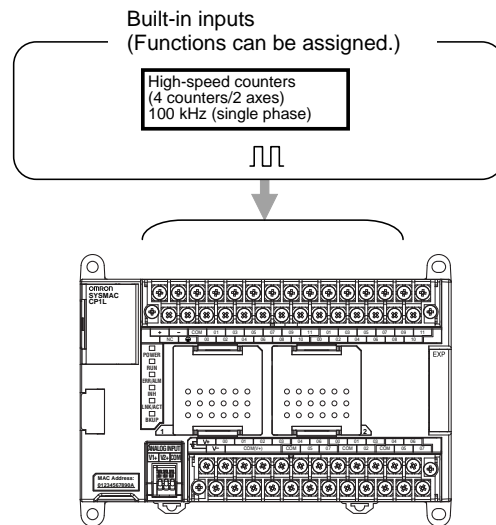
Comparing with CP1L series PLC, CP1L-EL/EM series PLCs have an independent 10K steps large FB capacity. Function blocks can be used in programming SYSMAC CP-series PLCs.

For details, refer to 1-4 Function Blocks.

### **Full Complement of High-speed Counter Functions**

High-speed counter inputs can be used by connecting rotary encoders to the built-in inputs. The ample number of high-speed counter inputs makes it possible to control a multi-axis device with a single PLC.

- Four 100 kHz (single phase)/50 kHz (differential phases) high-speed counter inputs (4 counters/2 axes) are provided as a standard feature. (See note.)



**Note** Settings in the PLC Setup determine whether each input point is to be used as a normal input, interrupt input, quick-response input, or high-speed counter.

### **Full Complement of High-speed Counter Functions**

#### **High-speed Processing for High-speed Counter Present Value (PV) Target Values or Range Comparison Interrupts**

An interrupt task can be started when the count reaches a specified value or falls within a specified range.

#### **High-speed Counter Input Frequency (Speed) Monitoring**

The input pulse frequency can be monitored using the PRV instruction (one point (counter 0) only, and you must select whether to use input frequency monitoring or counter 3; you cannot use both).

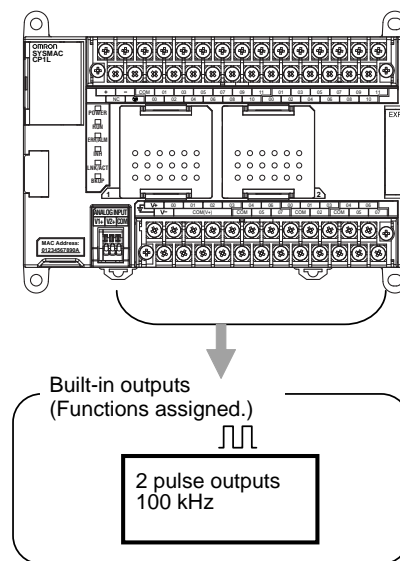
#### **High-speed Counter PV Holding/Refreshing**

It is possible to toggle between holding and refreshing the high-speed counter PV by turning ON and OFF the High-speed Counter Gate Flag from the ladder program.

### **Versatile Pulse Control (CPU Units with Transistor Outputs Only)**

Positioning and speed control by a pulse-input servo driver is enabled by outputting fixed duty ratio pulse output signals from the CPU Unit's built-in outputs.

- Pulse outputs for 2 axes at 100 kHz maximum are provided as standard features. (See note.)



**Note** The instruction used to control each output point determines whether it is used as a normal output, pulse output, or PWM output.

### **Full Complement of Pulse Output Functions**

#### **Select CW/CCW Pulse Outputs or Pulse Plus Direction Outputs for the Pulse Outputs**

The pulse outputs can be selected to match the pulse input specifications of the motor driver.

#### **Easy Positioning with Absolute Coordinate System Using Automatic Direction Setting**

For operations in an absolute coordinate system (i.e., when the origin is established or when the PV is changed by the INI instruction), the CW/CCW direction can be automatically set when PULSE OUTPUT instructions are executed according to whether the specified number of output pulses is more or less than the pulse output PV.

#### **Triangular Control**

If the amount of output pulses required for acceleration and deceleration (the target frequency times the time to reach the target frequency) exceeds the preset target number of output pulses during positioning (when the ACC instruction in independent mode or the PLS2 instruction is executed), the acceleration and deceleration will be shortened and triangular control will be executed instead of trapezoidal control. In other words, the trapezoidal pulse output will be eliminated, with no period of constant speed.

#### **Target Position Changes during Positioning (Multiple Start)**

While positioning using a PULSE OUTPUT (PLS2) instruction is in progress, the target position, target speed, acceleration rate, and deceleration rate can be changed by executing another PLS2 instruction.

**Positioning Changes during Speed Control (Interrupt Feeding)**

While speed control in continuous mode is in effect, it is possible to change to positioning in independent mode by executing a PULSE OUTPUT (PLS2) instruction. By this means, interrupt feeding (moving a specified amount) can be executed under specified conditions.

**Target Speed, Acceleration Rate, and Deceleration Rate Changes during Acceleration or Deceleration**

When a PULSE OUTPUT instruction with trapezoidal acceleration and deceleration is executed (for speed control or positioning), the target speed and acceleration and deceleration rates can be changed during acceleration or deceleration.

**Lighting and Power Control by Outputting Variable Duty Ratio Pulses**

Operations, such as lighting and power control, can be handled by outputting variable duty ratio pulse (PWM) output signals from the CPU Unit's built-in outputs.

**Origin Searches****Origin Search and Origin Return Operations Using a Single Instruction**

An accurate origin search combining all I/O signals (origin proximity input signal, origin input signal, positioning completed signal, error counter reset output, etc.) can be executed with a single instruction. It is also possible to move directly to an established origin using an origin return operation.

**Input Interrupts**

In direct mode, an interrupt task can be started when a built-in input turns ON or OFF. In counter mode, the rising or falling edges of built-in inputs can be counted, and an interrupt task started when the count reaches a specified value. The maximum number of interrupt input points is 6 for CPU Units with 20, 30 or 40 I/O points.

**Note** For each input point, a selection in the PLC Setup determines whether it is to be used as a normal input, interrupt input, quick-response input, or high-speed counter. The interrupt input response frequency in counter mode must be 5 kHz or less total for all interrupts.

**Quick-response Inputs**

By using quick-response inputs, built-in inputs up to a minimum input signal width of 50  $\mu$ s can be read regardless of the cycle time. The maximum number of quick-response input points is 6 for CPU Units with 20, 30 or 40 I/O points.

**Note** For each input, a PLC Setup parameter determines whether it is to be used as a normal input, interrupt input, quick-response input, or high-speed counter.

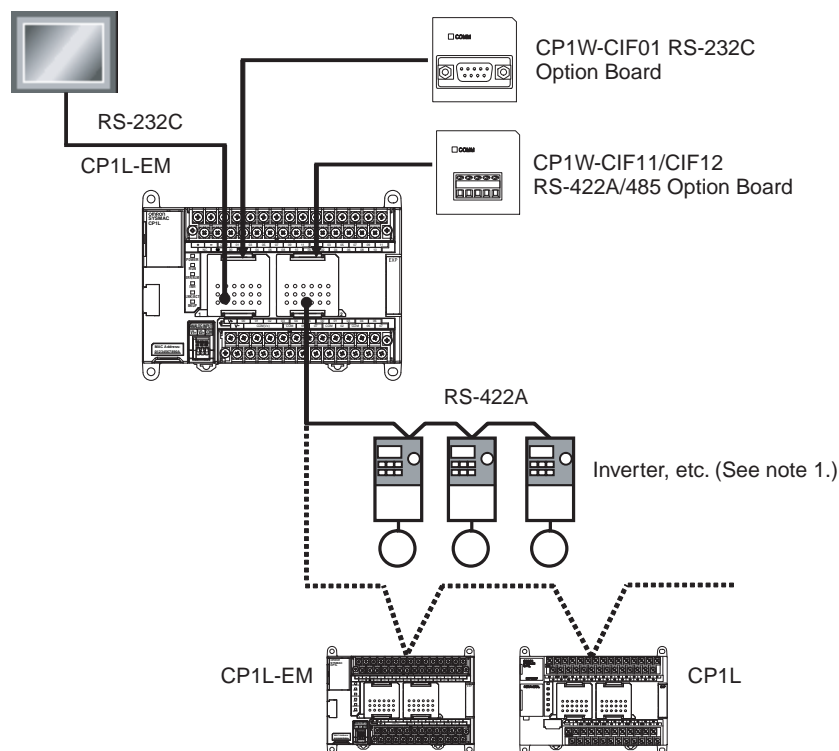
**Built-in Analog Input**

The CPU Units have analog functionality, with 2 analog voltage inputs built in. External analog values of 0 to 10 V (resolution: 1000) are converted to digital values and stored in a word in the AR Area. This enables applications that require on-site adjustment of settings that do not demand a high degree of accuracy, such as for example, a setting based on changes in outdoor temperatures or potentiometer inputs.

## Expansion Capability for Serial Ports

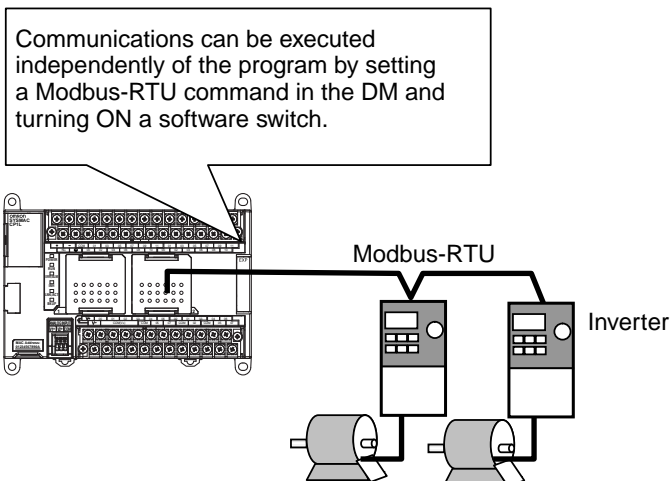
Up to two Serial Communications Boards each with one RS-232C port or one RS-422A/485 port can be added to a CPU Unit with 30 or 40 I/O points. One Serial Communications Board can be added to a CPU Unit with 20 I/O points. With the serial communications port, it is easy to simultaneously connect a computer, PT, PLC, and/or various components, such as an Inverter, Temperature Controller, or Smart Sensor.

NS-series PT, personal computer, bar code reader, etc.

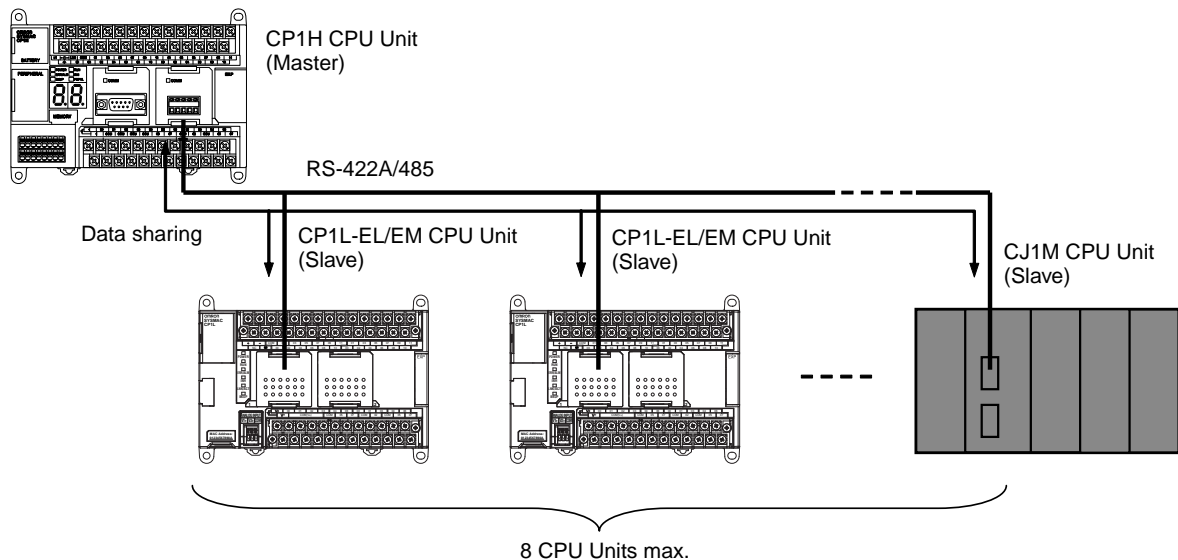


### Note

- (1) The Modbus-RTU easy master (available for all models) makes it easy to control Modbus Slaves (such as Inverters) with serial communications. After the Modbus Slave address, function, and data have been preset in a fixed memory area (DM), messages can be sent or received independently of the program by turning software switches.



- (2) By using the serial PLC Links, a maximum of 10 words of data per CPU Unit can be shared independently of the program among a maximum of nine CPU Units (CP1L-EL/EM/CP1H/CJ1M) using RS-422A/485 Option Boards.



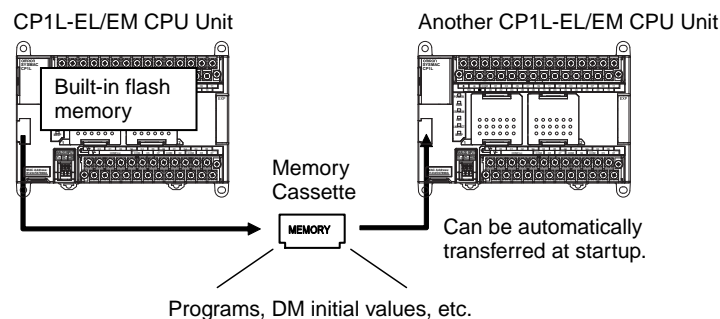
### **No-battery Operation**

Programs, the PLC Setup, and other data can be automatically saved to the CPU Unit's built-in flash memory. Moreover, DM Area data can be saved to the flash memory and then used as initial data when the power is turned ON.

This allows programs and initial values (such as recipe setup data) in the DM Area to be saved in the CPU Unit without the need to maintain a backup battery.

### **Memory Cassettes**

Built-in flash memory data, such as programs and DM initial-value data, can be stored in a Memory Cassette (optional) as backup data. In addition, programs and initial-value data can be easily copied to another CPU Unit using the Memory Cassette to recreate the same system.



### **Security**

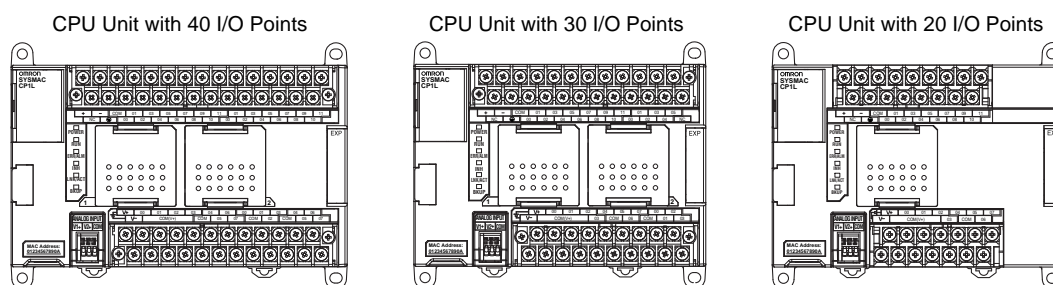
A password registration function is provided for the CPU Unit to prevent unauthorized copy of ladder programs. If an attempt is made to read a ladder program from a CX-Programmer, access to the program is denied if the password that is entered does not match the registered password. If incorrect passwords are entered for five consecutive attempts, the CPU Unit does not accept any more passwords for two hours.

### **Read Protection Using Extended Passwords**

With unit version 1.1 or later and CX-Programmer version 9.6 or higher, you can extend protection with UM read protection and task read protection to ensure better protection for your design assets.

## 1-2 System Configuration

### 1-2-1 Basic System



#### Maximum Number of Normal I/O Points

| Type | I/O capacity | Power supply voltage | Model          | Normal built-in inputs | Normal built-in outputs          | Weight     |
|------|--------------|----------------------|----------------|------------------------|----------------------------------|------------|
| EM   | 40 points    | 24 VDC               | CP1L-EM40DR-D  | 24 DC inputs           | 16 relay outputs                 | 555 g max. |
|      |              |                      | CP1L-EM40DT-D  |                        | 16 transistor (sinking) outputs  | 515 g max. |
|      |              |                      | CP1L-EM40DT1-D |                        | 16 transistor (sourcing) outputs | 515 g max. |
|      | 30 points    | 24 VDC               | CP1L-EM30DR-D  | 18 DC inputs           | 12 relay outputs                 | 485 g max. |
|      |              |                      | CP1L-EM30DT-D  |                        | 12 transistor (sinking) outputs  | 455 g max. |
|      |              |                      | CP1L-EM30DT1-D |                        | 12 transistor (sourcing) outputs | 455 g max. |
| EL   | 20 points    | 24 VDC               | CP1L-EL20DR-D  | 12 DC inputs           | 8 relay outputs                  | 400 g max. |
|      |              |                      | CP1L-EL20DT-D  |                        | 8 transistor (sinking) outputs   | 380 g max. |
|      |              |                      | CP1L-EL20DT1-D |                        | 8 transistor (sourcing) outputs  | 380 g max. |

#### Optional Products

| Item                | Model                                    | Specifications   | Weight    |
|---------------------|--|--|-----------|
| Memory Cassette     | CP1W-ME05M                               | Can be used to store user programs in flash memory, parameters, DM initial values, comment memory, FB programs, and data in RAM. | 10 g max. |
| LCD Option Board    | CP1W-DAM01                               | Can be used to monitor and change user-specified messages, time or other data of the PLC.  | 20 g max. |
| Analog Option Board | CP1W-ADB21<br>CP1W-DAB21V<br>CP1W-MAB221 | Non-isolated analog input/output unit. Can be used to expand the analog input/output ability.                                    | 25 g max. |

**Note** CP1W-CIF41 Ethernet Option Board cannot be used with the CP1L-EL/EM series PLCs.

#### Serial Communications Expansion

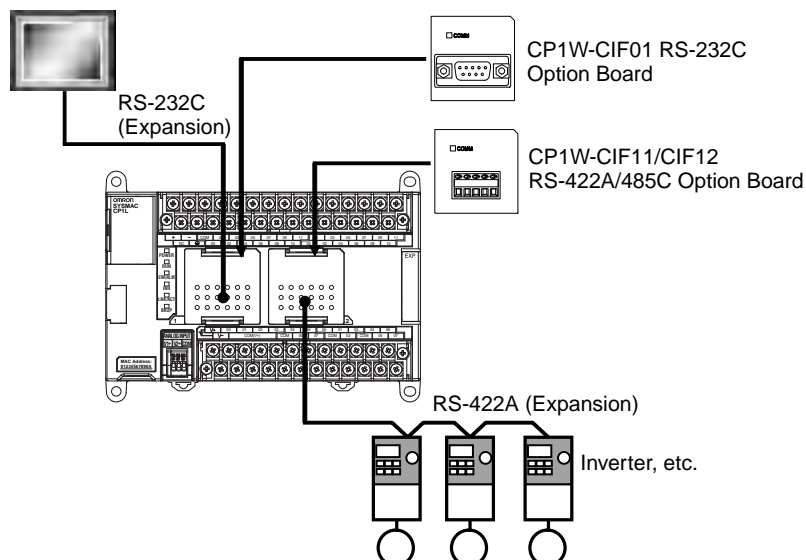
When serial communications are required for a CP1L-EL/EM CPU Unit, an RS-232C or RS-422A/485 Option Board can be added.

Two Option Boards can be mounted with a CPU Units with 30 or 40 I/O points and one Option Board can be mounted with a CPU Units with 20 I/O points.

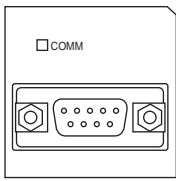
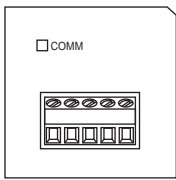
This enables connection by serial communications to NS-series PTs, Bar Code Readers, components such as Inverters, and computers without Ethernet ports (such as when using the CX-Programmer).



NS-series PT, personal computer, bar code reader, etc.



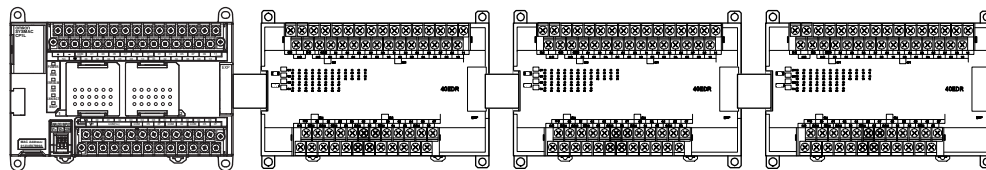
### Option Boards for Serial Communications

| Appearance  | Name                     | Model            | Port   | Serial communications modes   |
|---|--------------------------|------------------|--|---|
|   | RS-232C Option Board     | CP1W-CIF01       | One RS-232C port (D-Sub, 9 pins, female)           | Host Link, NT Link (1: N or 1:1 Link Master, 1:1 Link Slave), No-protocol, Serial PLC Link Slave, Serial PLC Link Master, Serial Gateway (conversion to CompoWay/F, conversion to Modbus-RTU), peripheral bus |
|  | RS-422A/485 Option Board | CP1W-CIF11/CIF12 | One RS-422A/485 port (terminal block for ferrules) |   |

## 1-2-2 System Expansion

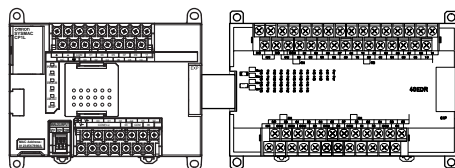
CP-series Expansion Units or Expansion I/O Units can be connected to a CP1L-EL/EM CPU Unit. Up to three Expansion Units or Expansion I/O Units can be connected to a CPU Unit with 30 or 40 I/O points and one Expansion Unit or Expansion I/O Unit can be connected to a CPU Unit with 20 I/O points. This allows for the expansion of various functions such as I/O points or temperature sensor inputs.

CP1L-EM CPU Unit with 30 or 40 I/O Points



A maximum of three CP-series Expansion I/O Units or Expansion Units can be added.

CP1L-EL CPU Unit with 20 I/O Points

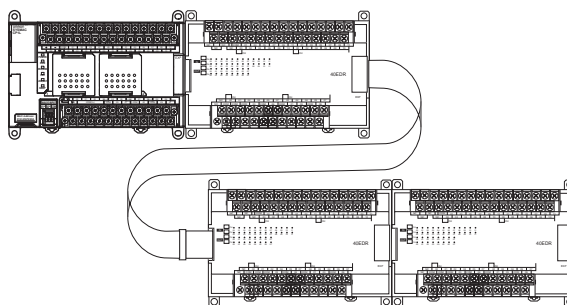


One CP-series Expansion I/O Unit or Expansion Unit can be added.

### Using I/O Connecting Cable

When using CP-series Expansion Units and Expansion I/O Units, it is possible to use CP1W-CN811 Connecting Cable to arrange the Units in upper and lower rows.

- I/O Connecting Cable can be used in one place only, and not in multiple places.

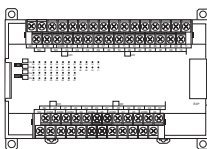
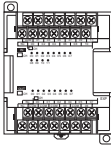
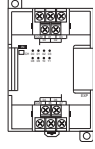


**Maximum I/O Points**

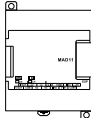

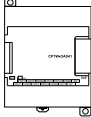



Up to three Expansion Units or Expansion I/O Units can be connected to a CPU Unit with 30 or 40 I/O points and one Expansion Unit or Expansion I/O Unit can be connected to a CPU Unit with 20 I/O points. The maximum I/O capacity is thus achieved by connecting either one or three Expansion Units or Expansion I/O Units.

| Type | I/O capacity | Model  | Built-in inputs | Built-in outputs | Maximum number of Expansion I/O Units or Expansion Units | Maximum total I/O points                                    |
|------|--------------|--|-----------------|------------------|--|---|
| EM   | 40 points    | CP1L-EM40DR-D<br>CP1L-EM40DT-D<br>CP1L-EM40DT1-D | 24              | 16               | 3 Units max.<br>Inputs: 24 × 3<br>Outputs: 16 × 3        | Max.: 160 points<br>Inputs: 96 points<br>Outputs: 64 points |
|      | 30 points    | CP1L-EM30DR-D<br>CP1L-EM30DT-D<br>CP1L-EM30DT1-D | 18              | 12               | 3 Units max.<br>Inputs: 24 × 3<br>Outputs: 16 × 3        | Max.: 150 points<br>Inputs: 90 points<br>Outputs: 60 points |
| EL   | 20 points    | CP1L-EL20DR-D<br>CP1L-EL20DT-D<br>CP1L-EL20DT1-D | 12              | 8                | 1 Unit max.<br>Inputs: 24<br>Outputs: 16                 | Max.: 60 points<br>Inputs: 36 points<br>Outputs: 24 points  |

**CP-series Expansion I/O Units**

| Appearance  | Model       | Normal inputs        | Normal outputs                   | Weight     |
|---|-------------|----------------------|----------------------------------|------------|
|   | CP1W-40EDR  | 24 VDC:<br>24 inputs | 16 relay outputs                 | 380 g max. |
|   | CP1W-40EDT  |                      | 16 transistor outputs (sinking)  | 320 g max. |
|   | CP1W-40EDT1 |                      | 16 transistor outputs (sourcing) |            |
|   | CP1W-32ER   | None                 | 32 relay outputs                 | 465 g max. |
|   | CP1W-32ET   |                      | 32 transistor outputs (sinking)  | 325 g max. |
|   | CP1W-32ET1  |                      | 32 transistor outputs (sourcing) |            |
|  | CP1W-20EDR1 | 24 VDC:<br>12 inputs | 8 relay outputs                  | 300 g max. |
|   | CP1W-20EDT  |                      | 8 transistor outputs (sinking)   |            |
|   | CP1W-20EDT1 |                      | 8 transistor outputs (sourcing)  |            |
|   | CP1W-16ER   | None                 | 16 relay outputs                 | 280 g max. |
|   | CP1W-16ET   |                      | 16 transistor outputs (sinking)  | 225 g max. |
|   | CP1W-16ET1  |                      | 16 transistor outputs (sourcing) |            |
|  | CP1W-8ED    | 24 VDC:<br>8 inputs  | None                             | 200 g max. |
|   | CP1W-8ER    | None                 | 8 relay outputs                  | 250 g max. |
|   | CP1W-8ET    |                      | 8 transistor outputs (sinking)   |            |
|   | CP1W-8ET1   |                      | 8 transistor outputs (sinking)   |            |

**CP-series Expansion Units**

| Name and appearance  | Model      | Specifications   |   |                    | Weight     |
|--|------------|--|---|--------------------|------------|
| <div>Analog I/O Units</div> <div></div>   | CP1W-MAD11 | 2 analog inputs  | 0 to 5 V/1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                    | Resolution: 6,000  | 150 g max. |
|  |            | 1 analog output  | 1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                             |                    |            |
|  | CP1W-MAD42 | 4 analog inputs  | 0 to 5 V/1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                    | Resolution: 12,000 | 260 g max. |
|  |            | 2 analog outputs   | 1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                             |                    |            |
|  | CP1W-MAD44 | 4 analog inputs  | 0 to 5 V/1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                    |                    |            |
|  |            | 4 analog outputs   | 1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                             |                    |            |
| <div>Analog Input Units</div> <div></div>   | CP1W-AD041 | 4 analog inputs  | 0 to 5 V/1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                    | Resolution: 6,000  | 200 g max. |
|  | CP1W-AD042 | 4 analog inputs  | 0 to 5 V/1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                    | Resolution: 12,000 |            |
| <div>Analog Output Units</div> <div></div>  | CP1W-DA021 | 2 analog outputs   | 1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                             | Resolution: 6,000  | 200 g max. |
|  | CP1W-DA041 | 4 analog outputs   |   |                    |            |
|  | CP1W-DA042 | 4 analog outputs   | 1 to 5 V/0 to 10 V/-10 to +10 V/0 to 20 mA/4 to 20 mA                             | Resolution: 12,000 |            |
| <div>Temperature Sensor Units</div> <div><br/></div> | CP1W-TS001 | 2 inputs   | Thermocouple input K, J   |                    | 250 g max. |
|  | CP1W-TS002 | 4 inputs   |   |                    |            |
|  | CP1W-TS003 | 4 inputs   | Thermocouple input K or J, 4 inputs or 2 analog inputs 0 to 10V/1 to 5V/4 to 20mA | Resolution: 12,000 | 225 g max. |
|  | CP1W-TS004 | 12 inputs  | Thermocouple input K, J   |                    | 380 g max. |
|  | CP1W-TS101 | 2 inputs   | Platinum resistance thermometer input Pt100, JPt100                               |                    | 250 g max. |
|  | CP1W-TS102 | 4 inputs   |   |                    |            |
| <div>CompoBus/S I/O Link Unit</div> <div></div>   | CP1W-SRT21 | As a CompoBus/S slave, 8 inputs and 8 outputs are allocated. |   |                    | 200 g max. |

### 1-2-3 Restrictions on System Configuration

The following restrictions apply to the CP-series Expansion Units and CP-series Expansion I/O Units that can be connected to CP1L-EL/EM CPU Units.

#### ■ Number of Expansion Units and Expansion I/O Units Connected

A maximum of three Units can be connected to a CPU Unit with 30 or 40 I/O points and one Unit can be connected to a CPU Unit with 20 I/O points.

Each CPU Unit can connect one device to pin 6 (+5V power supply) of the CP1W-CIF01 RS232C Option Board.

If two CP1W-CIF01 Option Boards are mounted on a CPU Unit with 30, 40 or 60 IO points and both of which use pin 6 (+5V power supply), a total of up to two Expansion Units can be connected to the CPU Unit.

#### ■ Restrictions on the number of simultaneously ON output points

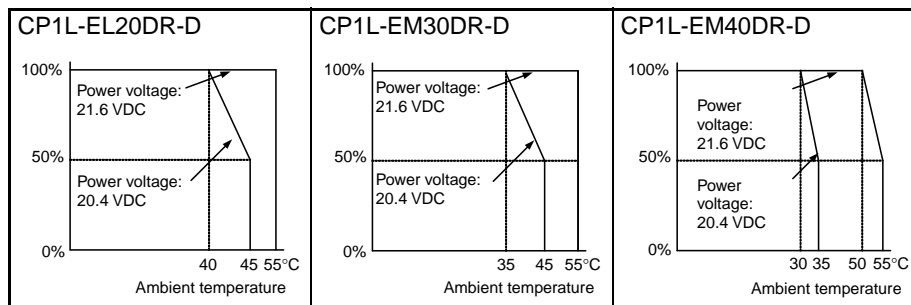
CP1W-32ER/32ET/32ET1's maximum number of simultaneously ON points is 24 (75%).

#### ■ Restrictions Imposed by Ambient Temperature

There are restrictions in the power supply voltage and output load current imposed by the ambient temperature for CPU Units with DC power. Use the CPU Unit within the following ranges of power supply voltage and output load current.

#### CPU Units with Relay Outputs (CP1L-E□□□DR-D)

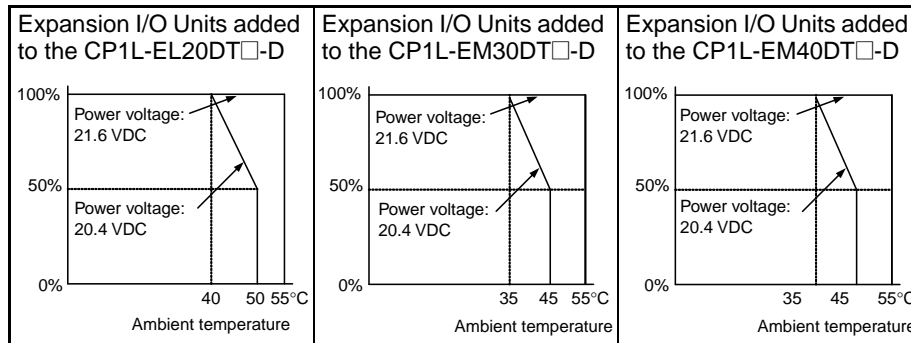
Relay Output Load Current Derating Curves for CPU Units and Expansion I/O Units



**Note** The above restrictions, apply to the relay output load current from the CPU Unit even if Expansion I/O Units are not connected.

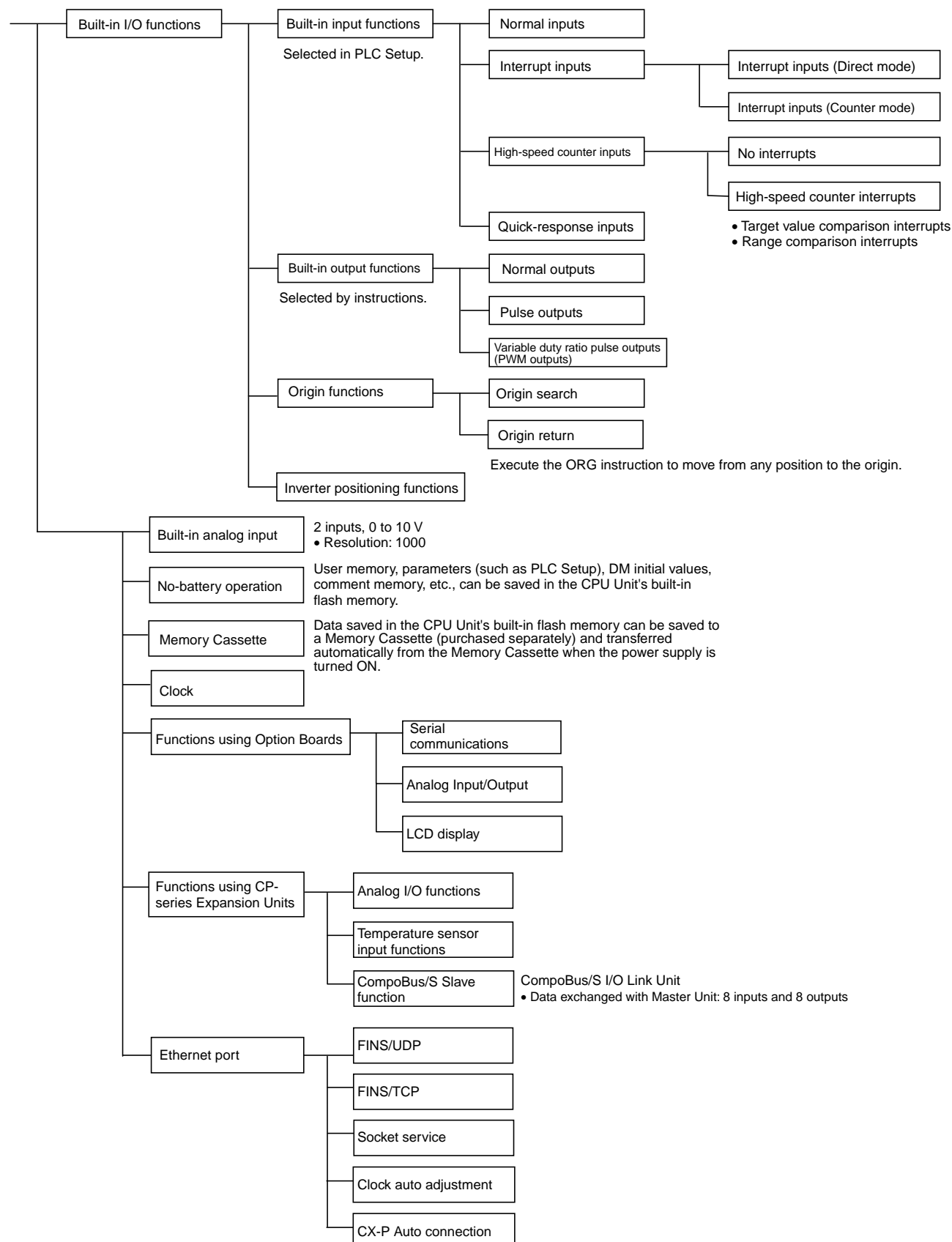
#### Using CP1W-8ER/16ER/20EDR1/32ER/40EDR Expansion I/O Units with CPU Units with Transistor Outputs (CP1L-E□□□DT□-D)

Relay Output Load Current Derating Curves for Expansion I/O Units



**Note** There are no restrictions on the transistor output load current from the CPU Unit.

## 1-3 Function Charts



## 1-4 Function Blocks

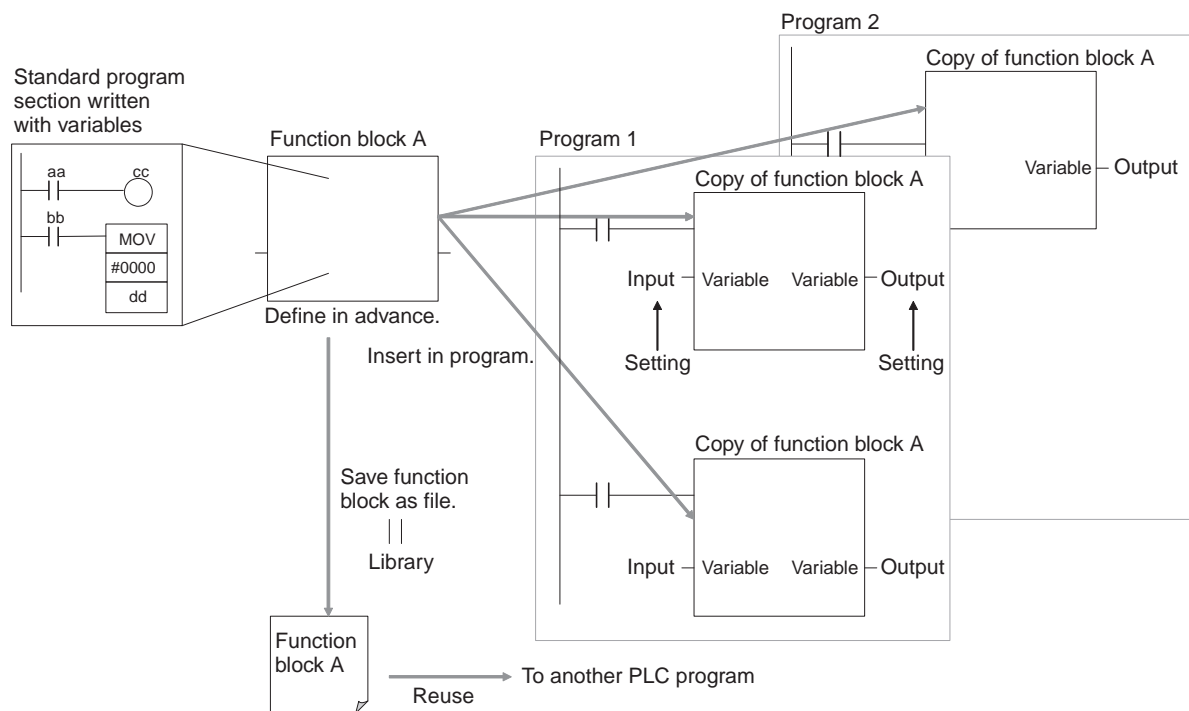
Function blocks can be used in programming SYSMAC CP-series PLCs.

### 1-4-1 Overview of Function Blocks

A function block is a basic program element containing a standard processing function that has been defined in advance. Once the function block has been defined, the user just has to insert the function block in the program and set the I/O in order to use the function.

As a standard processing function, a function block is not created with actual physical addresses, but local variables. The user sets parameters (addresses or values) in those variables to use the function block. The addresses used for the variables themselves are automatically assigned by the system (CX-Programmer) each time they are placed in the program.

In particular, each function block is saved by the CX-Programmer as an individual file that can be reused with programs for other PLCs. This makes it possible to create a library of standard processing functions.



## 1-4-2 Advantages of Function Blocks

Function blocks allow complex programming units to be reused easily. Once standard program sections have been created as function blocks and saved in files, they can be reused just by placing a function block in a program and setting the parameters for the function block's I/O. Reusing standardized function blocks reduces the time required for programming/debugging, reduces coding errors, and makes programs easier to understand.

### Structured Programming

Structured programs created with function blocks have better design quality and required less development time.

### Easy-to-read “Block Box” Design

The I/O operands are displayed as local variable names in the program, so the program is like a “black box” when entering or reading the program and no extra time is wasted trying to understand the internal algorithm.

### Different Processes Easily Created from a Single Function Block

Many different processes can be created easily from a single function block by using input variables for the parameters (such as timer SVs, control constants, speed settings, and travel distances) in the standard process.

### Reduced Coding Errors

Coding mistakes can be reduced, because blocks that have already been debugged can be reused.

### Data Protection

The local variables in the function block cannot be accessed directly from the outside, so the data can be protected. (Data cannot be changed unintentionally.)

### Improved Reusability through Programming with Variables

The function block's I/O is entered as local variables, so the data addresses in the function block do not have to be changed as they do when copying and reusing a program section.

### Creating Libraries

Processes that are independent and reusable (such as processes for individual steps, machinery, equipment, or control systems) can be saved as function block definitions and converted to library functions.

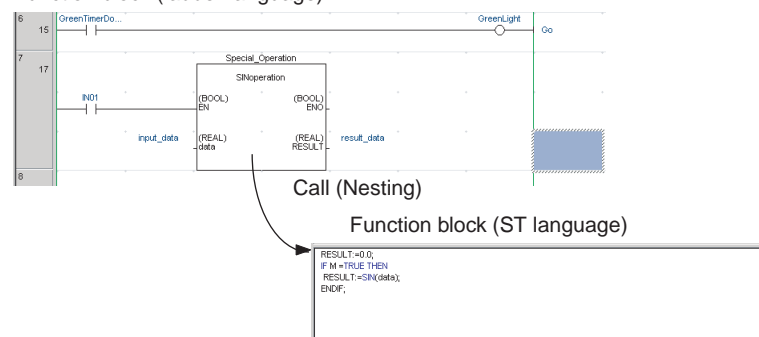
The function blocks are created with local variable names that are not tied to physical addresses, so new programs can be developed easily just by reading the definitions from the file and placing them in a new program.

### Nesting Multiple Languages

Mathematical expressions can be entered in structured text (ST) language.

Nesting function blocks is supported for CX-Programmer Ver. 6.0 or higher. For example, it is possible to express only special operations in ST language within a function block in a ladder diagram.

Function block (ladder language)



For details on using function blocks, refer to the *CX-Programmer Ver. 7.0 Operation Manual: Function Blocks* (Cat. No. W447).



## SECTION 2

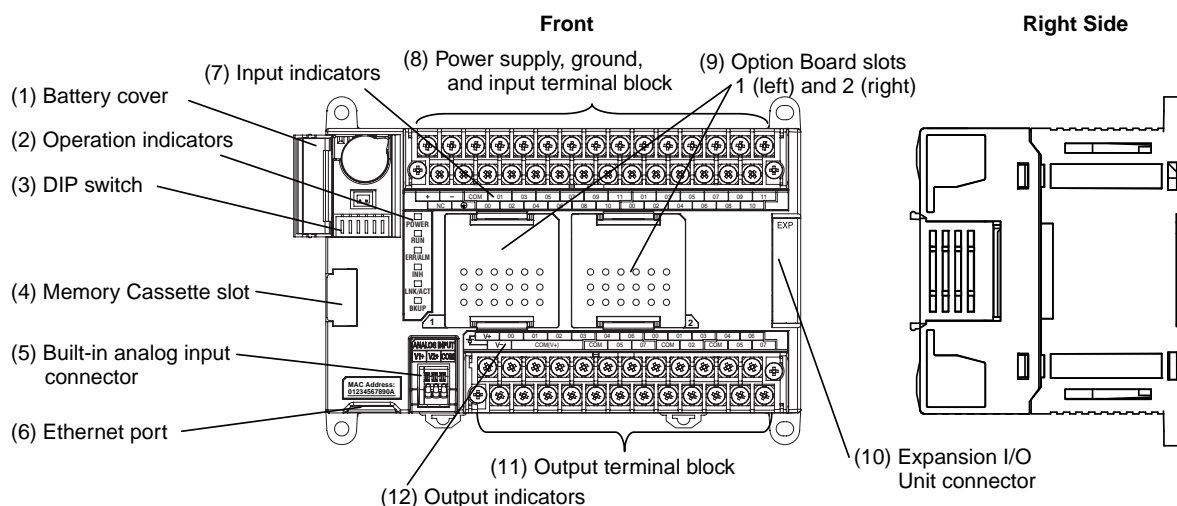
# Nomenclature and Specifications

This section describes the names and functions of CP1L-EL/EM parts and provides CP1L-EL/EM specifications.

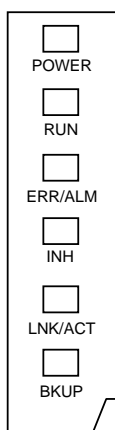
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## 2-1 Part Names and Functions

### 2-1-1 CP1L-EL/EM CPU Units

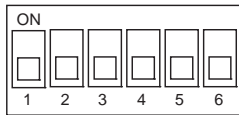


- (1) **Battery Cover**  
Covers the location where the battery is stored.
- (2) **Operation Indicators**  
Show CP1L-EL/EM operation status.



|                         |          |   |
|-------------------------|----------|---|
| <b>POWER (Green)</b>    | Lit      | Power is ON.  |
|                         | Not lit  | Power is OFF.   |
| <b>RUN (Green)</b>      | Lit      | The CP1L-EL/EM is executing a program in either RUN or MONITOR mode.  |
|                         | Not lit  | Operation is stopped in PROGRAM mode or due to a fatal error.   |
| <b>ERR/ALM (Red)</b>    | Lit      | A fatal error (including FALS execution) or a hardware error (WDT error) has occurred. CP1L-EL/EM operation will stop and all outputs will be turned OFF.   |
|                         | Flashing | A non-fatal error has occurred (including FAL execution). CP1L-EL/EM operation will continue.   |
|                         | Not lit  | Operation is normal.  |
| <b>INH (Yellow)</b>     | Lit      | The Output OFF Bit (A500.15) has turned ON. All outputs will be turned OFF.   |
|                         | Not lit  | Operation is normal.  |
| <b>LNK/ACT (Yellow)</b> | Lit      | A valid link is detected.   |
|                         | Flashing | Communications (either sending or receiving) are in progress through the Ethernet port.   |
|                         | Not lit  | Other than the above.   |
| <b>BKUP (Yellow)</b>    | Lit      | <p>A user program, parameters, or Data Memory is being written or accessed in the built-in flash memory (backup memory).</p> <p>A user program, parameters, Data Memory, DM initial values, or comment memory is being written or accessed in a Memory Cassette.</p> <p>The BKUP indicator also lights while user programs, parameters, and Data Memory are being restored when the PLC power supply is turned ON.</p> <p><b>Note</b> Do not turn OFF the PLC power supply while this indicator is lit.</p> |
|                         | Not lit  | Other than the above.   |

(3) DIP Switch  
CPU Units with 30 or 40 I/O Points



| No. | Setting | Description   | Application   | Default |
|-----|---------|---|---|---------|
| SW1 | ON      | User memory write-protected (See note.)                         | Used to prevent programs from being inadvertently overwritten.  | OFF     |
|     | OFF     | User memory not write-protected.                                |   |         |
| SW2 | ON      | Data automatically transferred from Memory Cassette at startup. | Used to enable programs, Data Memory, or parameters saved on a Memory Cassette to be opened by the CPU Unit at startup. | OFF     |
|     | OFF     | Data not transferred.   |   |         |
| SW3 | ON      | A395.12 ON  | This pin enables controlling a bit in memory without using an input relay.  | OFF     |
|     | OFF     | A395.12 OFF   |   |         |
| SW4 | ON      | Used for peripheral bus.  | Used to enable a Serial Communications Option Board mounted in Option Board Slot 1 to be used by the peripheral bus.    | OFF     |
|     | OFF     | According to PLC Setup.   |   |         |
| SW5 | ON      | Used for peripheral bus.  | Used to enable a Serial Communications Option Board mounted in Option Board Slot 2 to be used by the peripheral bus.    | OFF     |
|     | OFF     | According to PLC Setup.   |   |         |
| SW6 | OFF     | Keep turned OFF.  | ---   | OFF     |

**Note** The following data will be write-protected if pin SW1 is turned ON:

- The entire user program (all tasks)
- All data in parameter areas (such as the PLC Setup)

When SW1 is turned ON, the user program and the data in the parameter areas will not be cleared even if the All Clear operation is performed from a Peripheral Device (i.e., the CX-Programmer).

CPU Units with 20 I/O Points



| No. | Setting | Description   | Application   | Default |
|-----|---------|---|---|---------|
| SW1 | ON      | User memory write-protected (See note.)                         | Used to prevent programs from being inadvertently overwritten.  | OFF     |
|     | OFF     | User memory not write-protected.                                |   |         |
| SW2 | ON      | Data automatically transferred from Memory Cassette at startup. | Used to enable programs, Data Memory, or parameters saved on a Memory Cassette to be opened by the CPU Unit at startup. | OFF     |
|     | OFF     | Data not transferred.   |   |         |
| SW3 | ON      | A395.12 ON  | This pin enables controlling a bit in memory without using an input relay.  | OFF     |
|     | OFF     | A395.12 OFF   |   |         |
| SW4 | ON      | Used for peripheral bus.  | Used to enable a Serial Communications Option Board mounted in Option Board Slot 1 to be used by the peripheral bus.    | OFF     |
|     | OFF     | According to PLC Setup.   |   |         |

**Note** The following data will be write-protected if pin SW1 is turned ON:

- The entire user program (all tasks)
- All data in parameter areas (such as the PLC Setup)

When SW1 is turned ON, the user program and the data in the parameter areas will not be cleared even if the All Clear operation is performed from a Peripheral Device (i.e., the CX-Programmer).

(4) Memory Cassette Slot

Used for mounting a CP1W-ME05M Memory Cassette. When mounting a Memory Cassette, remove the dummy cassette.

Data, such as CP1L-EL/EM CPU Unit programs, parameters, and data memory, can be transferred to the Memory Cassette to be saved.

(5) Built-in Analog Input Connector

By applying 0 to 10 V of external voltage, it is possible to adjust the value of A642 and A643 within a range of 0 to 1000. This input is not isolated. (Refer to 8-4 *Built-in Analog Input*.)

(6) Ethernet Port

Using the built-in Ethernet port, user can easily connect the CX-Programmer to PLCs Online or exchange data between CP1L-EL/EM series PLCs and other Ethernet devices from either OMRON or another manufacturer. Various protocols are supported, including FINS/TCP, FINS/UDP, Socket, SNTP, DNS.

(7) Input Indicators

The input indicators light when input terminal contacts turn ON.


(8) Power Supply, Ground, and Input Terminal Block

|                               |   |
|-------------------------------|---|
| <b>Power supply terminals</b> | Used to provide a 24-VDC power supply.  |
| <b>Ground terminals</b>       | Protective ground (⊕):<br>To prevent electric shock, ground to 100 Ω or less. |
| <b>Input terminals</b>        | Used to connect input devices.  |

(9) Option Board Slots

The following Option Boards can be mounted in either slot 1 (left) or slot 2 (right).

- CP1W-CIF01 RS-232C Option Board
- CP1W-CIF11/CIF12 RS-422A/485 Option Board
- CP1W-DAM01 LCD Option Board
- CP1W-ADB21/DAB21V/MAB221 Analog Option Board

 **Caution** Always turn OFF the power supply to the PLC before mounting or removing an Option Board.

(10) Expansion I/O Unit Connector

CP-series Expansion I/O Units and Expansion Units (Analog I/O Units, Temperature Sensor Units, or CompoBus/S I/O Link Units) can be connected. Up to three Expansion Units or Expansion I/O Units can be connected to a CPU Unit with 30 or 40 I/O points and one Expansion Unit or Expansion I/O Unit can be connected to a CPU Unit with 20 I/O points. (For details on using Expansion Units and Expansion I/O Units, refer to SECTION 9 *Using Expansion Units and Expansion I/O Units*.)

(11) Output Terminal Block

The Output terminals are used for connecting output devices.

(12) Output Indicators

The output indicators light when output terminal contacts turn ON.

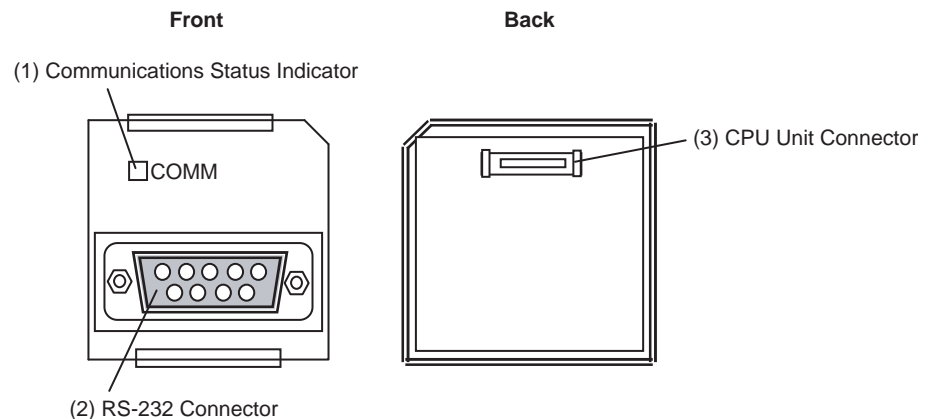
## 2-1-2 CP1W-CIF01 RS-232C Option Boards

A RS-232C Option Board can be mounted to an Option Board slot on the CPU Unit. With a CPU Unit with 30 or 40 I/O points, either Option Board slot may be used.

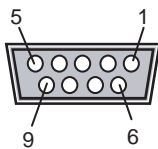
When mounting an Option Board, first remove the slot cover. Grasp both of the cover's up/down lock levers at the same time to unlock the cover, and then pull the cover out.

Then to mount the Option Board, check the alignment and firmly press it in until it snaps into place.

**Caution** Always turn OFF the power supply to the PLC before mounting or removing an Option Board.



### RS-232C Connector



| Pin            | Abbr.    | Signal name     | Signal direction |
|----------------|----------|-----------------|------------------|
| 1              | FG       | Frame Ground    | ---              |
| 2              | SD (TXD) | Send Data       | Output           |
| 3              | RD (RXD) | Receive Data    | Input            |
| 4              | RS (RTS) | Request to Send | Output           |
| 5              | CS (CTS) | Clear to Send   | Input            |
| 6              | 5V       | Power Supply    | ---              |
| 7              | DR (DSR) | Data Set Retry  | Input            |
| 8              | ER (DTR) | Equipment Ready | Output           |
| 9              | SG (0V)  | Signal Ground   | ---              |
| Connector hood | FG       | Frame Ground    | ---              |

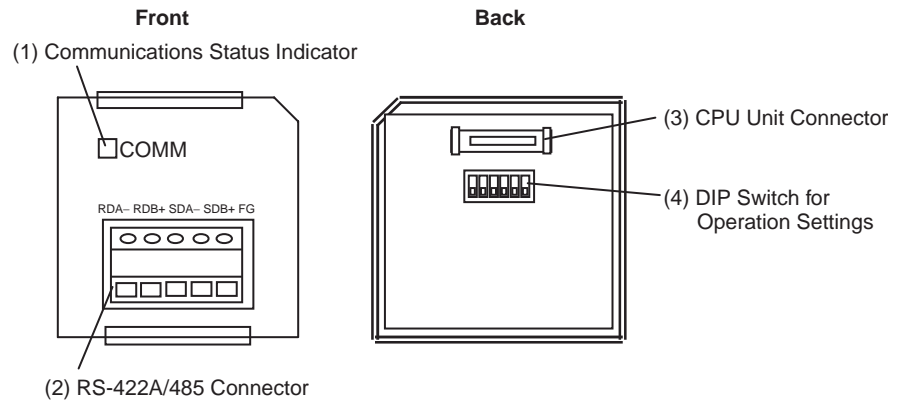
## 2-1-3 CP1W-CIF11/CIF12 RS-422A/485 Option Boards

A RS-422A/485 Option Board can be mounted to an Option Board slot on the CPU Unit. With a CPU Unit with 30 or 40 I/O points, either Option Board slot may be used.

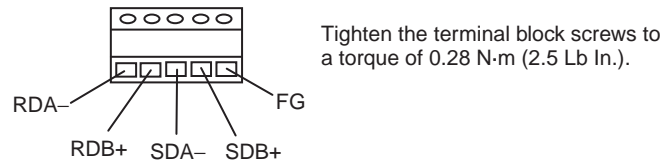
When mounting an Option Board, first remove the slot cover. Grasp both of the cover's up/down lock levers at the same time to unlock the cover, and then pull the cover out.

Then to mount the Option Board, check the alignment and firmly press it in until it snaps into place.

**Caution** Always turn OFF the power supply to the PLC before mounting or removing an Option Board.



### RS-422A/485 Terminal Block



### DIP Switch for Operation Settings

| CP1W-CIF11/12 |     | CP1W-CIF12-V1 |     | Settings |   |   |
|---------------|-----|---------------|-----|----------|---|---|
|               | Pin |               | Pin |          |   |   |
|               | 1   |               | 1   | ON       | ON (both ends)                              | Terminating resistance selection          |
|               |     |               |     | OFF      | OFF   | Resistance value: 220Ω typical            |
|               | 2   |               | 2   | ON       | 2-wire                                      | 2-wire or 4-wire selection (See note 1.)  |
|               |     |               |     | OFF      | 4-wire                                      |   |
|               | 3   |               | 3   | ON       | 2-wire                                      | 2-wire or 4-wire selection (See note 1.)  |
|               |     |               |     | OFF      | 4-wire                                      |   |
|               | 4   |               | 4   | ---      | ---   | Not used.                                 |
|               | 5   |               | 1   | ON       | RS control enabled                          | RS control selection for RD (See note 2.) |
|               |     |               |     | OFF      | RS control disabled (Data always received.) |   |
|               | 6   |               | 2   | ON       | RS control enabled                          | RS control selection for SD (See note 3.) |
|               |     |               |     | OFF      | RS control disabled (Data always sent.)     |   |

#### Note

- (1) Set both pins 2 and 3 to either ON (2-wire) or OFF (4-wire).
- (2) To disable the echo-back function, set pin 5 to ON (RS control enabled).
- (3) When connecting to a device on the N side in a 1: N connection with the 4-wire method, set pin 6 to ON (RS control enabled).  
Also, when connecting by the 2-wire method, set pin 6 to ON (RS control enabled).

## 2-2 Specifications

### 2-2-1 CP1L-EL/EM CPU Units

#### General Specifications

| Type                               | EM CPU Units   |  | EL CPU Units                                     |
|------------------------------------|--|--|--|
| Model                              | CP1L-EM40DR-D<br>CP1L-EM40DT-D<br>CP1L-EM40DT1-D   | CP1L-EM30DR-D<br>CP1L-EM30DT-D<br>CP1L-EM30DT1-D | CP1L-EL20DR-D<br>CP1L-EL20DT-D<br>CP1L-EL20DT1-D |
| Power supply                       | 24 VDC   |  |  |
| Operating voltage range            | 20.4 to 26.4 VDC   |  |  |
| Power consumption<br>(See note 2.) | 20 W max.  | 20 W max.  | 13 W max.  |
| Inrush current<br>(See note 1.)    | 30 A max.(for cold start.)<br>20 ms max.   |  |  |
| Insulation resistance              | No insulation between primary and secondary DC power supplies.   |  |  |
| Dielectric strength                | No insulation between primary and secondary DC power supplies.   |  |  |
| Noise resistance                   | Conforms to IEC 61000-4-4 2 kV (power supply line)   |  |  |
| Vibration resistance               | Conforms to JIS 60068-2-6<br>5 to 8.4 Hz, 3.5 mm amplitude, 8.4 to 150 Hz, acceleration: 9.8 m/s <sup>2</sup> in X, Y, and Z directions for 100 minutes each (time coefficient of 10 minutes × coefficient factor of 10 = total time of 100 minutes) |  |  |
| Shock resistance                   | Conforms to JIS 60068-2-27<br>147 m/s <sup>2</sup> three times each in X, Y, and Z directions  |  |  |
| Ambient operating                  | 0 to 55°C  |  |  |
| Ambient humidity                   | 10% to 90% (with no condensation)  |  |  |
| Atmosphere                         | No corrosive gas.  |  |  |
| Ambient storage                    | –20 to 75°C (excluding battery)  |  |  |
| Terminal screw size                | M3   |  |  |
| Power interrupt time               | 2 ms min.  |  |  |
| Weight                             | 555 g max.   | 485 g max.                                       | 400 g max.                                       |

**Note** (1) The above values are for a cold start for a DC power supply.

- A capacitor delay circuit is used in the inrush current control circuitry for the DC power supply. The capacitor will not be charged if a hot start is performed when the power supply has been OFF for only a short time, so in those cases the inrush current values may be higher (as much as two times higher) than those shown above.

Always allow for this when selecting fuses and breakers for external circuits.

- (2) This is the rated value for the maximum system configuration. Use the following formula to calculate DC power consumption for CPU Units with DC power.

Formula:

DC-powered CP1L-EL/EM power consumption = (5 V current consumption × 5 V/70% (CP1L-EL/EM internal power efficiency) + 24 V current consumption × 24 V) × 1.1 (current fluctuation factor)

Calculation Example

| System | CPU Unit      | Expansion Unit or Expansion I/O Unit |            |            | Total   |
|--------|---------------|--------------------------------------|------------|------------|---------|
|        |               | 1st Unit                             | 2nd Unit   | 3rd Unit   |         |
|        | CP1L-EM40DR-D | CP1W-20EDT                           | CP1W-TS001 | CP1W-DA041 |         |
| 5 V    | 0.320 A       | 0.130 A                              | 0.040 A    | 0.080 A    | 0.570 A |
| 24 V   | 0.080 A       | 0.000 A                              | 0.059 A    | 0.124 A    | 0.263 A |

CP1L-EL/EM Power Consumption

$$= (0.57 \text{ A} \times 5 \text{ V}/70\% + 0.263 \text{ A} \times 24 \text{ V}) \times 1.1$$

$$= 11.42 \text{ W}$$

The above calculation results show that a power supply with a capacity of 12 W or greater is required.

- (3) General specification of Expansion I/O Units and Expansion Units will be the same criteria with CPU Units.

## Current Consumption

### CPU Units

| I/O capacity  | Model          | Current consumption |         |
|---------------|----------------|---------------------|---------|
|               |                | 5 V DC              | 24 V DC |
| 40 I/O points | CP1L-EM40DR-D  | 0.32 A              | 0.08 A  |
|               | CP1L-EM40DT-D  | 0.42 A              | 0.01 A  |
|               | CP1L-EM40DT1-D | 0.42 A              | 0.01 A  |
| 30 I/O points | CP1L-EM30DR-D  | 0.30 A              | 0.07 A  |
|               | CP1L-EM30DT-D  | 0.39 A              | 0.01 A  |
|               | CP1L-EM30DT1-D | 0.39 A              | 0.01 A  |
| 20 I/O points | CP1L-EL20DR-D  | 0.31 A              | 0.06 A  |
|               | CP1L-EL20DT-D  | 0.37 A              | 0.01 A  |
|               | CP1L-EL20DT1-D | 0.37 A              | 0.01 A  |

- Note**
- (1) The current consumption of the CP1W-ME05M Memory Cassette and CP1W-CIF01/11 Option Boards are included in the current consumption of the CPU Unit.
- (2) The current consumption of the following is not included with the current consumption of the CPU Unit.

| Unit                       | Model       | Current consumption |         |
|----------------------------|-------------|---------------------|---------|
|                            |             | 5 V DC              | 24 V DC |
| Interface Unit             | CP1W-CIF12  | 0.075 A             | ---     |
| LCD Option Board           | CP1W-DAM01  | 0.040 A             | ---     |
| Analog Input Option Board  | CP1W-ADB21  | 0.020 A             | ---     |
| Analog Output Option Board | CP1W-DAB21V | 0.060 A             | ---     |
| Analog I/O Option Board    | CP1W-MAB221 | 0.080 A             | ---     |



- (3) The current consumptions given in the following table must be added to the current consumption of the CPU Unit if an Expansion Unit or Expansion I/O Unit is connected.

#### Expansion Units and Expansion I/O Units

| Unit name           |                          | Model                                      |             | Current consumption |         |
|---------------------|--------------------------|--|-------------|---------------------|---------|
|                     |                          |  |             | 5 VDC               | 24 VDC  |
| Expansion I/O Units |                          | 40 I/O points                              | CP1W-40EDR  | 0.080 A             | 0.090 A |
|                     |                          | 24 inputs                                  | CP1W-40EDT  | 0.160 A             | ---     |
|                     |                          | 16 outputs                                 | CP1W-40EDT1 |                     |         |
|                     |                          | 32 outputs                                 | CP1W-32ER   | 0.049 A             | 0.131 A |
|                     |                          |  | CP1W-32ET   | 0.113 A             | ---     |
|                     |                          |  | CP1W-32ET1  |                     |         |
|                     |                          | 20 I/O points                              | CP1W-20EDR1 | 0.103 A             | 0.044 A |
|                     |                          | 12 inputs                                  | CP1W-20EDT  | 0.130 A             | ---     |
|                     |                          | 8 outputs                                  | CP1W-20EDT1 |                     |         |
|                     |                          | 16 outputs                                 | CP1W-16ER   | 0.042 A             | 0.090 A |
|                     |                          |  | CP1W-16ET   | 0.076 A             | ---     |
|                     |                          |  | CP1W-16ET1  |                     |         |
|                     |                          | 8 inputs                                   | CP1W-8ED    | 0.018 A             | ---     |
|                     |                          | 8 outputs                                  | CP1W-8ER    | 0.026 A             | 0.044 A |
|                     |                          |  | CP1W-8ET    | 0.075 A             | ---     |
|                     |                          |  | CP1W-8ET1   |                     |         |
| Expansion Units     | Analog Input Unit        | 4 inputs                                   | CP1W-AD041  | 0.100 A             | 0.090 A |
|                     |                          |  | CP1W-AD042  | 0.100 A             | 0.050 A |
|                     | Analog Output Unit       | 2 outputs                                  | CP1W-DA021  | 0.040 A             | 0.095 A |
|                     |                          | 4 outputs                                  | CP1W-DA041  | 0.080 A             | 0.124 A |
|                     |                          |  | CP1W-DA042  | 0.070 A             | 0.160 A |
|                     | Analog I/O Units         | 2 inputs                                   | CP1W-MAD11  | 0.083 A             | 0.110 A |
|                     |                          | 1 output                                   |             |                     |         |
|                     |                          | 4 inputs                                   | CP1W-MAD42  | 0.120 A             | 0.120 A |
|                     |                          | 2 outputs                                  |             |                     |         |
|                     | Temperature Sensor Units | 4 inputs                                   | CP1W-MAD44  | 0.120 A             | 0.170 A |
|                     |                          | 4 outputs                                  |             |                     |         |
|                     |                          | K or J thermocouples                       | CP1W-TS001  | 0.040 A             | 0.059 A |
|                     |                          |  | CP1W-TS002  |                     |         |
|                     |                          |  | CP1W-TS004  | 0.080 A             | 0.050 A |
|                     |                          | K or J thermocouples or analog inputs      | CP1W-TS003  | 0.070 A             | 0.030 A |
|                     | CompoBus/S I/O Link Unit | Pt or JPt platinum resistance thermometers | CP1W-TS101  | 0.054 A             | 0.073 A |
|                     |                          |  | CP1W-TS102  |                     |         |
|                     | CompoBus/S I/O Link Unit | 8 inputs                                   | CP1W-SRT21  | 0.029 A             | ---     |
|                     |                          | 8 outputs                                  |             |                     |         |

**Note** CP1W-32ER/32ET/32ET1's maximum number of simultaneously ON points is 24 (75%).

**Characteristics**

| Type  |                       |              | EM CPU Units  |  | EL CPU Units                                     |
|---|-----------------------|--------------|---|--|--|
| Model   |                       |              | CP1L-EM40DR-D<br>CP1L-EM40DT-D<br>CP1L-EM40DT1-D  | CP1L-EM30DR-D<br>CP1L-EM30DT-D<br>CP1L-EM30DT1-D | CP1L-EL20DR-D<br>CP1L-EL20DT-D<br>CP1L-EL20DT1-D |
| Program capacity<br>(See note 1.)                             |                       |              | 10 K steps  |  | 5 K steps  |
| FB capacity   |                       |              | 10 K steps  |  |  |
| Control method  |                       |              | Stored program method   |  |  |
| I/O control method  |                       |              | Cyclic scan with immediate refreshing   |  |  |
| Program language  |                       |              | Ladder diagram  |  |  |
| Function blocks   |                       |              | Maximum number of function block definitions: 128<br>Maximum number of instances: 256<br>Languages usable in function block definitions: Ladder diagrams, structured text (ST)  |  |  |
| Instruction length  |                       |              | 1 to 7 steps per instruction  |  |  |
| Instructions  |                       |              | Approx. 500 (function codes: 3 digits)  |  |  |
| Instruction execution time                                    |                       |              | Basic instructions: 0.61 μs min.<br>Special instructions: 4.1 μs min.   |  |  |
| Common processing time  |                       |              | 0.38 ms   |  |  |
| Number of connectable Expansion Units and Expansion I/O Units |                       |              | 3 Units (CP Series)   |  | 1 Unit (CP Series)                               |
| Maximum number of I/O points                                  |                       |              | 160 points<br>(40 built in, 40 × 3 expansion)   | 150 points<br>(30 built in, 40 × 3 expansion)    | 60 points<br>(20 built in, 40 × 1 expansion)     |
| Built-in terminals<br>(Functions can be assigned.)            | Built-in I/O          |              | 40 terminals<br>(24 inputs and 16 outputs)  | 30 terminals<br>(18 inputs and 12 outputs)       | 20 terminals<br>(12 inputs and 8 outputs)        |
|   | Inter-rupt inputs     | Direct mode  | 6 inputs<br>Response time: 0.3 ms   |  |  |
|   |                       | Counter mode | 6 inputs<br>Response frequency: 5 kHz total, 16 bits<br>Incrementing counter or decrementing counter  |  |  |
|   | Quick-response inputs |              | 6 points<br>Min. input pulse width: 50 μs max.  |  |  |
|   | High-speed counters   |              | 4 inputs/2 axes (24 VDC)<br>• Single phase (pulse plus direction, up/down, increment), 100 kHz<br>• Differential phases (4×), 50 kHz<br>Value range: 32 bits, Linear mode or ring mode<br>Interrupts: Target value comparison or range comparison |  |  |
| Pulse outputs<br>(Transistor output models only)              | Pulse outputs         |              | 2 outputs, 1 Hz to 100 kHz<br>(CCW/CW or pulse plus direction)<br>Trapezoidal or S-curve acceleration and deceleration (Duty ratio: 50% fixed)  |  |  |
|   | PWM outputs           |              | 2 outputs, 0.1 to 6,553.5 Hz or 1 to 32,800 Hz<br>Variable duty ratio: 0.0% to 100.0% (in increments of 0.1% or 1%)<br>Accuracy: +1%/-0% at 0.1 Hz to 10,000 Hz and +5%/-0% at 10,000 Hz to 32,800 Hz   |  |  |
| Built-in analog input   |                       |              | 2 inputs (Resolution: 1/1000, Input range: 0 to 10 V)   |  |  |
| Ethernet port   |                       |              | Supported. (1 Ethernet port built-in)   |  |  |

| Type                                |                       | EM CPU Units   |  | EL CPU Units                                     |
|-------------------------------------|-----------------------|--|--|--|
| Model                               |                       | CP1L-EM40DR-D<br>CP1L-EM40DT-D<br>CP1L-EM40DT1-D   | CP1L-EM30DR-D<br>CP1L-EM30DT-D<br>CP1L-EM30DT1-D | CP1L-EL20DR-D<br>CP1L-EL20DT-D<br>CP1L-EL20DT1-D |
| Serial port (RS-232C , RS-422A/485) |                       | Ports not provided as standard equipment. (EM-type CPU Unit: 2 ports max., EL-type CPU Unit: 1 port)<br>The following Option Boards can be mounted:<br><ul style="list-style-type: none"> <li>• CP1W-CIF01: One RS-232C port</li> <li>• CP1W-CIF11/CIF12: One RS-422A/485 port</li> </ul> Applicable communications modes (same for all of the above ports): Host Link, NT Link (1: N mode), No-protocol, Serial PLC Link Slave, Serial PLC Link Master, Serial Gateway (conversion to CompoWay/F, conversion to Modbus-RTU), peripheral bus (See note 2.)   |  |  |
| Number of tasks                     |                       | 288 (32 cycle execution tasks and 256 interrupt tasks)   |  |  |
|                                     | Scheduled interrupt   | 1 (interrupt task 2, fixed)  |  |  |
|                                     | Input interrupt tasks | 6 (interrupt tasks 140 to 145, fixed)<br>(High-speed counter interrupts and interrupt tasks specified by external interrupts can also be executed.)  |  |  |
| Maximum subroutine number           |                       | 256  |  |  |
| Maximum jump number                 |                       | 256  |  |  |
| Scheduled interrupts                |                       | 1  |  |  |
| Clock function                      |                       | Supported.<br>Accuracy (monthly deviation): -0.5 min to +4.5 min (ambient temperature: 55°C),<br>-2.0 min to +2.0 min (ambient temperature: 25°C),<br>-2.5 min to +1.5 min (ambient temperature: 0°C)  |  |  |
| Memory Backup                       | Built-in flash memory | User programs and parameters (such as the PLC Setup) are automatically saved to the flash memory. It is also possible to save and read data memory initial data.<br>The data is automatically transferred to RAM when the power supply is turned ON. (Data memory initial data, however, may or may not be transferred, depending on the selection in the PLC Setup.   |  |  |
|                                     | Battery backup        | The HR Area, DM Area, and counter values (flags, PV) are backed up by a battery.<br>Battery model: CJ1W-BAT01 (Built into the CP1L-EL/EM CPU Unit.)<br>Maximum battery service life: 5 years<br>Guaranteed (ambient temperature: 55°C): 13,000 hours (approx. 1.5 years)<br>Effective value (ambient temperature: 25°C): 43,000 hours (approx. 5 years)  |  |  |
| Memory Cassette function            |                       | A CP1W-ME05M Memory Cassette (512K words, optional) can be mounted. It can be used to back up the following data on the CPU Unit's RAM and to transfer the data at startup.<br><ul style="list-style-type: none"> <li>• Data saved on Memory Cassette: User programs, parameters (such as the PLC Setup), DM Area, data memory initial data, comment memory (CX-Programmer conversion tables, comments, program indices), and FB program memory.</li> <li>• Writing to Memory Cassette: By operations from the CX-Programmer.</li> <li>• Reading from Memory Cassette: At startup, or by operations from the CX-Programmer.</li> </ul> |  |  |

- Note**
- (1) The function block capacity is not included in the program capacity.
  - (2) Can be used as Modbus-RTU easy master function.

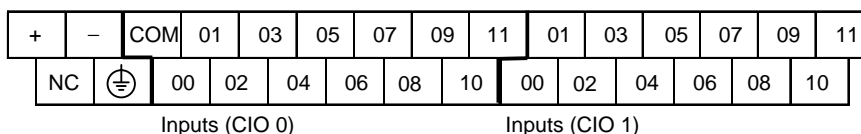
## 2-2-2 I/O Memory Details

| Type                |                      | EM CPU Units   |   | EL CPU Units   |
|---------------------|----------------------|--|---|--|
| Model               |                      | CP1L-EM40DR-D<br>CP1L-EM40DT-D<br>CP1L-EM40DT1-D   | CP1L-EM30DR-D<br>CP1L-EM30DT-D<br>CP1L-EM30DT1-D                | CP1L-EL20DR-D<br>CP1L-EL20DT-D<br>CP1L-EL20DT1-D   |
| I/O Areas           | Input bits           | 24 bits<br>CIO 0.00 to CIO 0.11<br>CIO 1.00 to CIO 1.11  | 18 bits<br>CIO 0.00 to CIO 0.11<br>CIO 1.00 to CIO 1.05         | 12 bits<br>CIO 0.00 to CIO 0.11  |
|                     | Output bits          | 16 bits<br>CIO 100.00 to CIO 100.07<br>CIO 101.00 to CIO 101.07  | 12 bits<br>CIO 100.00 to CIO 100.07<br>CIO 101.00 to CIO 101.03 | 8 bits<br>CIO 100.00 to CIO 100.07   |
|                     | 1:1 Link Bit Area    | 256 bits (16 words): CIO 3000.00 to CIO 3015.15 (words CIO 3000 to CIO 3015)   |   |  |
|                     | Serial PLC Link Area | 1,440 bits (90 words): CIO 3100.00 to CIO 3189.15 (words CIO 3100 to CIO 3189)   |   |  |
|                     | Work bits            | 4,800 bits (300 words): CIO 1200.00 to CIO 1499.15 (words CIO 1200 to CIO 1499)<br>6,400 bits (400 words): CIO 1500.00 to CIO 1899.15 (words CIO 1500 to CIO 1899)<br>15,360 bits (960 words): CIO 2000.00 to CIO 2959.15 (words CIO 2000 to CIO 2959)<br>9,600 bits (600 words): CIO 3200.00 to CIO 3799.15 (words CIO 3200 to CIO 3799)<br>37,504 bits (2,344 words): CIO 3800.00 to CIO 6143.15 (words CIO 3800 to CIO 6143)  |   |  |
| Work bits           |                      | 8,192 bits (512 words): W000.00 to W511.15 (words W0 to W511)  |   |  |
| TR Area             |                      | 16 bits: TR0 to TR15   |   |  |
| HR Area             |                      | 8,192 bits (512 words): H0.00 to H511.15 (words H0 to H511)  |   |  |
| AR Area             |                      | Read-only (Write-prohibited) 7,168 bits (448 words): A0.00 to A447.15 (words A0 to A447)<br>Read/Write 8,192 bits (512 words): A448.00 to A959.15 (words A448 to A959)   |   |  |
| Timers              |                      | 4,096 bits: T0 to T4095  |   |  |
| Counters            |                      | 4,096 bits: C0 to C4095  |   |  |
| DM Area             |                      | 32 Kwords: D0 to D32767<br><b>Note</b> Initial data can be transferred to the CPU Unit's built-in flash memory using the data memory initial data transfer function. A setting in the PLC Setup can be used so that the data in flash memory is transferred to RAM at startup.<br>DM fixed allocation words for Modbus-RTU Easy Master D32200 to D32249 for Serial Port 1, D32300 to D32349 for Serial Port 2<br>DM fixed allocation words for socket service D32400 to D32477 for Ethernet port |   | 10 Kwords: D0 to D9999 and D32000 to D32767<br><b>Note</b> Initial data can be transferred to the CPU Unit's built-in flash memory using the data memory initial data transfer function. A setting in the PLC Setup can be used so that the data in flash memory is transferred to RAM at startup.<br>DM fixed allocation words for Modbus-RTU Easy Master D32300 to D32349 for Serial Port 1<br>DM fixed allocation words for socket service D32400 to D32477 for Ethernet port |
| Data Register Area  |                      | 16 registers (16 bits): DR0 to DR15  |   |  |
| Index Register Area |                      | 16 registers (16 bits): IR0 to IR15  |   |  |
| Task Flag Area      |                      | 32 flags (32 bits): TK0 to TK31  |   |  |
| Trace Memory        |                      | 4,000 words (500 samples for the trace data maximum of 31 bits and 6 words.)   |   |  |

## 2-2-3 I/O Specifications

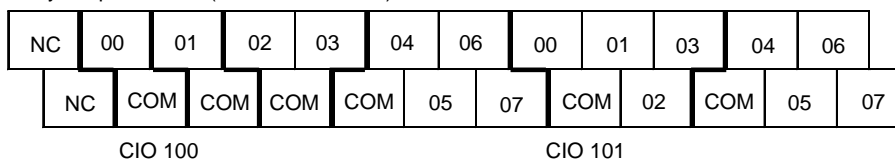
### I/O Terminal Blocks of CPU Units with 40 I/O Points

#### Input Terminal Block (Top Block)

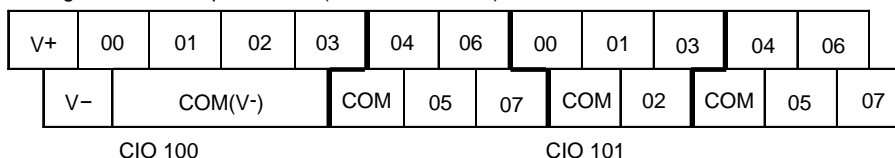


#### Output Terminal Block Arrangement (Bottom Block)

Relay Output Models (CP1L-EM40DR-D)

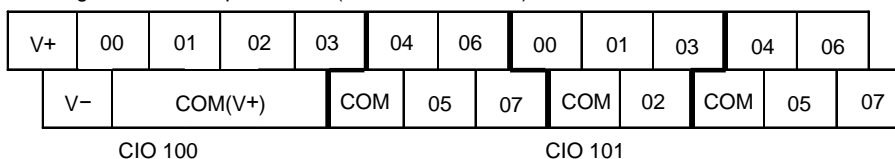


Sinking Transistor Output Models (CP1L-EM40DT-D)



- Note**
- (1) COM(V-) has been connected with V- in inner circuit.
  - (2) V+/V- input terminals are used as the power supply terminals for CIO100.00 to CIO100.03. Supply the power of 24 VDC when using CIO100.00 to CIO100.03.

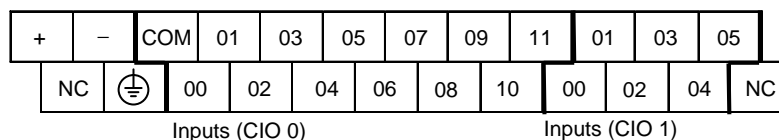
Sourcing Transistor Output Models (CP1L-EM40DT1-D)



- Note**
- (1) COM(V+) has been connected with V+ in inner circuit.
  - (2) V+/V- input terminals are used as the power supply terminals for CIO100.00 to CIO100.03. Supply the power of 24 VDC when using CIO100.00 to CIO100.03.

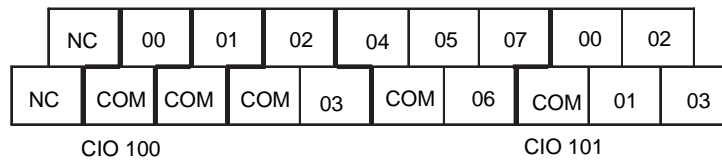
### I/O Terminal Blocks of CPU Units with 30 I/O Points

#### Input Terminal Block (Top Block)

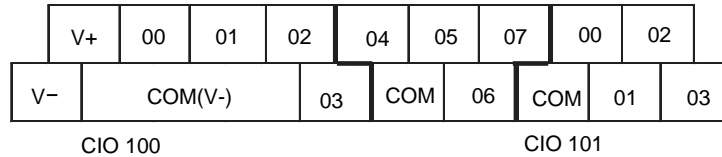


**Output Terminal Block (Bottom Block)**

Relay Output Models (CP1L-EM30DR-D)

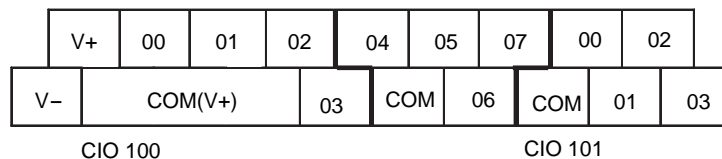


Sinking Transistor Output Models (CP1L-EM30DT-D)

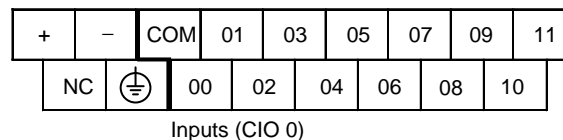


- Note**
- (1) COM(V-) has been connected with V- in inner circuit.
  - (2) V+/V- input terminals are used as the power supply terminals for CIO100.00 to CIO100.03. Supply the power of 24 VDC when using CIO100.00 to CIO100.03.

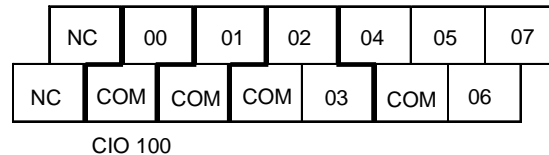
Sourcing Transistor Output Models (CP1L-EM30DT1-D)



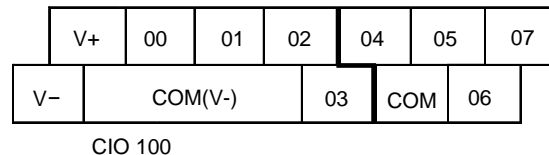
- Note**
- (1) COM(V+) has been connected with V+ in inner circuit.
  - (2) V+/V- input terminals are used as the power supply terminals for CIO100.00 to CIO100.03. Supply the power of 24 VDC when using CIO100.00 to CIO100.03.

**I/O Terminal Blocks of CPU Units with 20 I/O Points****Input Terminal Block (Top Block)****Output Terminal Block (Bottom Block)**

Relay Output Models (CP1L-EL20DR-D)



Sinking Transistor Output Models (CP1L-EL20DT-D)



- Note**
- (1) COM(V-) has been connected with V- in inner circuit.
  - (2) V+/V- input terminals are used as the power supply terminals for CIO100.00 to CIO100.03. Supply the power of 24 VDC when using CIO100.00 to CIO100.03.

Sourcing Transistor Output Models (CP1L-EL20DT1-D)

|    |         |    |    |     |    |    |
|----|---------|----|----|-----|----|----|
| V+ | 00      | 01 | 02 | 04  | 05 | 07 |
| V- | COM(V+) |    | 03 | COM | 06 |    |

CIO 100

- Note**
- (1) COM(V+) has been connected with V+ in inner circuit.
  - (2) V+/V- input terminals are used as the power supply terminals for CIO100.00 to CIO100.03. Supply the power of 24 VDC when using CIO100.00 to CIO100.03.

## Allocating Built-in Input and Output Terminals

### Setting Input Functions Using PLC Setup

| Address |     | Input operation settings |                              |                        | High-speed counters   |  | Origin searches                                   |
|---------|-----|--------------------------|------------------------------|------------------------|---|--|---|
| Word    | Bit | Normal inputs            | Interrupt inputs (See note.) | Quick-response inputs  | Operation settings:<br>High-speed counters enabled<br>Phase-Z reset |  | Origin searches enabled for pulse outputs 0 and 1 |
|         |     |                          |                              |                        | Single-phase (increment pulse input)                                | Two-phase (differential phase x4, up/down, or pulse/direction) |   |
| CIO 0   | 00  | Normal input 0           | ---                          | ---                    | Counter 0, increment input  | Counter 0, A phase, up, or count input                         | ---   |
|         | 01  | Normal input 1           | ---                          | ---                    | Counter 1, increment input  | Counter 0, B phase, down, or direction input                   | ---   |
|         | 02  | Normal input 2           | ---                          | ---                    | Counter 2, increment input  | Counter 1, A phase, up, or count input                         | ---   |
|         | 03  | Normal input 3           | ---                          | ---                    | Counter 3, increment input  | Counter 1, B phase, down, or direction input                   | ---   |
|         | 04  | Normal input 4           | Interrupt input 0            | Quick-response input 0 | Counter 0, phase-Z/reset input                                      | Counter 0, phase-Z reset input                                 | ---   |
|         | 05  | Normal input 5           | Interrupt input 1            | Quick-response input 1 | Counter 1, phase-Z reset input                                      | Counter 1, phase-Z reset input                                 | ---   |
|         | 06  | Normal input 6           | Interrupt input 2            | Quick-response input 2 | Counter 2, phase-Z reset input                                      | ---  | Pulse output 0: Origin input signal               |
|         | 07  | Normal input 7           | Interrupt input 3            | Quick-response input 3 | Counter 3, phase-Z reset input                                      | ---  | Pulse output 1: Origin input signal               |
|         | 08  | Normal input 8           | Interrupt input 4            | Quick-response input 4 | ---   | ---  | ---   |
|         | 09  | Normal input 9           | Interrupt input 5            | Quick-response input 5 | ---   | ---  | ---   |
|         | 10  | Normal input 10          | ---                          | ---                    | ---   | ---  | Pulse output 0: Origin proximity input signal     |
|         | 11  | Normal input 11          | ---                          | ---                    | ---   | ---  | Pulse output 1: Origin proximity input signal     |

| Address |     | Input operation settings |                                 |                       | High-speed counters   |  | Origin searches   |
|---------|-----|--------------------------|---------------------------------|-----------------------|---|--|---|
| Word    | Bit | Normal inputs            | Interrupt inputs<br>(See note.) | Quick-response inputs | Operation settings:<br>High-speed counters enabled<br>Phase-Z reset |  | Origin searches<br>enabled for pulse<br>outputs 0 and 1 |
|         |     |                          |                                 |                       | Single-phase<br>(increment<br>pulse input)                          | Two-phase (differential<br>phase x4, up/down, or<br>pulse/direction) |   |
| CIO 1   | 00  | Normal input 12          | ---                             | ---                   | ---   | ---  | ---   |
|         | 01  | Normal input 13          | ---                             | ---                   | ---   | ---  | ---   |
|         | 02  | Normal input 14          | ---                             | ---                   | ---   | ---  | ---   |
|         | 03  | Normal input 15          | ---                             | ---                   | ---   | ---  | ---   |
|         | 04  | Normal input 16          | ---                             | ---                   | ---   | ---  | ---   |
|         | 05  | Normal input 17          | ---                             | ---                   | ---   | ---  | ---   |
|         | 06  | Normal input 18          | ---                             | ---                   | ---   | ---  | ---   |
|         | 07  | Normal input 19          | ---                             | ---                   | ---   | ---  | ---   |
|         | 08  | Normal input 20          | ---                             | ---                   | ---   | ---  | ---   |
|         | 09  | Normal input 21          | ---                             | ---                   | ---   | ---  | ---   |
|         | 10  | Normal input 22          | ---                             | ---                   | ---   | ---  | ---   |
|         | 11  | Normal input 23          | ---                             | ---                   | ---   | ---  | ---   |

**Note** The bits CIO 1.06 to CIO 1.11 cannot be used for CPU Units with 30 I/O points.

The bits CIO 1.00 to CIO 1.11 cannot be used for CPU Units with 20 I/O points.



## Setting Output Functions Using Instructions and PLC Setup

| Address |     | When the instructions to the right are not executed | When a pulse output instruction (SPED, ACC, PLS2, or ORG) is executed |                            | When origin searches are enabled in the PLC Setup, and an origin search is executed with ORG instruction | When the PWM instruction is executed |
|---------|-----|---|---|----------------------------|--|--------------------------------------|
| Word    | Bit | Normal outputs                                      | Fixed duty ratio pulse output   |                            |  | Variable duty ratio pulse output     |
|         |     |   | CW/CCW  | Pulse plus direction       | + When the origin search function is used  | PWM output                           |
| CIO 100 | 00  | Normal output 0                                     | Pulse output 0 (CW)   | Pulse output 0 (pulse)     | ---  | ---                                  |
|         | 01  | Normal output 1                                     | Pulse output 0 (CCW)  | Pulse output 0 (direction) | ---  | PWM output 0                         |
|         | 02  | Normal output 2                                     | Pulse output 1 (CW)   | Pulse output 1 (pulse)     | ---  | ---                                  |
|         | 03  | Normal output 3                                     | Pulse output 1 (CCW)  | Pulse output 1 (direction) | ---  | PWM output 1                         |
|         | 04  | Normal output 4                                     | ---   | ---                        | Origin search 0 (Error counter reset output)   | ---                                  |
|         | 05  | Normal output 5                                     | ---   | ---                        | Origin search 1 (Error counter reset output)   | ---                                  |
|         | 06  | Normal output 6                                     | ---   | ---                        | ---  | ---                                  |
|         | 07  | Normal output 7                                     | ---   | ---                        | ---  | ---                                  |
| CIO 101 | 00  | Normal output 8                                     | ---   | ---                        | ---  | ---                                  |
|         | 01  | Normal output 9                                     | ---   | ---                        | ---  | ---                                  |
|         | 02  | Normal output 10                                    | ---   | ---                        | ---  | ---                                  |
|         | 03  | Normal output 11                                    | ---   | ---                        | ---  | ---                                  |
|         | 04  | Normal output 12                                    | ---   | ---                        | ---  | ---                                  |
|         | 05  | Normal output 13                                    | ---   | ---                        | ---  | ---                                  |
|         | 06  | Normal output 14                                    | ---   | ---                        | ---  | ---                                  |
|         | 07  | Normal output 15                                    | ---   | ---                        | ---  | ---                                  |

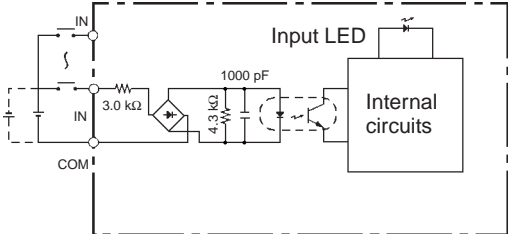
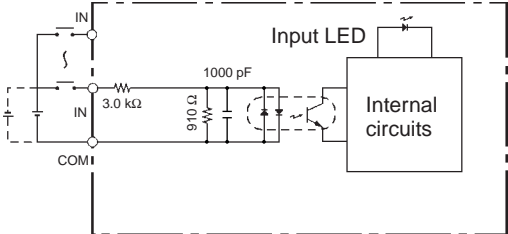
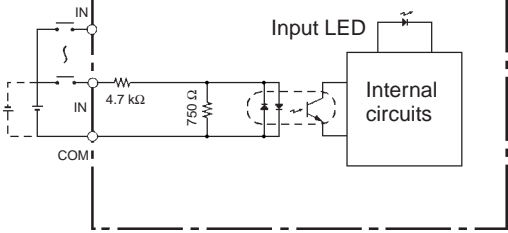
**Note** The bits CIO 101.04 to CIO 101.07 cannot be used for CPU Units with 30 I/O points.

The bits CIO 101.00 to CIO 101.07 cannot be used for CPU Units with 20 I/O points.

## Input Specifications

## Normal Inputs

| Item                | Specification             |  |   |
|---------------------|---------------------------|--|---|
|                     | High-speed Counter Inputs | Interrupt Inputs and Quick-response Inputs | Normal inputs   |
|                     | CIO 0.00 to CIO 0.03      | CIO 0.04 to CIO 0.09 (See note 1.)         | CIO 0.10 to CIO 0.11 and CIO 1.00 to CIO 1.11 (See note 2.) |
| Input voltage       | 24 VDC $+10\%$ / $-15\%$  |  |   |
| Applicable inputs   | 2-wire and 3-wire sensors |  |   |
| Input impedance     | 3.0 k $\Omega$            | 3.0 k $\Omega$                             | 4.7 k $\Omega$  |
| Input current       | 7.5 mA typical            | 7.5 mA typical                             | 5 mA typical  |
| ON voltage          | 17.0 VDC min.             | 17.0 VDC min.                              | 14.4 VDC min.   |
| OFF voltage/current | 1 mA max. at 5.0 VDC max. | 1 mA max. at 5.0 VDC max.                  | 1 mA max. at 5.0 VDC max.                                   |
| ON delay            | 2.5 $\mu$ s max.          | 50 $\mu$ s max.                            | 1 ms max. (See note 3.)                                     |

| Item                  | Specification  |  |   |
|-----------------------|--|--|---|
|                       | High-speed Counter Inputs  | Interrupt Inputs and Quick-response Inputs | Normal inputs   |
|                       | CIO 0.00 to CIO 0.03   | CIO 0.04 to CIO 0.09 (See note 1.)         | CIO 0.10 to CIO 0.11 and CIO 1.00 to CIO 1.11 (See note 2.) |
| OFF delay             | 2.5 $\mu$ s max.   | 50 $\mu$ s max.                            | 1 ms max. (See note 3.)                                     |
| Circuit configuration | <p>Input bits: CIO 0.00 to CIO 0.03</p>  <p>Input bits: CIO 0.04 to CIO 0.09</p>  <p>Input bits: CIO 0.10 to CIO 0.11, CIO 1.00 to CIO 1.11</p>  |  |   |

- Note**
- (1) High-speed counter inputs, interrupt inputs, and quick-response inputs can also be used as normal inputs.
  - (2) The bits that can be used depend on the model of CPU Unit.
  - (3) The response time is the hardware delay value. The delay set in the PLC Setup (0 to 32 ms, default: 8 ms) must be added to this value.

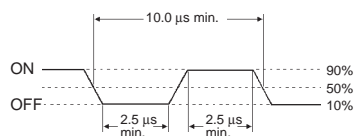
### High-speed Counter Inputs

| Bit                  | Differential phase mode   | Pulse plus direction input mode | Up/down input mode    | Increment mode        |
|----------------------|---|---------------------------------|-----------------------|-----------------------|
| CIO 0.00, CIO 0.02   | A-phase pulse input   | Pulse input                     | Increment pulse input | Increment pulse input |
| CIO 0.01, CIO 0.03   | B-phase pulse input   | Direction input                 | Decrement pulse input | Normal input          |
| CIO 0.04, CIO 0.05   | Z-phase pulse input or hardware reset input (Can be used as ordinary inputs when high-speed counter is not being used.) |                                 |                       |                       |
| Max. count frequency | 50 kHz (4×)   | 100 kHz                         |                       |                       |

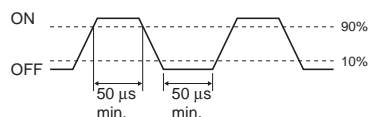
**Input Bits for High-speed Counters**

| Counter              | Single phase | Phase A  | Phase B  | Phase Z  |
|----------------------|--------------|----------|----------|----------|
| High-speed counter 0 | CIO 0.00     | CIO 0.00 | CIO 0.01 | CIO 0.04 |
| High-speed counter 1 | CIO 0.01     | CIO 0.02 | CIO 0.03 | CIO 0.05 |
| High-speed counter 2 | CIO 0.02     | ---      | ---      | ---      |
| High-speed counter 3 | CIO 0.03     | ---      | ---      | ---      |

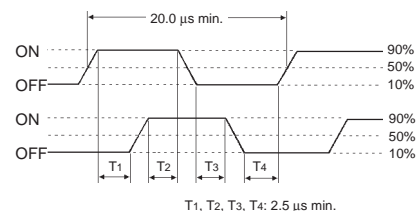
Pulse plus direction input mode,  
Increment mode  
Up/down input mode



Input bits: CIO 0.04 to CIO 0.09



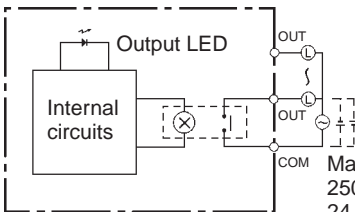
Differential phase mode

**Interrupt Inputs and Quick-response Inputs**

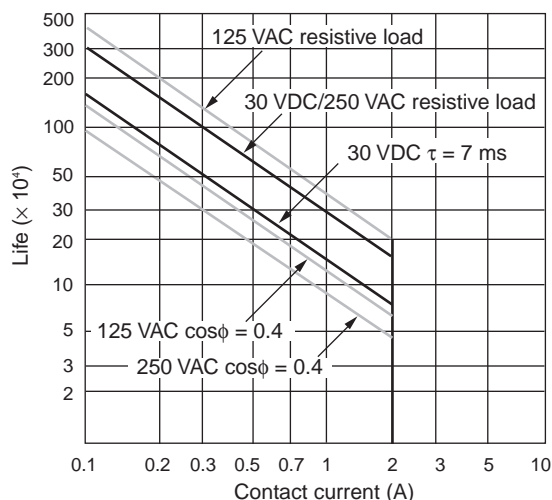
With CPU Units with 20, 30 or 40 I/O points, the six input bits from CIO 0.04 to CIO 0.09 can be used as either normal inputs or as interrupt or quick-response inputs depending on the settings in the PLC Setup.

| Input bits | Interrupt inputs  | Quick-response inputs  |
|------------|-------------------|------------------------|
| CIO 0.04   | Interrupt input 0 | Quick-response input 0 |
| CIO 0.05   | Interrupt input 1 | Quick-response input 1 |
| CIO 0.06   | Interrupt input 2 | Quick-response input 2 |
| CIO 0.07   | Interrupt input 3 | Quick-response input 3 |
| CIO 0.08   | Interrupt input 4 | Quick-response input 4 |
| CIO 0.09   | Interrupt input 5 | Quick-response input 5 |

**Output Specifications****Relay Outputs**

| Item                    |            |                | Specification  |
|-------------------------|------------|----------------|--|
| Max. switching capacity |            |                | 2 A, 250 VAC ( $\cos\phi = 1$ )<br>2 A, 24 VDC (4 A/common)  |
| Min. switching capacity |            |                | 10 mA, 5 VDC   |
| Service life of relay   | Electrical | Resistive load | 100,000 operations (24 VDC)  |
|                         |            | Inductive load | 48,000 operations (250 VAC, $\cos\phi = 0.4$ )   |
|                         | Mechanical |                | 20,000,000 operations  |
| ON delay                |            |                | 15 ms max.   |
| OFF delay               |            |                | 15 ms max.   |
| Circuit configuration   |            |                |  <p>Maximum<br/>250 VAC: 2 A<br/>24 VDC: 2 A</p> |

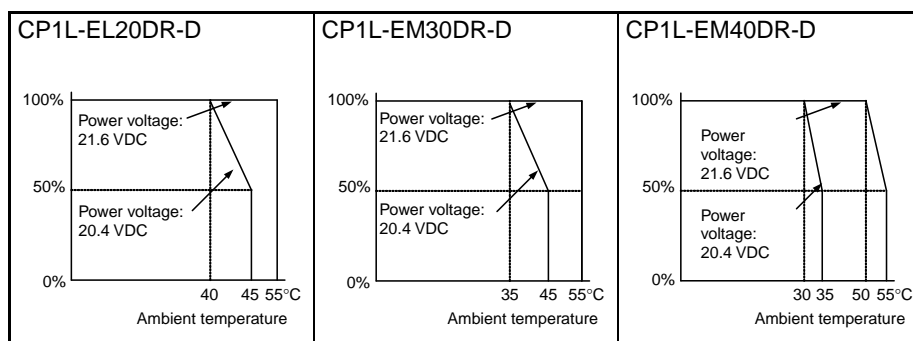
- Note** (1) Under the worst conditions, the service life of output contacts is as shown above. The service life of relays is as shown in the following diagram as a guideline.



- (2) There are restrictions imposed by the ambient temperature.

CPU Units with Relay Outputs (CP1L-E□□□DR-D)

Relay Output Load Current Derating Curves for CPU Units and Expansion I/O Units

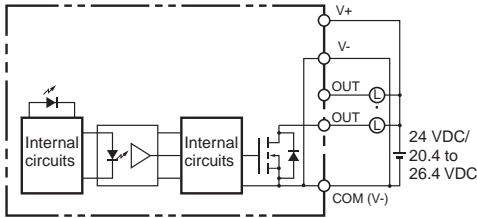
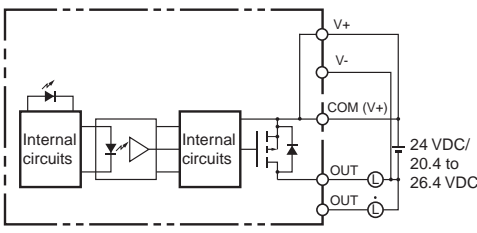
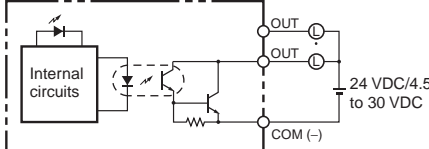
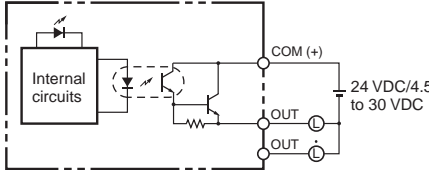


- Note** The above restrictions, apply to the relay output load current from the CPU Unit even if Expansion I/O Units are not connected.

## Transistor Outputs (Sinking or Sourcing)

### Normal Outputs

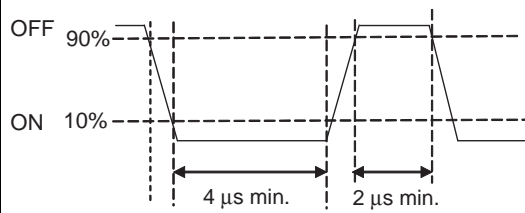
| Item                    | Specification   |                                      |
|-------------------------|---|--------------------------------------|
|                         | CIO 100.00 to CIO 100.03  | CIO 100.04 to CIO 101.07 (See note.) |
| Max. switching capacity | 4.5 to 30 VDC, 300 mA/output, 0.9 A/common, EM40D□-D 3.6 A/Unit<br>EM30D□-D 2.7 A/Unit<br>EL20D□-D 1.8 A/Unit |                                      |
| Min. switching capacity | 4.5 to 30 VDC, 1 mA   |                                      |
| Leakage current         | 0.1 mA max.   |                                      |
| Residual voltage        | 0.6 V max.  | 1.5 V max.                           |
| ON delay                | 0.1 ms max.   |                                      |
| OFF delay               | 0.1 ms max.   | 1 ms max.                            |

| Item                  | Specification  |  |
|-----------------------|--|--|
|                       | CIO 100.00 to CIO 100.03   | CIO 100.04 to CIO 101.07 (See note.)   |
| Fuse                  | None   |  |
| Circuit configuration | <ul style="list-style-type: none"> <li>Normal outputs CIO 100.00 to CIO 100.03 (Sinking Outputs)</li> </ul>  <ul style="list-style-type: none"> <li>Normal outputs CIO 100.00 to CIO 100.03 (Sourcing Outputs)</li> </ul>  | <ul style="list-style-type: none"> <li>Normal outputs CIO 100.04 to CIO 101.07 (Sinking Outputs)</li> </ul>  <ul style="list-style-type: none"> <li>Normal outputs CIO 100.04 to CIO 101.07 (Sourcing Outputs)</li> </ul>  |

**Note** The bits that can be used depend on the model of the CPU Unit.

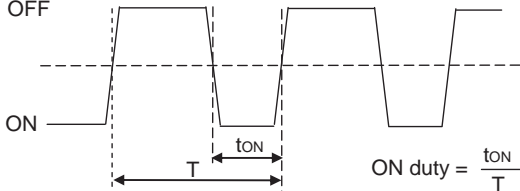
**Caution** Do not connect a load to an output terminal or apply a voltage in excess of the maximum switching capacity.

#### Pulse Outputs (CIO 100.00 to CIO 100.03)

| Item                    | Specification  |
|-------------------------|--|
| Max. switching capacity | 30 mA/4.75 to 26.4 VDC   |
| Min. switching capacity | 7 mA/4.75 to 26.4 VDC  |
| Max. output frequency   | 100 kHz  |
| Output waveform         |  <p>The OFF and ON refer to the output transistor. The output transistor is ON at level "L".</p> |

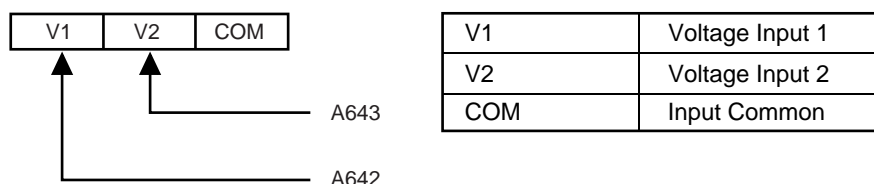
- Note**
- (1) The load for the above values is assumed to be the resistance load, and does not take into account the impedance for the connecting cable to the load.
  - (2) Due to distortions in pulse waveforms resulting from connecting cable impedance, the pulse widths in actual operation may be smaller than the values shown above.

## PWM Outputs (CIO 100.01 and CIO 100.03)

| Item                    | Specification   |
|-------------------------|---|
| Max. switching capacity | 30 mA/4.75 to 26.4 VDC  |
| Max. output frequency   | 32.8 kHz  |
| PWM output accuracy     | For ON duty +1%, -0%: 10 kHz output<br>For ON duty +5%, -0%: 0 to 32.8 kHz output   |
| Output waveform         | <div> <p>OFF</p>  <p>ON</p> <p><math>ON\ duty = \frac{t_{ON}}{T} \times 100\%</math></p> <p>The OFF and ON refer to the output transistor. The output transistor is ON at level "L".</p> </div> |

## 2-2-4 Built-in Analog Input Specifications

## Built-in Analog Input Terminal Block Arrangement



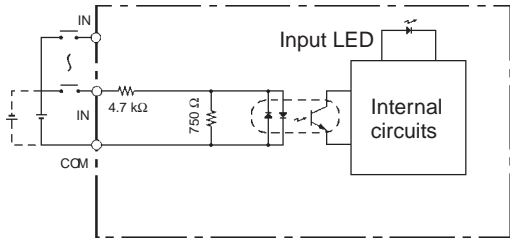
## Analog Input Specifications

| Item                     | Specification   |
|--------------------------|---|
| Number of inputs         | 2 inputs (2 words allocated in the AR Area)                           |
| Input signal range       | Voltage input: 0 V to 10 V  |
| Max. rated input         | 0 V to 15 V   |
| External input impedance | 100 K $\Omega$ min.   |
| Resolution               | 1/1000 (full scale)   |
| Overall accuracy         | 25°C: $\pm 2.0\%$ (full scale)<br>0 to 55°C: $\pm 3.0\%$ (full scale) |
| A/D conversion data      | 0000 to 03E8 hex  |
| Averaging function       | Not supported   |
| Conversion time          | Same as PLC cycle time  |
| Isolation method         | None  |

## 2-2-5 CP-series Expansion I/O Unit I/O Specifications

## Input Specifications (CP1W-40EDR/40EDT/40EDT1/20EDR1/20EDT/20EDT1/8ED)

| Item            | Specification           |
|-----------------|-------------------------|
| Input voltage   | 24 VDC $+10\%/-15\%$    |
| Input impedance | 4.7 k $\Omega$          |
| Input current   | 5 mA typical            |
| ON voltage      | 14.4 VDC min.           |
| OFF voltage     | 5.0 VDC max.            |
| ON delay        | 1 ms max. (See note 1.) |

| Item                  | Specification  |
|-----------------------|--|
| OFF delay             | 1 ms max. (See note 1.)  |
| Circuit configuration |  |

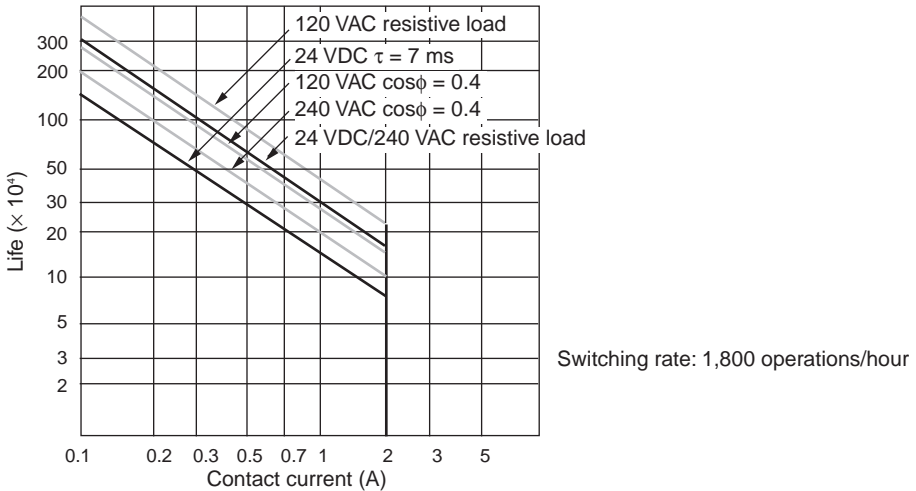
- Note**
- (1) The response time is the hardware delay value. The delay set in the PLC Setup (0 to 32 ms, default: 8 ms) must be added to this value. For the CP1W-40EDR/EDT/EDT1, a fixed value of 16 ms must be added.
  - (2) Do not apply voltage in excess of the rated voltage to the input terminal.

Output Specifications

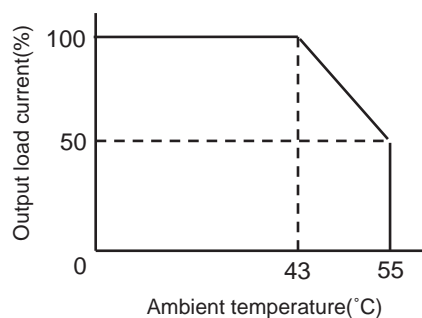
Relay Outputs (CP1W-40EDR/32ER/20EDR1/16ER/8ER)

| Item                                 |            |                | Specification  |
|--------------------------------------|------------|----------------|--|
| Max. switching capacity              |            |                | 2 A, 250 VAC ( $\cos\phi = 1$ ),<br>2 A, 24 VDC (4 A/common) |
| Min. switching capacity              |            |                | 5 VDC, 10 mA   |
| Service life of relay<br>(See note.) | Electrical | Resistive load | 150,000 operations (24 VDC)                                  |
|                                      |            | Inductive load | 100,000 operations (240 VAC, $\cos\phi = 0.4$ )              |
|                                      | Mechanical |                | 20,000,000 operations  |
| ON delay                             |            |                | 15 ms max.   |
| OFF delay                            |            |                | 15 ms max.   |
| Circuit configuration                |            |                | <div></div>  |

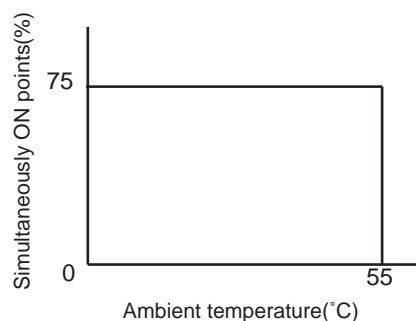
- Note**
- (1) Under the worst conditions, the service life of output contacts is as shown above. The service life of relays is as shown in the following diagram as a guideline.



- (2) With the CP1W-32ER/CP1W-16ER, the load current is restricted depending on the ambient temperature. Design the system considering the load current based on the following graph.

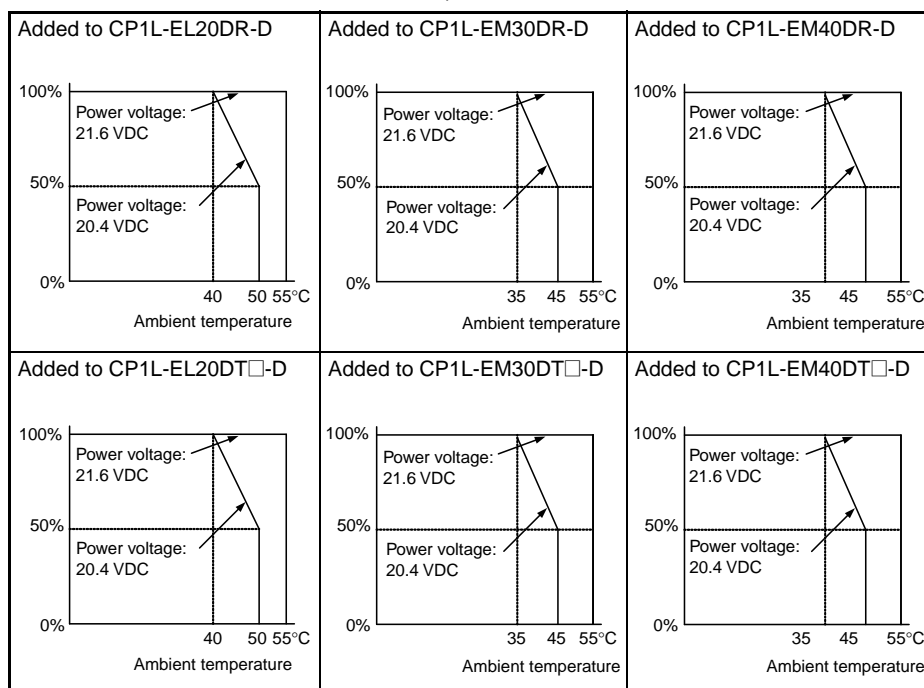


- (3) CP1W-32ER's maximum number of simultaneously ON output points is 24 (75%). Design the system considering the simultaneously ON points and load current based on the following curve.



- (4) There are restrictions imposed by the ambient temperature.

Relay Output Load Current Derating Curves for Expansion I/O Units (CP1W-8ER/16ER/20EDR1/32ER/40EDR)



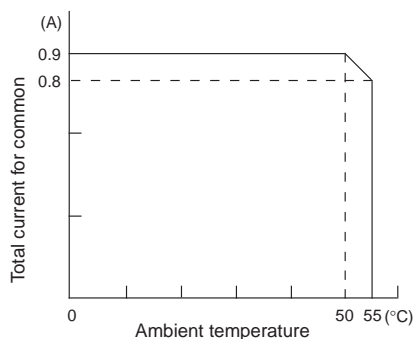


## Transistor Outputs (Sinking or Sourcing)

| Item  | Specification   |  |  |  |   |
|---|---|--|--|--|---|
|   | CP1W-40EDT<br>CP1W-40EDT1   | CP1W-32ET<br>CP1W-32ET1  | CP1W-20EDT<br>CP1W-20EDT1  | CP1W-16ET<br>CP1W-16ET1  | CP1W-8ET<br>CP1W-8ET1   |
| Max. switching capacity<br>(See note2.)           | 4.5 to 30 VDC<br>0.3 A/output   | 4.5 to 30 VDC<br>0.3 A/output                                      | 24 VDC <sup>10%/</sup> <sub>-5%</sub><br>0.3 A/output              | 4.5 to 30 VDC<br>0.3 A/output                                      | <ul style="list-style-type: none"> <li>•OUT00/01 4.5 to 30 VDC, 0.2 A/output</li> <li>•OUT02 to 07 4.5 to 30 VDC, 0.3 A/output</li> </ul> |
|   | 0.9 A/common<br>3.6 A/Unit  | 0.9 A/common<br>7.2 A/Unit   | 0.9 A/common<br>1.8 A/Unit   | 0.9 A/common<br>3.6 A/Unit   | 0.9 A/common<br>1.8 A/Unit  |
| Leakage current                                   | 0.1 mA max.   | 0.1 mA max.  | 0.1 mA max.  | 0.1 mA max.  | 0.1 mA max.   |
| Residual voltage                                  | 1.5 V max.  | 1.5 V max.   | 1.5 V max.   | 1.5 V max.   | 1.5 V max.  |
| ON delay  | 0.1 ms max.   | 0.1 ms max.  | 0.1 ms.  | 0.1 ms max.  | 0.1 ms max.   |
| OFF delay   | 1 ms max.<br>24 VDC <sup>+10%/</sup> <sub>-5%</sub><br>5 to 300 mA  | 1 ms max.<br>24 VDC <sup>+10%/</sup> <sub>-5%</sub><br>5 to 300 mA | 1 ms max.<br>24 VDC <sup>+10%/</sup> <sub>-5%</sub><br>5 to 300 mA | 1 ms max.<br>24 VDC <sup>+10%/</sup> <sub>-5%</sub><br>5 to 300 mA | 1 ms max.<br>24 VDC <sup>+10%/</sup> <sub>-5%</sub><br>5 to 300 mA  |
| Max. number of Simultaneously ON Points of Output | 16 pts (100%)   | 24 pts (75%)   | 8 pts (100%)   | 16 pts (100%)  | 8 pts (100%)  |
| Fuse (See note 1.)                                | 1 fuse/common   |  |  |  |   |
| Circuit configuration                             | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Sinking Outputs</p> </div> <div style="text-align: center;"> <p>Sourcing Outputs</p> </div> </div> |  |  |  |   |

**Note**

- (1) The fuse cannot be replaced by the user.
- (2) If the ambient temperature is maintained below 50°C, up to 0.9 A/common can be used.

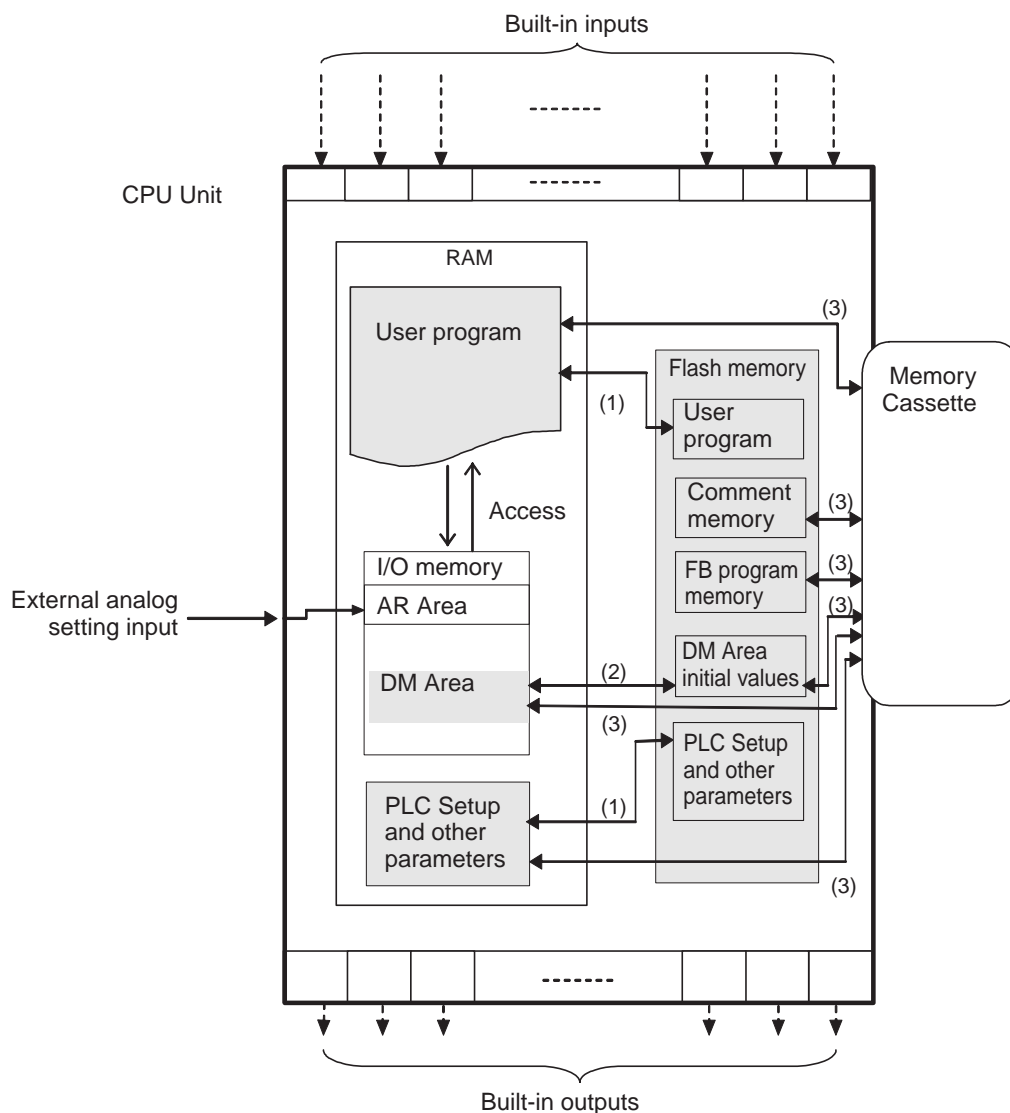


**Caution** Do not connect a load to an output terminal or apply a voltage in excess of the maximum switching capacity.

## 2-3 CP1L-EL/EM CPU Unit Operation

### 2-3-1 Overview of CPU Unit Configuration

The CP1L-EL/EM CPU Unit memory consists of the following blocks.



- (1)
  - Data is backed up from RAM to the built-in flash memory when changes are made, e.g., from the CX-Programmer.
  - When the power supply is turned ON, data is transferred from the built-in flash memory to RAM.
- (2)
  - A CX-Programmer operation can be used to transfer DM Area initial values from RAM to the built-in flash memory.
  - The PLC Setup can be set so that DM Area initial values are transferred from the built-in flash memory to RAM when the power supply is turned ON.
- (3)
  - CX-Programmer operations can be used to transfer data from RAM to the Memory Cassette or from the built-in flash memory to the Memory Cassette.

- When the power supply is turned ON, data is transferred from the Memory Cassette to the built-in flash memory and RAM. Data can also be transferred from the Memory Cassette to the built-in flash memory and RAM using the CX-Programmer.

### **User Program**

The user program consists of up to 288 tasks, including interrupt tasks. Each task is programmed from the CX-Programmer and then transferred to the CPU Unit.

There are two types of tasks: cyclic tasks and interrupt tasks. Cyclic tasks are executed once each cycle and interrupt tasks are executed only when the interrupt conditions are met. There can be up to 32 cyclic tasks and up to 256 interrupt tasks. Cyclic tasks are executed in the order of the task numbers.

Instructions programmed in the tasks are executed in order from the first instruction and then I/O memory is refreshed. When all cyclic tasks have been executed, I/O refreshing with PLC Units is performed and then the cyclic tasks are executed again starting from the one with the lowest task number. This is called the cyclic scan method.

### **I/O Memory**

The I/O memory area is a RAM area read and written by the user. Some parts of the I/O memory are cleared when the power is interrupted. Other parts are maintained. There are parts that used for data exchange with PLC Units and parts that are used internally.

There are two ways to refresh the parts of I/O memory used for data exchange with PLC Units: Once each program execution cycle and immediately when needed when executing specific instructions.

### **Parameter Area**

In addition to the I/O memory used as instructions operands by the user, there is also a separate memory area that can be manipulated only from the CX-Programmer. This area, called the parameter area, contains the following.

- PLC Setup
- Routing tables

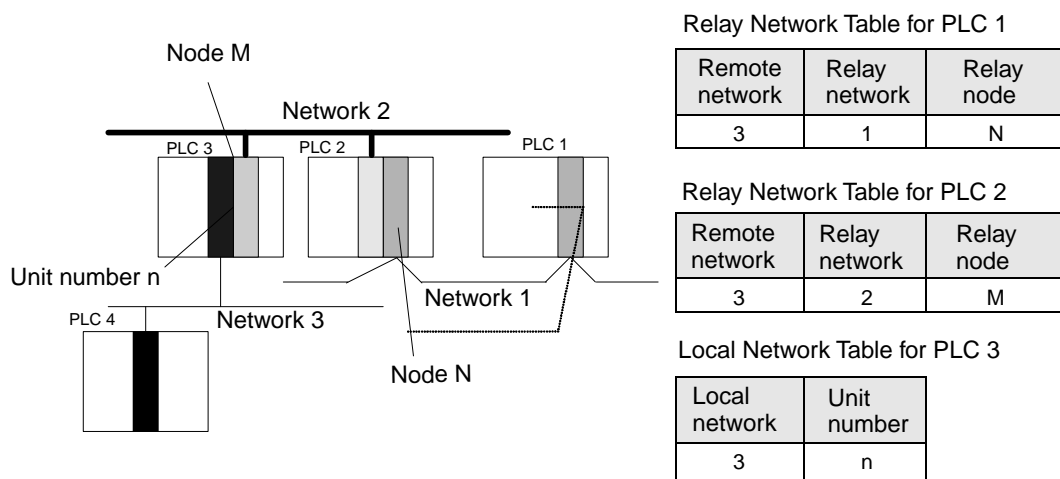
### **PLC Setup**

The PLC Setup contains configuration parameters that can be set by the user to define the basic specifications of the CPU Unit. Included are serial port settings, a minimum cycle time setting, and other parameters. For details, refer to the *CX-Programmer Operation Manual*.

### **Routing Tables**

Tables specifying the communications paths from the Communications Units on the local PLC to remote PLCs connected on other networks must be registered in all the CPU Units in network PLCs to send and receive data between networks. These tables are called the routing tables. The routing tables consist of the relay network table and local network table.

Routing tables are created from the CX-Programmer or Support Software for Communications Units (e.g., CX-Integrator) and then transferred to each CPU Unit.



### Remote Network Table

The remote network tables lists the node number and network address of the first relay node that must be passed through to reach any remote network to which the PLC is not directly connected. Once the routing tables have been registered, any remote network can be reached by passing through relay nodes.

### Local Network Table

The local network table contains the unit number and network address of all Communications Units that are part of the local PLC.

## Built-in Flash Memory

Flash memory is built into the CP1L-EL/EM CPU Units. Data in the following areas is automatically backed up to the flash memory whenever it is written in any way other than by instructions in the user program, e.g., when the CX-Programmer or PT is used to transfer or edit data, edit the program online, or transfer data from a Memory Cassette.

- User program area
- Parameter area (PLC Setup and routing tables)

The next time the power supply is turned ON, the data in the built-in flash memory is automatically transferred to user memory (i.e., the user program area and parameter area).

It is also possible to save data from data areas in I/O memory in the built-in flash memory using operations from the CX-Programmer.

The symbol table, comment file, and program index file can be stored in the comment memory in flash memory. When the program is transferred from the CX-Programmer to the CPU Unit, function block program information is also stored automatically in flash memory.

### Note

The BKUP indicator on the front of the CPU Unit will light whenever the built-in flash memory is being written or the Memory Cassette is being accessed. Never turn OFF the power supply to the CPU Unit when the BKUP indicator is lit.

## Memory Cassette

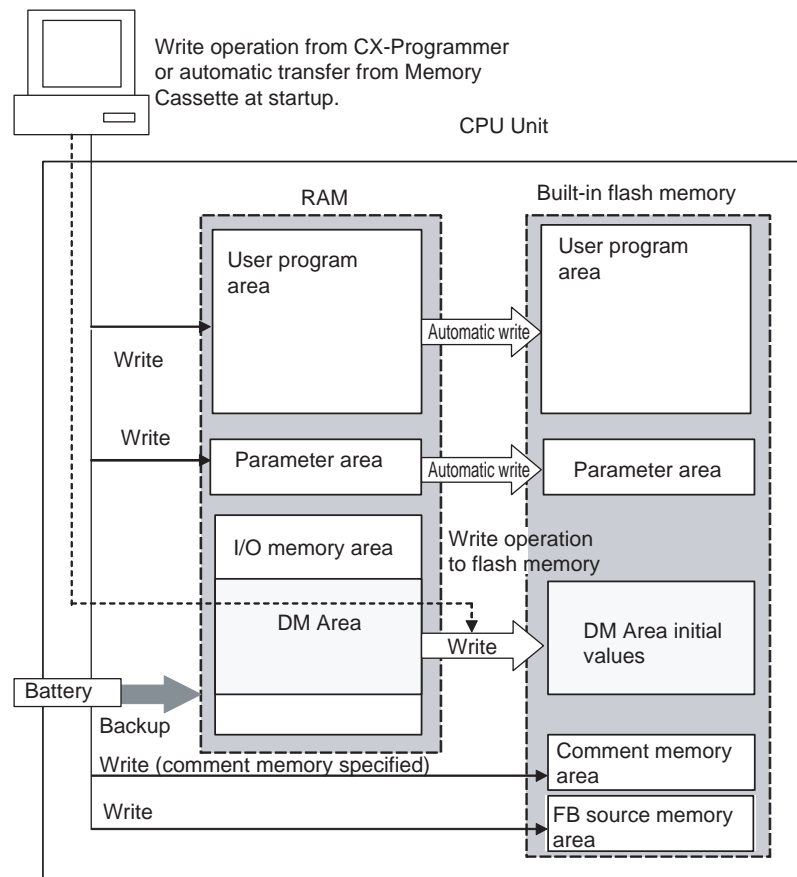
Memory Cassettes can be used as required in system operation and maintenance. For example, they can be used to save programs, data memory contents, PLC Setup data, or I/O comments from the CX-Programmer. The contents of a Memory Cassette can also be automatically transferred if desired.

## 2-3-2 Flash Memory Data Transfers

### Built-in Flash Memory

#### Writing to Flash Memory

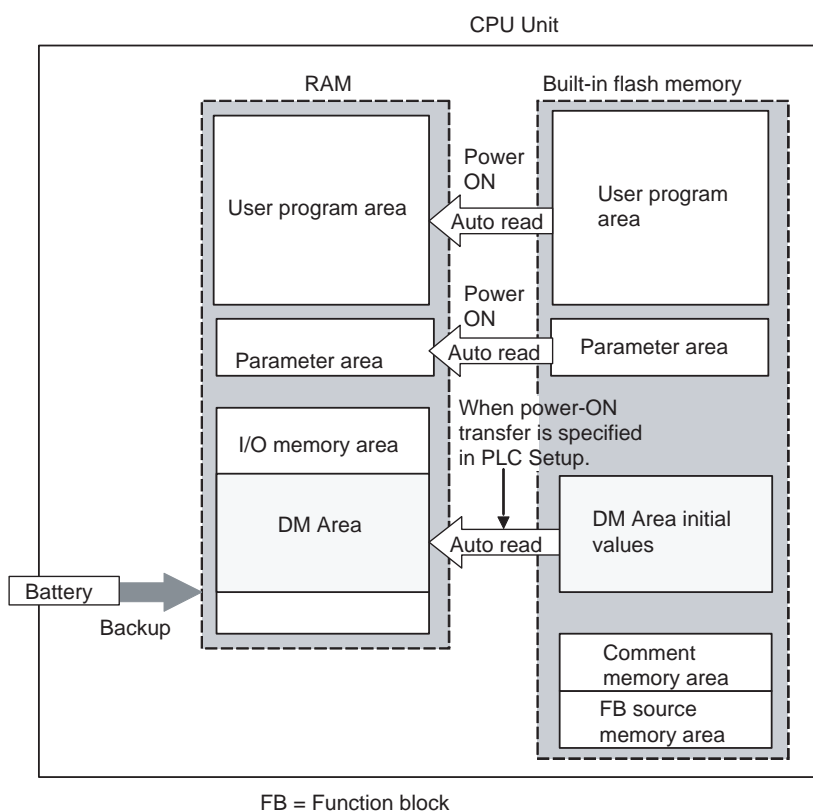
| Data                            | Transfer method   |
|---------------------------------|---|
| User program and parameter data | This data is automatically transferred from RAM to flash memory when a project is transferred from the CX-Programmer, when the data is written to RAM from a PT or other external device, or when the data is transferred from a Memory Cassette. |
| DM Area data                    | This data is transferred to flash memory only when the transfer is specified from the CX-Programmer.  |
| Comment memory data             | This data is written to flash memory when a project is transferred from the CX-Programmer and transferring comment memory is specified.   |
| Function block source data      | This data is written to flash memory when a project containing one or more function blocks is transferred from the CX-Programmer.   |



FB = Function block

## Reading from Flash Memory

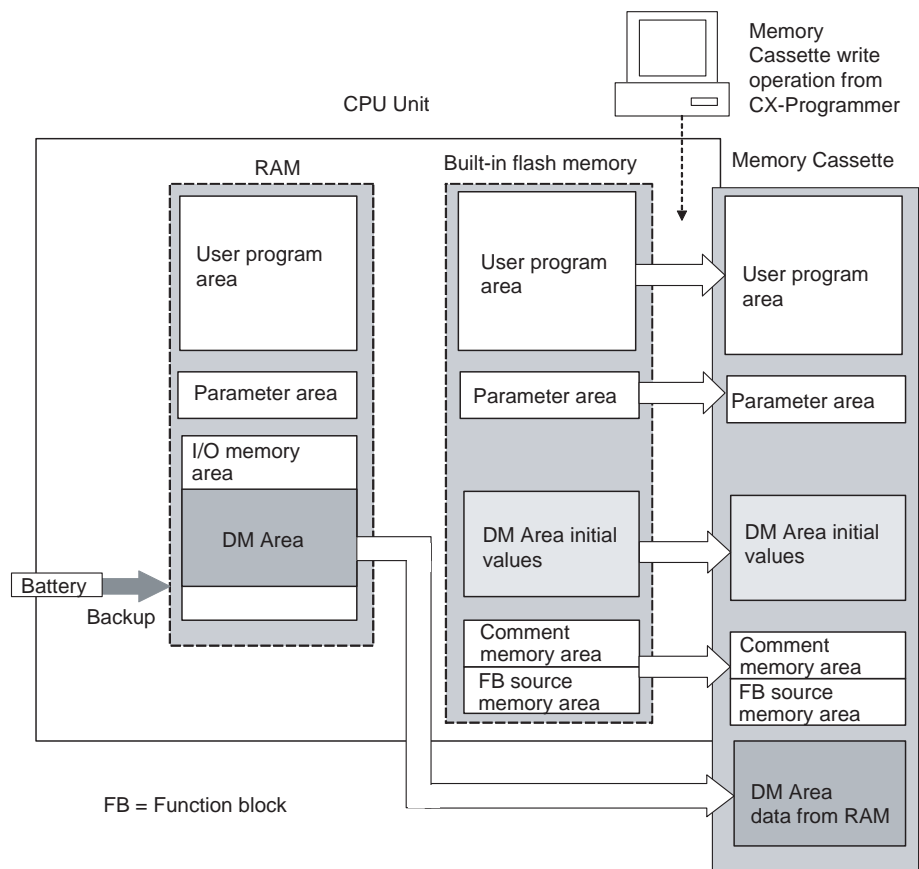
| Data                            | Read method  |
|---------------------------------|--|
| User program and parameter data | This data is automatically read to RAM when power is turned ON.  |
| DM Area data                    | Reading this data when power is turned ON can be enabled or disabled in the PLC Setup.   |
| Comment memory data             | When the project is transferred from the CX-Programmer, comment memory can be specified as a destination to transfer the comment memory data to built-in flash memory. |
| Function block source data      | When a project that contains function blocks is transferred from the CX-Programmer, the function block source data is transferred to built-in flash memory.            |



### 2-3-3 Memory Cassette Data Transfers

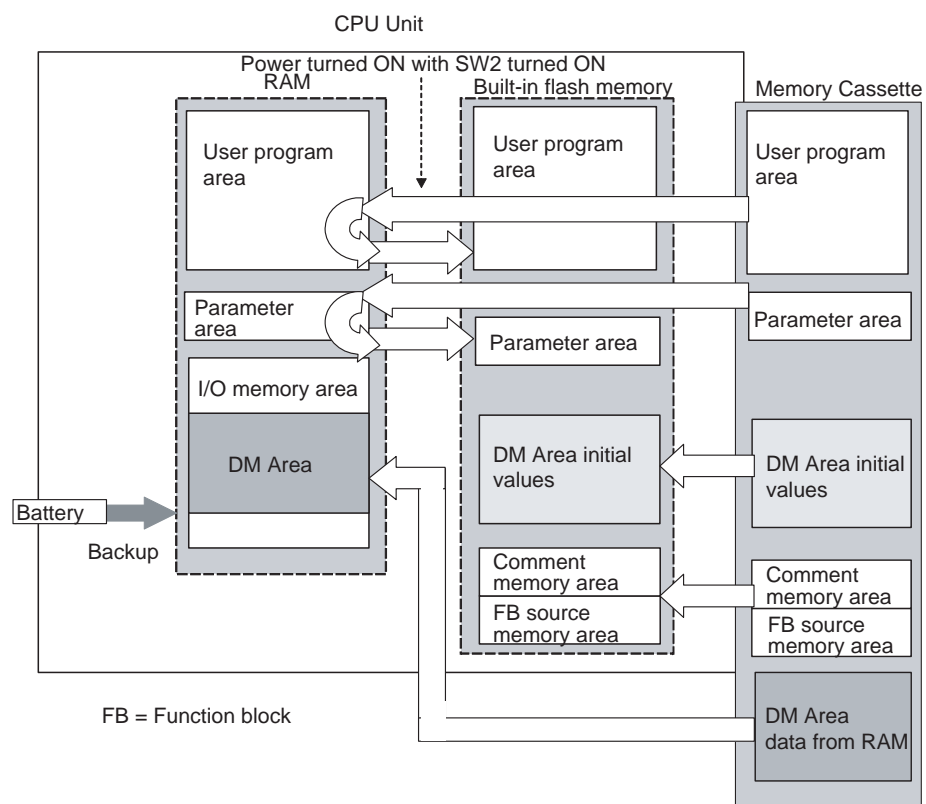
#### Writing to a Memory Cassette

| Data  | Method  | Source   |
|---|---|--|
| User program and parameter data               | Data is written to a Memory Cassette using write operations from the CX-Programmer. | Data in the built-in flash memory is written to the Memory Cassette.   |
| Comment memory and function block source data |   | Either of both of the following can be transferred to the Memory Cassette.                                     |
| DM Area data                                  |   | <ul style="list-style-type: none"> <li>• Data in the built-in flash memory.</li> <li>• Data in RAM.</li> </ul> |



**Reading from a Memory Cassette**

| Data  | Method   | Destination  |
|---|--|--|
| User program and parameter data               | This data is transferred by turning SW2 on the DIP switch to ON and turning ON the power supply. | Data in the Memory Cassette is transferred to RAM and then automatically transferred to the built-in flash memory.   |
| Comment memory and function block source data |  | Data is transferred to the built-in flash memory.  |
| DM Area data                                  |  | DM Area data originally from the built-in flash memory is transferred back to the flash memory and DM Area data originally from RAM is transferred to RAM. |

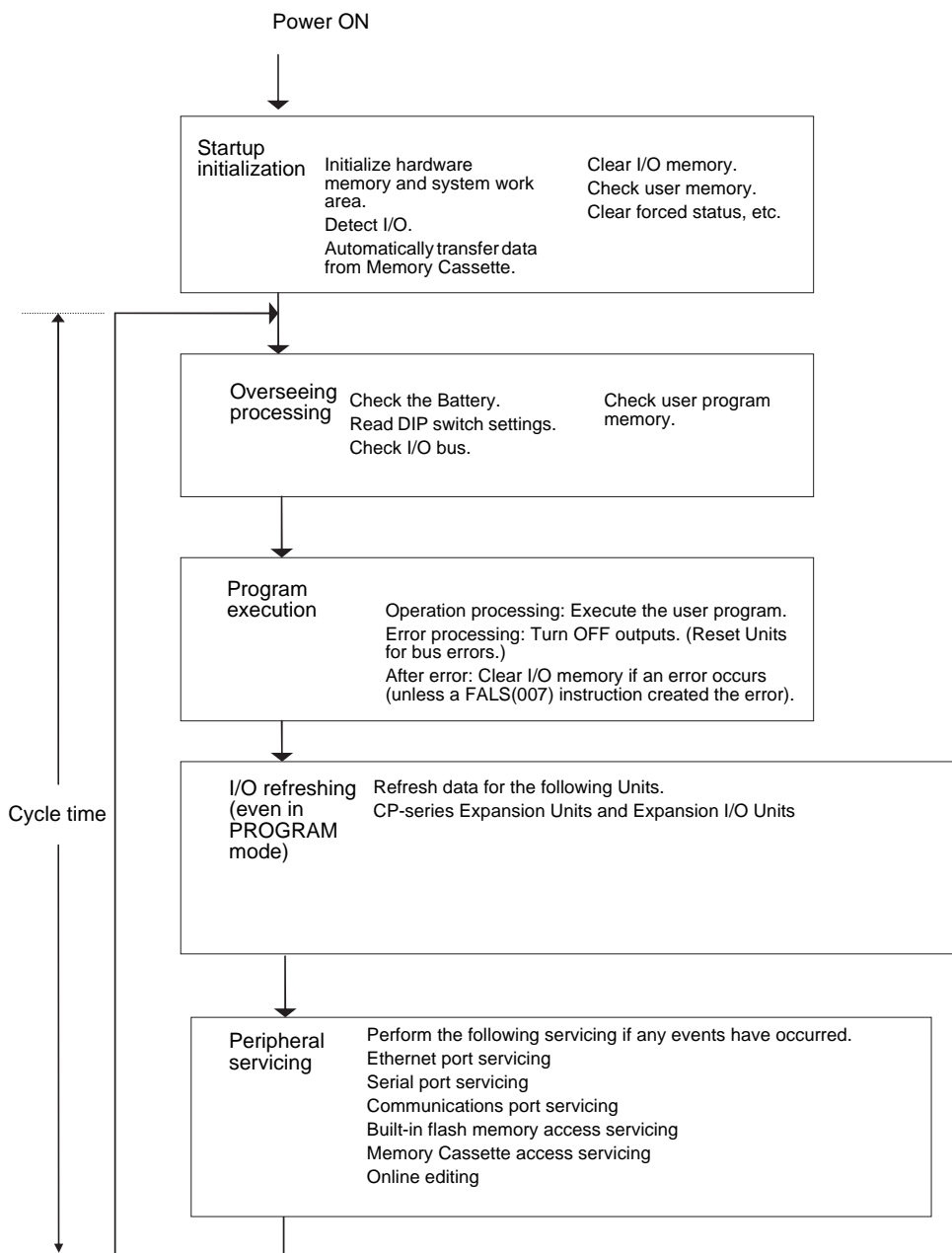




## 2-4 CPU Unit Operation

### 2-4-1 General Flow

The following flowchart shows the overall operation of the CPU Unit. First the user program is executed and then I/O is refreshed and peripheral servicing is performed. These processes are then repeated in cyclic fashion.



## 2-4-2 I/O Refreshing and Peripheral Servicing

### I/O Refreshing

I/O refreshing involves cyclically transferring data with external devices using preset words in memory. I/O refreshing includes the following:

- Refreshing between I/O words in the CIO Area and CPU Unit built-in I/O, CP-series Expansion Units, and CP-series Expansion I/O Units.

All I/O refreshing is performed in the same cycle (i.e., time slicing is not used). I/O refreshing is always performed after program execution.

| Units   | Max. data exchange              | Data exchange area |
|---|---------------------------------|--------------------|
| CPU Unit built-in I/O                             | 2 input words<br>2 output words | I/O Bit Area       |
| CP-series Expansion Units and Expansion I/O Units | Fixed depending on Units        | I/O Bit Area       |

### Peripheral Servicing

Peripheral servicing involves servicing non-scheduled events for external devices. This includes both events from external devices and service requests to external devices.

Most peripheral servicing involves FINS commands. The specific amount of time set in the system is allocated to each type of servicing and executed every cycle. If all servicing cannot be completed within the allocated time, the remaining servicing is performed the next cycle.

| Service                                | Description  |
|--|--|
| Ethernet port servicing                | <ul style="list-style-type: none"> <li>• Non-scheduled servicing for communications (either sending or receiving) via the Ethernet port.</li> </ul>  |
| Serial port servicing                  | <ul style="list-style-type: none"> <li>• Non-scheduled servicing for FINS or Host Link commands received via a serial port from the CX-Programmer, PTs, or host computers (e.g., requests for program transfers, monitoring, forced-set/reset operations, or online editing)</li> <li>• Non-scheduled servicing from the CPU Unit transmitted from a serial port (non-solicited communications)</li> </ul> |
| Communications port servicing          | <ul style="list-style-type: none"> <li>• Servicing to execute network communications or serial communications for the SEND, RECV, CMND instructions using communications ports 0 to 7 (internal logical ports)</li> <li>• Servicing to execute background execution using communications ports 0 to 7 (internal logical ports)</li> </ul>  |
| Built-in flash memory access servicing | <ul style="list-style-type: none"> <li>• Read/write processing for built-in flash memory</li> </ul>  |
| Memory Cassette access servicing       | <ul style="list-style-type: none"> <li>• Read/write processing for a Memory Cassette</li> </ul>  |

#### Note

- (1) Ethernet port, serial port, and communications port servicing is allocated 8% of the previous cycle time by default (the default can be changed) for each service. If servicing is separated over many cycles, delaying completion of the servicing, set the same allocated time (same time for all services) rather than a percentage under execute time settings in the PLC Setup.
- (2) An error will be occurred if the cycle time is too long. Modify the CX-Programmer's response monitoring time longer according to the following method.

Start the CX-Programmer. Select **Change Model** from the **PLC** Menu. The **Change PLC** Dialog Box will be displayed. Click the **Settings** Button on the right side of **Network Type**. The **Network Settings [USB]** Dialog Box will be displayed. Click the **Network** Tab and increase the value in **Response Timeout(s)**.

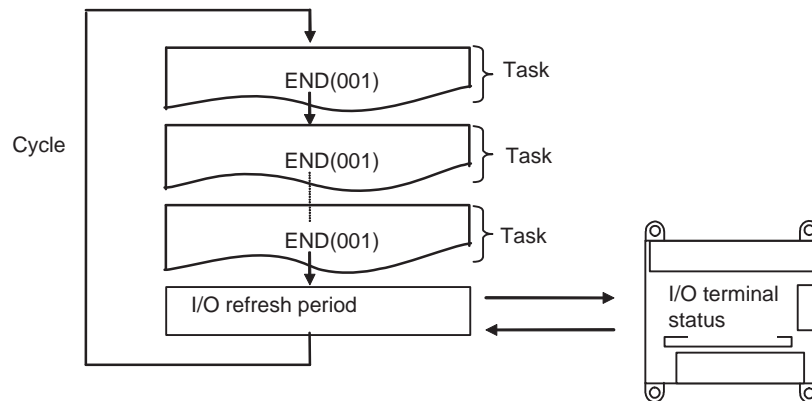
### 2-4-3 I/O Refresh Methods

I/O for CPU Unit built-in I/O and I/O on CP-series Expansion Units and Expansion I/O Units is performed at the following times.

- 1,2,3...
1. Cyclic refresh period
  2. When instructions with an immediate refresh variation are executed
  3. When IORF(097) is executed

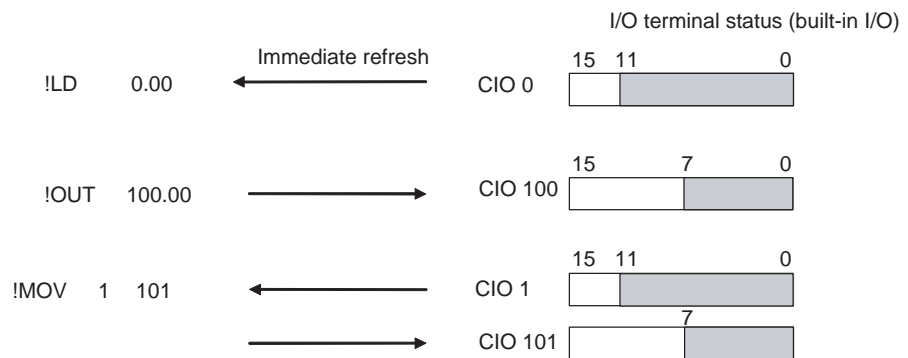
#### Cyclic Refreshing

I/O is refreshed after all the instructions in executable tasks have been executed.



#### Immediate Refreshing

When the immediate refreshing variation of an instruction is specified and the instruction's operand is an input bit or word in the Built-in I/O Area, the word containing the bit or the word itself will be refreshed.



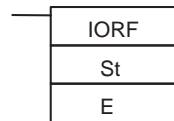
#### **Note**

- (1) Immediate refreshing is possible only for the Built-in I/O Area. Use IORF(097) for I/O on CP-series Expansion Units and Expansion I/O Units.
- (2) Refreshing Range
  - Bit Operands  
The ON/OFF status of the 16 I/O points allocated to the word containing the specified bit will be refreshed.
  - Word Operands  
The ON/OFF status of the 16 I/O points allocated to the specified word will be refreshed.
- (3) Refresh Timing
  - Input or source operands are read just before the instruction is executed.
  - Output or destination (results) operands are written just after the instruction is executed.

- (4) Using instructions with the immediate refresh option, instruction execution time will be increased, increasing the overall cycle time. Be sure to confirm that this will not adversely affect system operation.

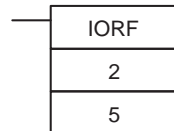
### IORF(097) Refreshing

When IORF(097) (I/O REFRESH) is executed, the I/O bits in the specified range of words are refreshed. IORF(097) can be used for CP-series Expansion Units and CP-series Expansion I/O Units.



**St:** Starting word  
**E:** End word  
 All the words from St to E, inclusive are refreshed.

Example



Here, the four words from CIO 2 to CIO 5 are refreshed.

If high-speed response is required from input to output, execute IORF(097) before and after the relevant instructions.

**Note** IORF(097) has a relatively long execution time which increases with the number of words being refreshed. Be sure to consider the affect of this time on the overall cycle time. Refer to the *CP Series Programmable Controllers Programming Manual* for instruction execution times.

## 2-4-4 Initialization at Startup

The following initializing processes will be performed once each time the power is turned ON.

- Confirm mounted Units and I/O allocations.
- Clear the non-holding areas of I/O memory according to the status of the IOM Hold Bit. (See note 1.)
- Clear forced status according to the status of the Forced Status Hold Bit. (See note 2.)
- Automatically transfer data from the Memory Cassette if one is mounted and automatic transfer at startup is specified.
- Perform self-diagnosis (user memory check).
- Restore the user program. (See note 3.)

**Note** (1) The I/O memory is held or cleared according to the status of the IOM Host Bit and the setting for IOM Hold Bit Status at Startup in the PLC Setup (read only when power is turned ON).

| Auxiliary bit                  |             | IOM Hold Bit (A500.12)                      |  |
|--------------------------------|-------------|---|--|
| PLC Setup setting              |             | Clear (OFF)                                 | Hold (ON)                                  |
| IOM Hold Bit Status at Startup | Clear (OFF) | At power ON: Clear<br>At mode change: Clear | At power ON: Clear<br>At mode change: Hold |
|                                | Hold (ON)   |   | At power ON: Hold<br>At mode change: Hold  |

**Note** When the mode is changed between PROGRAMMING mode and RUN or MONITOR mode, I/O memory initialization is according to the status of the IOM Hold Bit at that time.

- (2) The forced status held or cleared according to the status of the Force Status Hold Bit and the setting for Forced Status Hold Bit Status at Startup in the PLC Setup (read only when power is turned ON).

| Auxiliary bit                            |             | Forced Status Hold Bit (A500.13)            |  |
|--|-------------|---|--|
| PLC Setup setting                        |             | Clear (OFF)                                 | Hold (ON)                                  |
| Forced Status Hold Bit Status at Startup | Clear (OFF) | At power ON: Clear<br>At mode change: Clear | At power ON: Clear<br>At mode change: Hold |
|  | Hold (ON)   |   | At power ON: Hold<br>At mode change: Hold  |

**Note** When the mode is changed between PROGRAMMING mode and RUN or MONITOR mode, forced status initialization is according to the status of the Forced Status Hold Bit at that time.

- (3) User program recovery is performed if online editing is performed but the power supply to the PLC is turned OFF before the CPU Unit can complete backup processing. The BKUP indicator will light during backup processing.

## 2-5 CPU Unit Operating Modes

### 2-5-1 Operating Modes

The CPU Unit has three operating modes that control the entire user program and are common to all tasks.

**PROGRAM:** Programs are not executed and preparations, such as initializing the PLC Setup and other settings, transferring programs, checking programs, force-setting and force-resetting can be executed prior to program execution.

**MONITOR:** Programs are executed, but some operations, such as online editing, forced-set/reset, and changes to present values in I/O memory, are enabled for trial operation and other adjustments.

**RUN:** Programs are executed and some operations are disabled.

### 2-5-2 Status and Operations in Each Operating Mode

The following table lists status and operations for each mode.

| Operation           |                    | PROGRAM mode | RUN mode             | MONITOR mode         |
|---------------------|--------------------|--------------|----------------------|----------------------|
| Program execution   |                    | Stopped      | Executed             | Executed             |
| I/O refreshing      |                    | Executed     | Executed             | Executed             |
| External I/O status |                    | OFF          | According to program | According to program |
| I/O memory          | Non-holding memory | Cleared      | According to program | According to program |
|                     | Holding memory     | Held         |                      |                      |

| Operation                |                           | PROGRAM mode  | RUN mode | MONITOR mode |
|--------------------------|---------------------------|---------------|----------|--------------|
| CX-Programmer operations | I/O memory monitoring     | OK            | OK       | OK           |
|                          | Program monitoring        | OK            | OK       | OK           |
|                          | Program transfers         | From CPU Unit | OK       | OK           |
|                          |                           | To CPU Unit   | X        | X            |
|                          | Checking program          | OK            | X        | X            |
|                          | Setting PLC Setup         | OK            | X        | X            |
|                          | Changing program          | OK            | X        | OK           |
|                          | Force-setting/resetting   | OK            | X        | OK           |
|                          | Changing timer/counter SV | OK            | X        | OK           |
|                          | Changing timer/counter PV | OK            | X        | OK           |
|                          | Change I/O memory PV      | OK            | X        | OK           |

**Note** The following table shows the relationship of operating modes to tasks.

| Mode    | Cyclic task status  | Interrupt task status                   |
|---------|---|---|
| PROGRAM | Disabled status (INI)   | Stopped                                 |
| RUN     | <ul style="list-style-type: none"> <li>Any task that has not yet been executed, will be in disabled status (INI).</li> <li>A task will go to READY status if the task is set to go to READY status at start-up or the TASK ON (TKON) instruction has been executed for it.</li> </ul> | Executed if interrupt condition is met. |
| MONITOR |   |   |
|         | <ul style="list-style-type: none"> <li>A task in READY status will be executed (RUN status) when it obtains the right to execute.</li> <li>A status will go to Standby status (WAIT) if a READY task is put into Standby status by a TASK OFF (TKOF) instruction.</li> </ul>          |   |

### 2-5-3 Operating Mode Changes and I/O Memory

#### Operating Mode Changes and I/O Memory

| Mode Changes                     | Non-holding areas  | Holding Areas  |
|----------------------------------|--|--|
|                                  | <ul style="list-style-type: none"> <li>I/O bits</li> <li>Data Link bits</li> <li>Work bits</li> <li>Timer PV/Completion Flags</li> <li>Index Registers</li> <li>Data Registers</li> <li>Task Flags</li> </ul> Auxiliary Area bits/words are holding or non-holding depending on the address. | <ul style="list-style-type: none"> <li>HR Area</li> <li>DM Area</li> <li>Counter PV and Completion Flags</li> </ul> Auxiliary Area bits/words are holding or non-holding depending on the address. |
| RUN or MONITOR to PROGRAM        | Cleared (See note 1.)  | Held   |
| PROGRAM to RUN or MONITOR        | Cleared (See note 1.)  | Held   |
| RUN to MONITOR or MONITOR to RUN | Held (See note 2.)   | Held   |

**Note** 1. The following processing is performed if the I/O Memory Hold Bit is ON. Outputs from Output Units will be turned OFF when operation stops even if I/O bit status is held in the CPU Unit.

2. The cycle time will increase by approximately 10 ms when the operating mode is changed from MONITOR to RUN mode. This will not, however, cause an error for exceeding the maximum cycle time limit.

| I/O Memory Hold Bit status (A500.12) | I/O Memory                                   |                             |               | Output bits allocated to Output Units        |                             |               |
|--------------------------------------|--|-----------------------------|---------------|--|-----------------------------|---------------|
|                                      | Mode changed between PROGRAM and RUN/MONITOR | Operation stopped           |               | Mode changed between PROGRAM and RUN/MONITOR | Operation stopped           |               |
|                                      |  | Fatal error other than FALS | FALS executed |  | Fatal error other than FALS | FALS executed |
| OFF                                  | Cleared                                      | Cleared                     | Held          | OFF  | OFF                         | OFF           |
| ON                                   | Held   | Held                        | Held          | Held   | OFF                         | OFF           |

**Note** Refer to *SECTION 4 I/O Memory Allocation*.

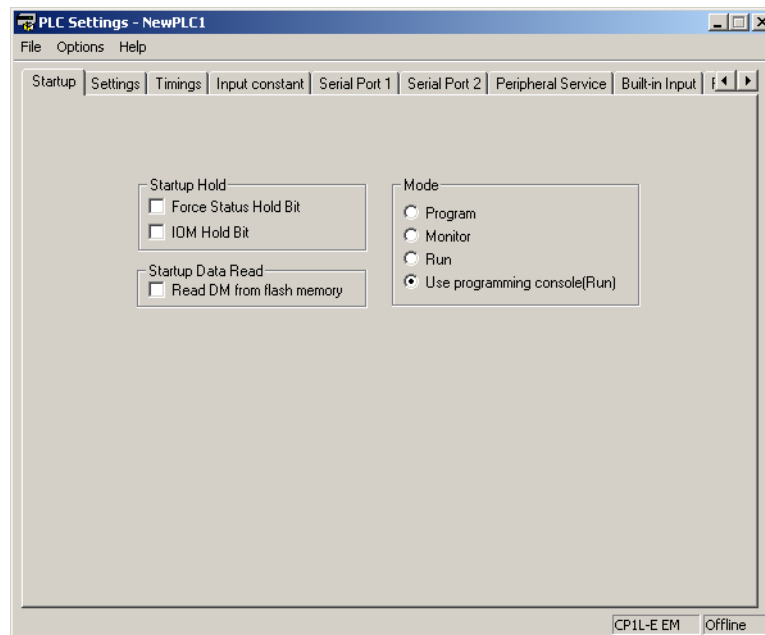
## 2-5-4 Startup Mode Setting

This setting in the PLC Setup determines the operating mode that will be used by the CPU Unit when the power supply is turned ON.

### PLC Setup

| Name         | Description                                      | Settings   | Default                             |
|--------------|--|--|-------------------------------------|
| Startup Mode | Specifies the CPU Unit operating mode at startup | <ul style="list-style-type: none"> <li>• Program (See note.)</li> <li>• Monitor</li> <li>• Run</li> <li>• Use programming console</li> </ul> | Use programming console (See note.) |

**Note** A Programming Console cannot be connected to the CP1L-EL/EM.



**Note** A Programming Console cannot be connected to a CP1L-EL/EM CPU Unit. If *Use programming console* is set, the CPU Unit will start in RUN mode.

## 2-6 Power OFF Operation

### 2-6-1 Overview

The following processing is performed when CPU Unit power is turned OFF. Power OFF processing will be performed if the power supply voltage falls below the specified value while the CPU Unit is in RUN or MONITOR mode.

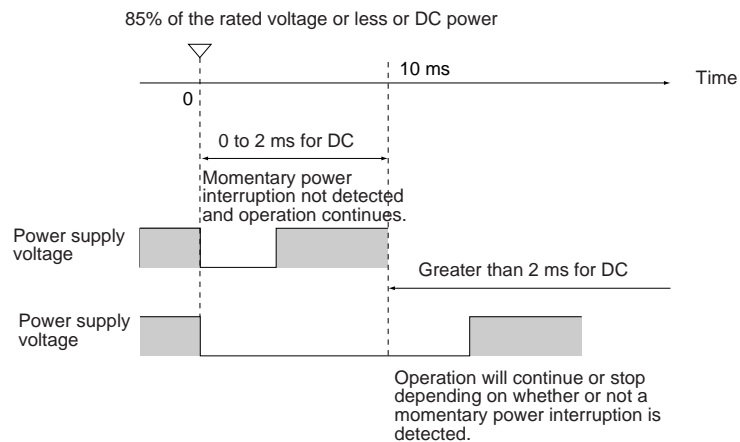
- 1,2,3...**
1. The CPU Unit will stop.
  2. Outputs from all Output Units will be turned OFF.

**Note** (1) All outputs will turn OFF despite the status of the I/O Memory Hold Bit or I/O Memory Hold Bit at power ON settings in the PLC Setup.

- (2) DC Power  
85% of rated voltage: 20.4 V DC or less

The following processing will be performed if power drops only momentarily (momentary power interruption).

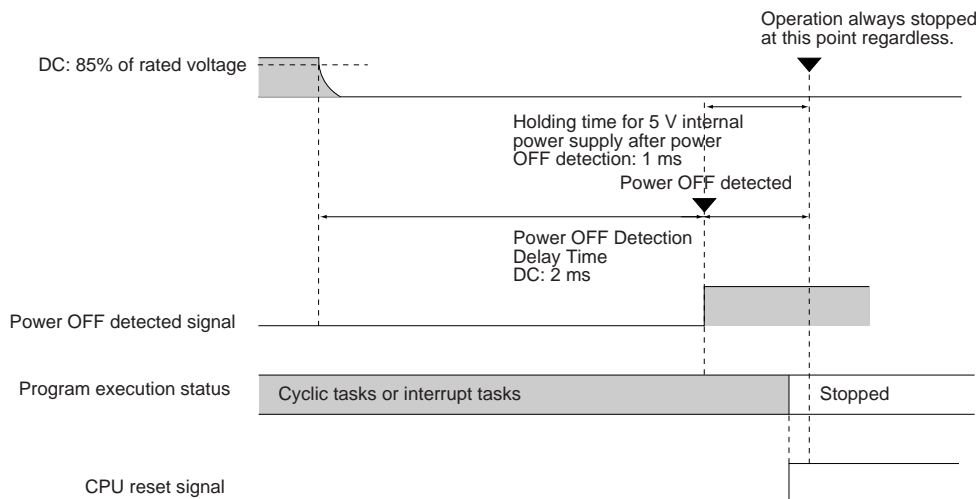
- 1,2,3...**
1. The system will continue to run unconditionally if the momentary power interruption lasts less than 2 ms for DC power, i.e., the time it takes the rated voltage at 85% or less to return to 85% or higher is less than 2 ms for DC power.
  2. A momentary power interruption that lasts more than 2 ms for DC power may or may not be detected.





The following timing chart shows the CPU Unit power OFF operation in more detail.

### Power OFF Timing Chart



Power OFF detection time:

The time from when the power supply voltages drops to 85% for DC power until the power OFF condition is detected.

Holding time for 5 V internal power supply after power OFF detection:

The maximum time that the 5 V internal power supply voltage will be maintained after the power OFF condition is detected. The holding time is fixed at 1 ms.

### Description of Operation

Power OFF will be detected if the DC power supply falls below 85% of the rated voltage for the power OFF detection time (2 ms minimum for DC power). The CPU reset signal will turn ON while the internal power supply is being held and the CPU Unit will be reset.

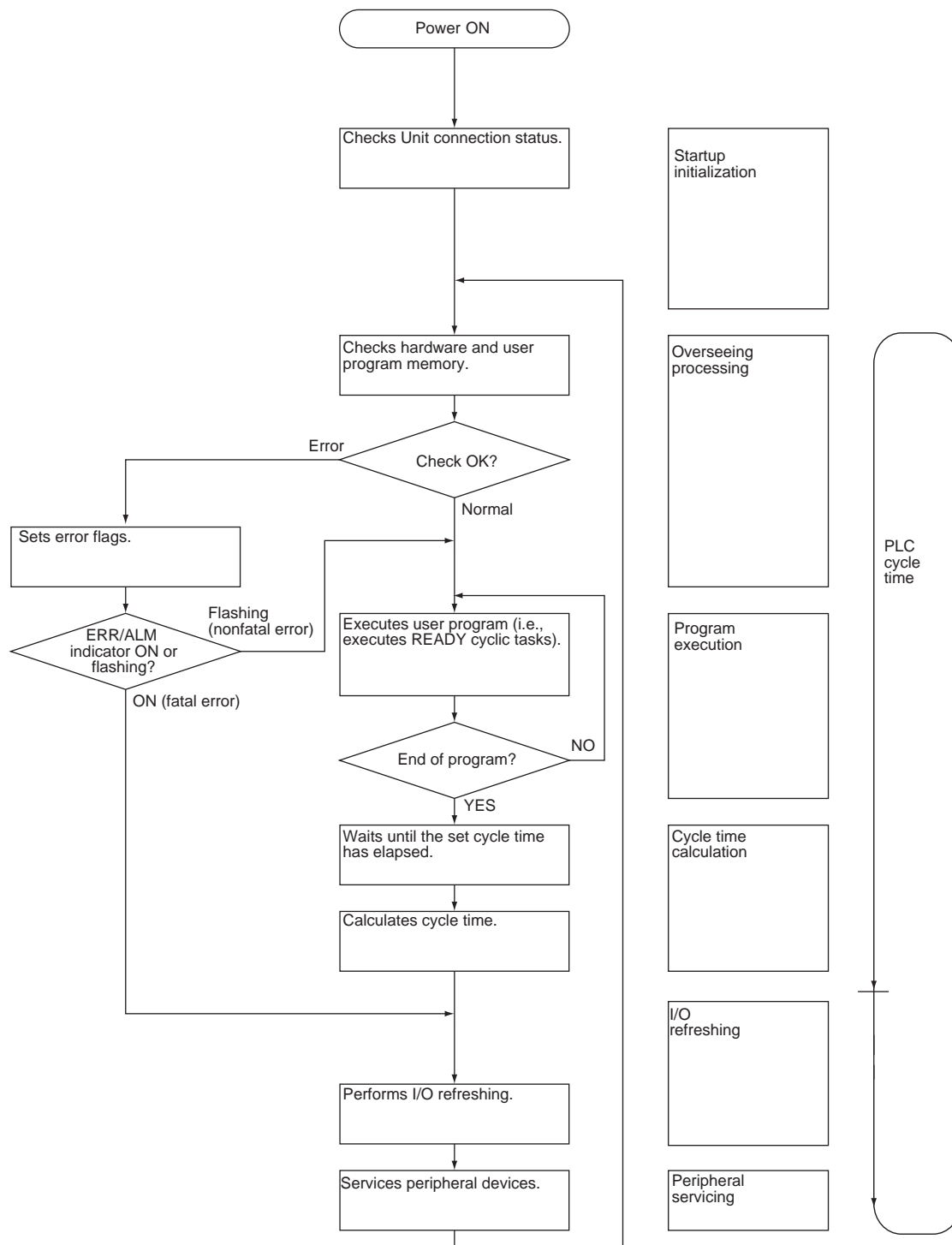
## 2-6-2 Instruction Execution for Power Interruptions

If power is interrupted and the interruption is detected when the CPU Unit is operating in RUN or MONITOR mode, the instruction currently being executed will be completed and then the CPU Unit will be reset.

## 2-7 Computing the Cycle Time

### 2-7-1 CPU Unit Operation Flowchart

The CPU Unit processes data in repeating cycles from the overseeing processing up to peripheral servicing as shown in the following diagram.



## 2-7-2 Cycle Time Overview

The cycle time depends on the following conditions.

- Type and number of instructions in the user program (in all cyclic tasks that are executed during a cycle, and within interrupt tasks for which the execution conditions have been satisfied)
- Type and number of CP-series Expansion Units and Expansion I/O Units
  - Use of protocol macros and the largest communications message
- Fixed cycle time setting in the PLC Setup
- Use of Ethernet and serial ports
- Fixed peripheral servicing time in the PLC Setup

- Note**
1. The cycle time is not affected by the number of tasks that are used in the user program. The tasks that affect the cycle time are those cyclic tasks that are READY in the cycle.
  2. When the mode is switched from MONITOR mode to RUN mode, the cycle time will be extended by 10 ms (this will not, however, take the cycle time over its limit).

The cycle time is the total time required for the PLC to perform the five operations given in the following tables.

$$\text{Cycle time} = (1) + (2) + (3) + (4) + (5)$$

### 1: Overseeing

| Details   | Processing time and fluctuation cause |
|---|---------------------------------------|
| Checks the I/O bus and user program memory, checks for battery errors, etc. | 0.4 ms                                |

### 2: Program Execution

| Details   | Processing time and fluctuation cause |
|---|---------------------------------------|
| Executes the user program, and calculates the total time taken for the instructions to execute the program. | Total instruction execution time      |

### 3: Cycle Time Calculation

| Details   | Processing time and fluctuation cause  |
|---|--|
| Waits for the specified cycle time to elapse when a minimum (fixed) cycle time has been set in the PLC Setup.<br>Calculates the cycle time. | When the cycle time is not fixed, the time for step 3 is approximately 0.<br>When the cycle time is fixed, the time for step 3 is the preset fixed cycle time minus the actual cycle time ((1) + (2) + (4) + (5)). |

### 4: I/O Refreshing

| Details  | Processing time and fluctuation cause   |
|--|---|
| CPU Unit built-in I/O and I/O on CP-series Expansion Units and Expansion I/O Units | Outputs from the CPU Unit to the actual outputs are refreshed first for each Unit, and then inputs.<br><br>I/O refresh time for each Unit multiplied by the number of Units used. |

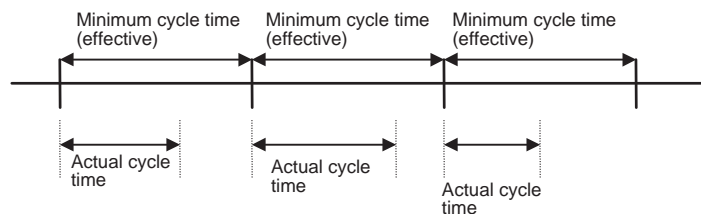
## 5: Peripheral Servicing

| Details                                | Processing time and fluctuation cause  |
|--|--|
| Services Ethernet port.                | If a uniform peripheral servicing time hasn't been set in the PLC Setup for this servicing, 8% of the previous cycle's cycle time (calculated in step (3)) will be allowed for peripheral servicing.<br>If a uniform peripheral servicing time has been set in the PLC Setup, servicing will be performed for the set time. Servicing will be performed for at least 0.1 ms, however, whether the peripheral servicing time is set or not.<br>If the ports are not connected, the servicing time is 0 ms.      |
| Services serial ports                  |  |
| Services communications ports.         | If a uniform peripheral servicing time hasn't been set in the PLC Setup for this servicing, 8% of the previous cycle's cycle time (calculated in step (3)) will be allowed for peripheral servicing.<br>If a uniform peripheral servicing time has been set in the PLC Setup, servicing will be performed for the set time. Servicing will be performed for at least 0.1 ms, however, whether the peripheral servicing time is set or not.<br>If no communications ports are used, the servicing time is 0 ms. |
| Services built-in flash memory access. |  |
| Serves Memory Cassette access.         | If a uniform peripheral servicing time hasn't been set in the PLC Setup for this servicing, 8% of the previous cycle's cycle time (calculated in step (3)) will be allowed for peripheral servicing.<br>If a uniform peripheral servicing time has been set in the PLC Setup, servicing will be performed for the set time. Servicing will be performed for at least 0.1 ms, however, whether the peripheral servicing time is set or not.<br>If there is no access, the servicing time is 0 ms.               |

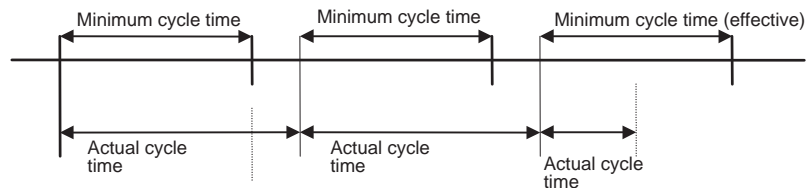
## 2-7-3 Functions Related to the Cycle Time

**Minimum Cycle Time**

Set the minimum cycle time to a non-zero value to eliminate inconsistencies in I/O responses. A minimum cycle time can be set in the PLC Setup between 1 and 32,000 ms in 1-ms increments.



This setting is effective only when the actual cycle time is shorter than the minimum cycle time setting. If the actual cycle time is longer than the minimum cycle time setting, the actual cycle time will remain unchanged.

**PLC Setup**

| Name               | Settings  | Default                       |
|--------------------|---|-------------------------------|
| Minimum cycle time | 0000 to 7D00 hex<br>(1 to 32,000 ms in 1-ms increments) | 0000 hex: Variable cycle time |

## Watch Cycle Time

If the cycle time exceeds the watch (maximum) cycle time setting, the Cycle Time Too Long Flag (A401.08) will be turned ON and PLC operation will be stopped.

### PLC Setup

| Name                            | Settings                                       | Default                           |
|---------------------------------|--|-----------------------------------|
| Enable Watch Cycle Time Setting | 0: Default (1 s)<br>1: User setting            | 0000 hex: Watch cycle time of 1 s |
| Watch Cycle Time                | 001 to FA0: 10 to 40,000 ms (10-ms increments) |                                   |

### Related Flags

| Name                     | Address | Description   |
|--------------------------|---------|---|
| Cycle Time Too Long Flag | A401.08 | Turns ON if the present cycle time exceeds the Watch Cycle Time set in the PLC Setup. |

## Cycle Time Monitoring

The maximum cycle time is stored in A262 and A263 and the present cycle time is stored in A264 and A265 every cycle.

### Related Words

| Name               | Addresses     | Description   |
|--------------------|---------------|---|
| Maximum Cycle Time | A262 and A263 | These words contain the maximum cycle time in increments of 0.1 ms. The time is updated every cycle and is recorded in 32-bit binary (0 to FFFF FFFF hex, or 0 to 429,496,729.5 ms). (A263 is the leftmost word.) |
| Present Cycle Time | A264 and A265 | These words contain the present cycle time in increments of 0.1 ms. The time is updated every cycle and is recorded in 32-bit binary (0 to FFFF FFFF, or 0 to 429,496,729.5 ms). (A265 is the leftmost word.)     |

The average cycle time for the past eight cycles can be read from the CX-Programmer.

**Note** The following methods are effective in reducing the cycle time.

- Place tasks that do not need to be executed on standby.
- Use JMP-JME instructions to skip instructions that do not need to be executed.

## 2-7-4 I/O Refresh Times for PLC Units

### CP-series Expansion Unit and Expansion I/O Unit I/O Refresh Times

| Name                     | Model       | I/O refresh time per Unit |
|--------------------------|-------------|---------------------------|
| Expansion I/O Units      | CP1W-40EDR  | 0.39 ms                   |
|                          | CP1W-40EDT  | 0.39 ms                   |
|                          | CP1W-40EDT1 | 0.39 ms                   |
|                          | CP1W-32ER   | 0.33 ms                   |
|                          | CP1W-32ET   | 0.33 ms                   |
|                          | CP1W-32ET1  | 0.33 ms                   |
|                          | CP1W-20EDT  | 0.18 ms                   |
|                          | CP1W-20EDT1 | 0.18 ms                   |
|                          | CP1W-16ER   | 0.25 ms                   |
|                          | CP1W-16ET   | 0.25 ms                   |
|                          | CP1W-16ET1  | 0.25 ms                   |
|                          | CP1W-8ED    | 0.13 ms                   |
|                          | CP1W-8ER    | 0.08 ms                   |
|                          | CP1W-8ET    | 0.08 ms                   |
|                          | CP1W-8ET1   | 0.08 ms                   |
| Analog Input Units       | CP1W-AD041  | 0.61 ms                   |
|                          | CP1W-AD042  | 0.87 ms                   |
| Analog Output Units      | CP1W-DA021  | 0.33 ms                   |
|                          | CP1W-DA041  | 0.33 ms                   |
|                          | CP1W-DA042  | 0.40 ms                   |
| Analog I/O Units         | CP1W-MAD11  | 0.32 ms                   |
|                          | CP1W-MAD42  | 0.87 ms                   |
|                          | CP1W-MAD44  | 0.97 ms                   |
| Temperature Sensor Units | CP1W-TS001  | 0.25 ms                   |
|                          | CP1W-TS002  | 0.52 ms                   |
|                          | CP1W-TS003  | 0.67 ms                   |
|                          | CP1W-TS004  | 0.47 ms                   |
|                          | CP1W-TS101  | 0.25 ms                   |
|                          | CP1W-TS102  | 0.52 ms                   |
| CompoBus/S I/O Link Unit | CP1W-SRT21  | 0.21 ms                   |

**Note** The I/O refresh time for CPU Unit built-in I/O is included in overhead processing.

### 2-7-5 Cycle Time Calculation Example

The following example shows the method used to calculate the cycle time when CP-series Expansion I/O Units only are connected to a CP1L-EL/EM CPU Unit.

#### Conditions

| Item                        | Details                      |  |
|-----------------------------|------------------------------|--|
| CP1L-EL/EM                  | CP1W-40EDR<br>40-pt I/O Unit | 1 Unit   |
| User program                | 5 K steps                    | LD instructions: 2.5 K steps,<br>OUT instructions: 2.5 K steps |
| Ethernet port connection    | Yes and no                   |  |
| Fixed cycle time processing | No                           |  |
| Serial port connection      | No                           |  |
| Other peripheral servicing  | No                           |  |

#### Calculation Example

| Process name               | Calculation  | Processing time         |                             |
|----------------------------|--|-------------------------|-----------------------------|
|                            |  | Ethernet port connected | Ethernet port not connected |
| (1) Overseeing             | ---  | 0.4 ms                  | 0.4 ms                      |
| (2) Program execution      | $0.55 \mu\text{s} \times 2,500 + 1.1 \mu\text{s} \times 2,500$ | 4.1 ms                  | 4.1 ms                      |
| (3) Cycle time calculation | (Minimum cycle time not set)                                   | 0 ms                    | 0 ms                        |
| (4) I/O refreshing         | 0.39 ms  | 0.39 ms                 | 0.39 ms                     |
| (5) Peripheral servicing   | (Only Ethernet port connected)                                 | 0.1 ms                  | 0 ms                        |
| Cycle time                 | (1) + (2) + (3) + (4) + (5)                                    | 4.99 ms                 | 4.89 ms                     |

### 2-7-6 Online Editing Cycle Time Extension

When online editing is executed to change the program from the CX-Programmer while the CPU Unit is operating in MONITOR mode, the CPU Unit will momentarily suspend operation while the program is being changed. The period of time that the cycle time is extended is determined by the following conditions.

- Number of steps changed
- Editing operations (insert/delete/overwrite)
- Types of instructions

The cycle time extension for online editing is negligibly affected by the size of task programs. If the maximum program size for a task is 10 Ksteps, the online editing cycle time extension will be as follows:

| CPU Unit            | Increase in cycle time for online editing                          |
|---------------------|--|
| CP1L-EL/EM CPU Unit | Maximum: 16 ms, Normal: 12 ms<br>(for a program size of 10 Ksteps) |

When editing online, the cycle time will be extended by according to the editing that is performed. Be sure that the additional time will not adversely affect system operation.

**Note** When there is one task, online editing is processed all in the cycle time following the cycle in which online editing is executed (written). When there are multiple tasks (cyclic tasks and interrupt tasks), online editing is separated, so that for  $n$  tasks, processing is executed over  $n$  to  $n \times 2$  cycles max.

## 2-7-7 I/O Response Time

The I/O response time is the time it takes from when an input turns ON, the data is recognized by the CPU Unit, and the user program is executed, up to the time for the result to be output to an output terminal. The length of the I/O response time depends on the following conditions.

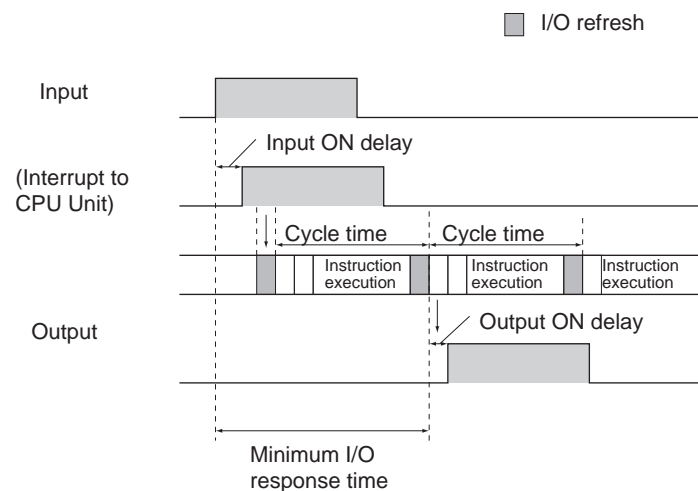
- Timing of Input Bit turning ON.
- Cycle time.

### Minimum I/O Response Time

The I/O response time is shortest when data is retrieved immediately before I/O refresh of the CPU Unit. The minimum I/O response time is calculated as follows:

Minimum I/O response time = Input ON delay + Cycle time + Output ON delay

**Note** The input and output ON delays depend on the type of terminals used on the CPU Unit or the model number of the Unit being used.

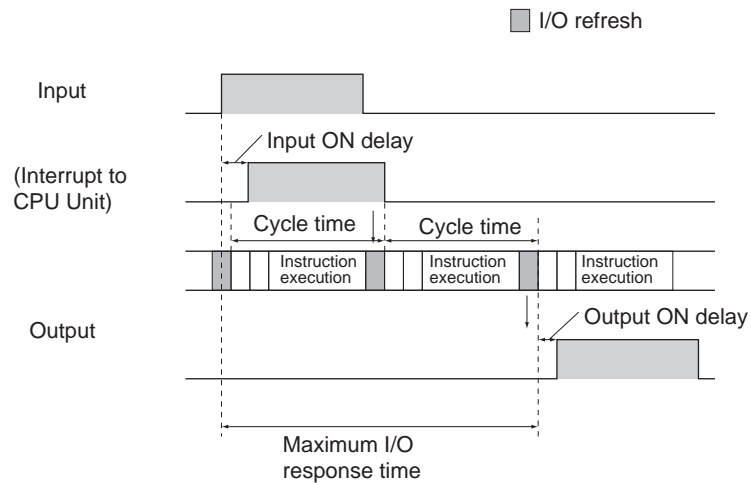


### Maximum I/O Response Time

The I/O response time is longest when data is retrieved immediately after I/O refresh period of the CPU Unit. The maximum I/O response time is calculated as follows:

Maximum I/O response time = Input ON delay + (Cycle time  $\times$  2) + Output ON delay





### Calculation Example

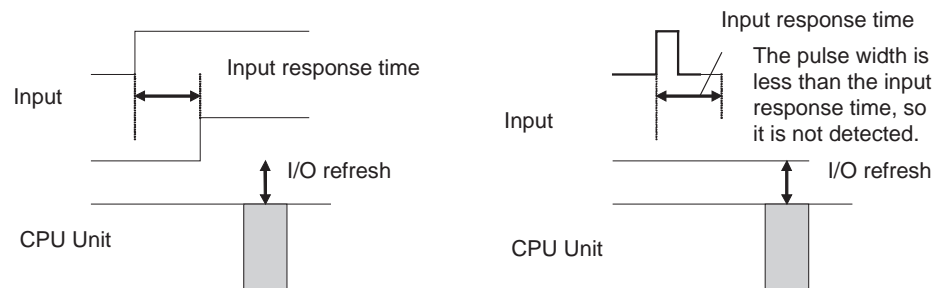
|             |                 |   |
|-------------|-----------------|---|
| Conditions: | Input ON delay  | 1 ms (normal input with input constant set to 0 ms) |
|             | Output ON delay | 0.1 ms (transistor output)                          |
|             | Cycle time      | 20 ms   |

Minimum I/O response time = 1 ms + 20 ms + 0.1 ms = 21.1 ms

Maximum I/O response time = 1 ms + (20 ms × 2) + 0.1 ms = 41.1 ms

## Input Response Times

Input response times can be set in the PLC Setup. Increasing the response time reduces the effects of chattering and noise. Decreasing the response time allows reception of shorter input pulses, (but the pulse width must be longer than the cycle time).



## PLC Setup

| Name            | Description          | Settings   | Default       |
|-----------------|----------------------|--|---------------|
| Input constants | Input response times | 00 hex: 8 ms<br>10 hex: 0 ms<br>11 hex: 0.5 ms<br>12 hex: 1 ms<br>13 hex: 2 ms<br>14 hex: 4 ms<br>15 hex: 8 ms<br>16 hex: 16 ms<br>17 hex: 32 ms | 00 hex (8 ms) |

## 2-7-8 Interrupt Response Times

### Input Interrupt Tasks

The interrupt response time for I/O interrupt tasks is the time taken from when a built-in input has turned ON (or OFF) until the I/O interrupt task has actually been executed. The length of the interrupt response time for I/O interrupt tasks depends on the following conditions. (About 0.3ms)

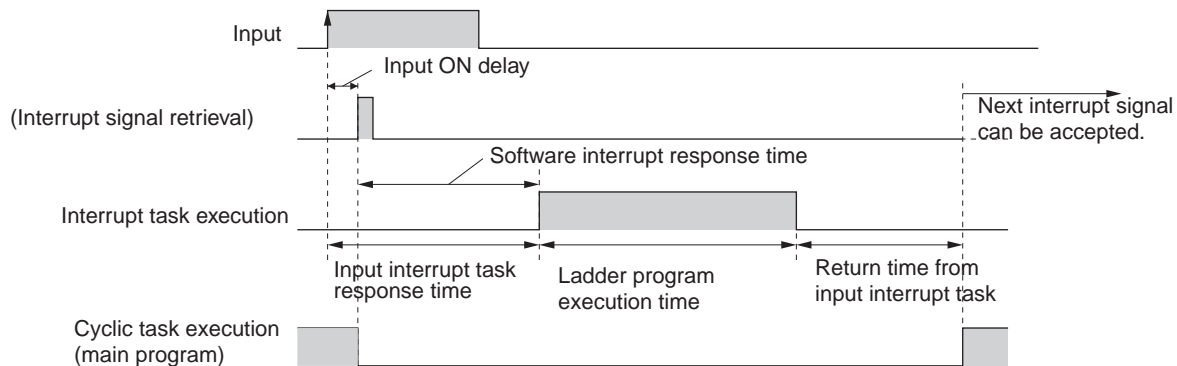
| Item                        | Interrupt response time                        | Counter interrupts                            |
|-----------------------------|--|---|
| Hardware response           | Rise time: 50 $\mu$ s                          | ---   |
|                             | Fall time: 50 $\mu$ s                          | ---   |
| Software interrupt response | Minimum: 134 $\mu$ s                           | Minimum: 236 $\mu$ s                          |
|                             | Maximum: 234 $\mu$ s + Wait time (See note 1.) | Maximum: 336 $\mu$ s + Wait time (See note1.) |

#### Note

- (1) The wait time occurs when there is competition with other interrupts. As a guideline, the wait time will be 6 to 169  $\mu$ s.
- (2) I/O interrupt tasks can be executed during execution of the user program (even while an instruction is being executed by stopping the execution of an instruction), I/O refresh, peripheral servicing, or overseeing. The interrupt response time is not affected by which of the above processing operations during which the interrupt inputs turns ON. I/O interrupts, however, are not executed during execution of other interrupt tasks even if the I/O interrupt conditions are satisfied. Instead, the I/O interrupts are executed in order of priority after the current interrupt task has completed execution and the software interrupt response time has elapsed.

The interrupt response time of input interrupt tasks is calculated as follows:

Interrupt response time = Input ON delay + Software interrupt response time

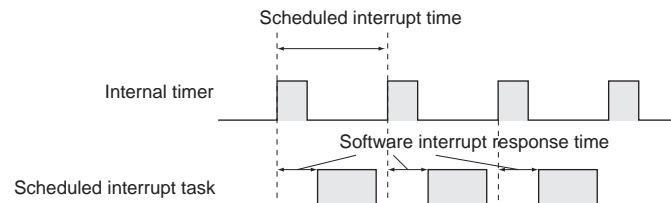


The time from completing the ladder program in the input interrupt task until returning to cyclic task execution is 60  $\mu$ s.

**Scheduled Interrupt Tasks**

The interrupt response time of scheduled interrupt tasks is the time taken from after the scheduled time specified by the MSKS(690) instruction has elapsed until the interrupt task has actually been executed. The length of the interrupt response time for scheduled interrupt tasks is 1 ms max. There is also an error of 80  $\mu$ s in the time to the first scheduled interrupt (0.5 ms min.).

**Note** Scheduled interrupt tasks can be executed during execution of the user program (even while an instruction is being executed by stopping the execution of an instruction), I/O refresh, peripheral servicing, or overseeing. The interrupt response time is not affected by which of the above processing operations during which the scheduled interrupt time occurs. Scheduled interrupts, however, are not executed during execution of other interrupt tasks even if the interrupt conditions are satisfied. Instead, the interrupts are executed in order of priority after the current interrupt task has completed execution and the software interrupt response time has elapsed.



### 2-7-9 Serial PLC Link Response Performance

The response times for CPU Units connected via a Serial PLC Link (master to slave or slave to master) can be calculated as shown below. If a PT is in the Serial PLC Link, however, the amount of communications data will not be fixed and the values will change.

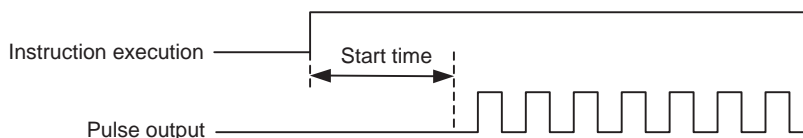
- Maximum I/O response time (not including hardware delay) =  
Master cycle time + Communications cycle time + Slave cycle time + 4 ms
- Minimum I/O response time (not including hardware delay) =  
Slave communications time + 0.8 ms

Here,

|   |   |
|---|---|
| Number of participating slave nodes     | The number of slaves to which links have been established within the maximum unit number set in the master.   |
| Number of non-participating slave nodes | The number of slaves not participating in the links within the maximum unit number set in the master  |
| Communications cycle time (ms)          | Slave communications time $\times$ Number of participating slave nodes + 10 $\times$ Number of non-participating slave nodes  |
| Slave communications time (ms)          | <ul style="list-style-type: none"> <li>• Communications time set to <i>Standard</i><br/><math>0.4 + 0.286 \times ((\text{No. of slaves} + 1) \times \text{No. of link words} \times 2 + 12)</math></li> <li>• Communications time set to <i>Fast</i><br/><math>0.4 + 0.0955 \times ((\text{No. of slaves} + 1) \times \text{No. of link words} \times 2 + 12)</math></li> </ul> |

## 2-7-10 Pulse Output Start Time

The pulse output start time is the time required from executing a pulse output instruction until pulses are output externally. This time depends on the pulse output instruction that is used and operation that is performed.



| Pulse output instruction      | Start time  |
|-------------------------------|-------------|
| SPED: continuous              | 86 $\mu$ s  |
| SPED: independent             | 98 $\mu$ s  |
| ACC: continuous               | 103 $\mu$ s |
| ACC: independent, trapezoidal | 122 $\mu$ s |
| ACC: independent, triangular  | 123 $\mu$ s |
| PLS2: trapezoidal             | 145 $\mu$ s |
| PLS2: triangular              | 146 $\mu$ s |

## 2-7-11 Pulse Output Change Response Time

The pulse output change response time is the time for any change made by executing an instruction during pulse output to actually affect the pulse output operation.

| Pulse output instruction  | Change response time   |
|---|--|
| INI: immediate stop   | 63 $\mu$ s + 1 pulse output time                                   |
| SPED: immediate stop  | 106 $\mu$ s + 1 pulse output time                                  |
| ACC: deceleration stop  | 1 control cycle (4 ms) minimum,<br>2 control cycles (8 ms) maximum |
| PLS2: deceleration stop   |  |
| SPED: speed change  |  |
| ACC: speed change   |  |
| PLS2: target position change in reverse direction                 |  |
| PLS2: target position change in same direction at same speed      |  |
| PLS2: target position change in same direction at different speed |  |

## SECTION 3

# Installation and Wiring

This section describes how to install and wire the CP1L-EL/EM.

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## 3-1 Fail-safe Circuits

Always set up safety circuits outside of the PLC to prevent dangerous conditions in the event of errors in the CP1L-EL/EM CPU Unit or external power supply. In particular, be careful of the following points.

### Supply Power to the CP1L-EL/EM CPU Unit before the Controlled System

If the PLC's power supply is turned ON after the controlled system's power supply, outputs in Units such as DC Output Units may malfunction momentarily. To prevent any malfunction, add an external circuit that prevents the power supply to the controlled system from going ON before the power supply to the PLC itself.

### Managing CPU Unit Errors

When any of the following errors occurs, PLC operation (program execution) will stop and all outputs from Output Units will be turned OFF.

- A CPU error (watchdog timer error) or CPU on standby
- A fatal error (memory error, I/O bus error, duplicate number error, too many I/O points error, I/O setting error, program error, cycle time too long error, or FALS(007) error) (See note.)

Always add any circuits necessary outside of the PLC to ensure the safety of the system in the event of an error that stops PLC operation.

#### **Note**

When a fatal error occurs, all outputs from Output Units will be turned OFF even if the IOM Hold Bit has been turned ON to protect the contents of I/O memory. (When the IOM Hold Bit is ON, the outputs will retain their previous status after the PLC has been switched from RUN/MONITOR mode to PROGRAM mode.)

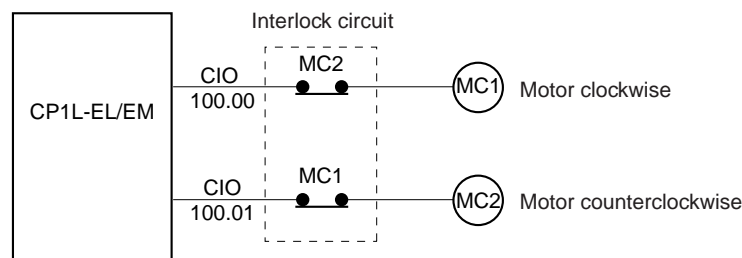
### Managing Output Malfunctions

It is possible for an output to remain ON due to a malfunction in the internal circuitry of the Output Unit, such as a relay or transistor malfunction. Always add any circuits necessary outside of the PLC to ensure the safety of the system in the event that an output fails to go OFF.

### Interlock Circuits

When the PLC controls an operation such as the clockwise and counterclockwise operation of a motor and if there is any possibility of an accident or mechanical damage due to faulty PLC operation, provide an external interlock such as the one shown below to prevent both the forward and reverse outputs from turning ON at the same time.

#### **Example**



This circuit prevents outputs MC1 and MC2 from both being ON at the same time even if both PLC outputs CIO 100.00 and CIO 100.01 are both ON, so the motor is protected even if the PLC is programmed improperly or malfunctions.

## 3-2 Installation Precautions

### 3-2-1 Installation and Wiring Precautions

Always consider the following factors when installing and wiring the PLC to improve the reliability of the system and make the most of the CP1L-EL/EM functions.

#### Ambient Conditions

Do not install the PLC in any of the following locations.

- Locations subject to ambient temperatures lower than 0°C or higher than 55°C.
- Locations subject to drastic temperature changes or condensation.
- Locations subject to ambient humidity lower than 10% or higher than 90%.
- Locations subject to corrosive or flammable gases.
- Locations subject to excessive dust, salt, or metal filings.
- Locations that would subject the PLC to direct shock or vibration.
- Locations exposed to direct sunlight.
- Locations that would subject the PLC to water, oil, or chemical reagents.

Always enclose or protect the PLC sufficiently in the following locations.

- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power lines.

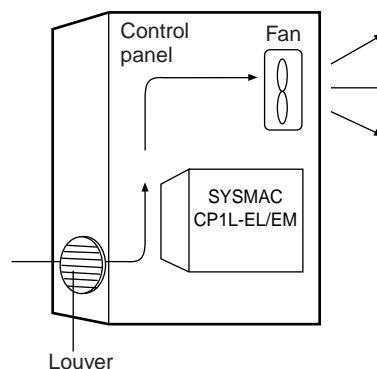
#### Installation in Cabinets or Control Panels

##### Temperature Control

When the CP1L-EL/EM is being installed in a cabinet or control panel, always provide proper ambient conditions as well as access for operation and maintenance.

The ambient temperature within the enclosure must be within the operating range of 0°C to 55°C. When necessary, take the following steps to maintain the proper temperature.

- Provide enough space for good air flow.
- Do not install the PLC above equipment that generates a large amount of heat, such as heaters, transformers, or high-capacity resistors.
- If the ambient temperature exceeds 55°C, install a cooling fan or air conditioner.



**Accessibility for Operation and Maintenance**

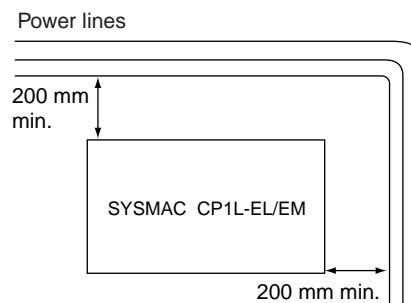
- To ensure safe access for operation and maintenance, separate the PLC as much as possible from high-voltage equipment and moving machinery.
- The PLC will be easiest to install and operate if it is mounted at a height of about 1,000 to 1,600 mm.

**⚠ Caution** Do not touch the power supply or the area around the I/O terminals while power is being supplied or immediately after power has been turned OFF. Doing so may result in burns.

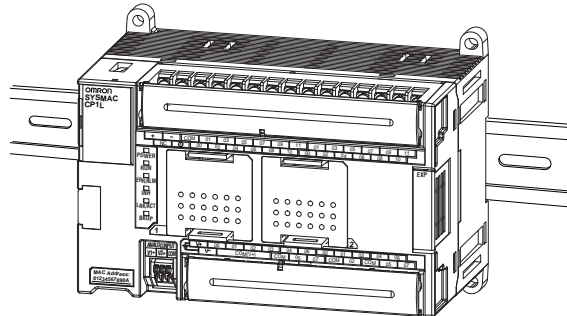
**⚠ Caution** After the power supply has been turned OFF, wait until the PLC has sufficiently cooled before touching it.

**Improving Noise Resistance**

- Do not mount the PLC in a control panel containing high-voltage equipment.
- Install the PLC at least 200 mm from power lines.

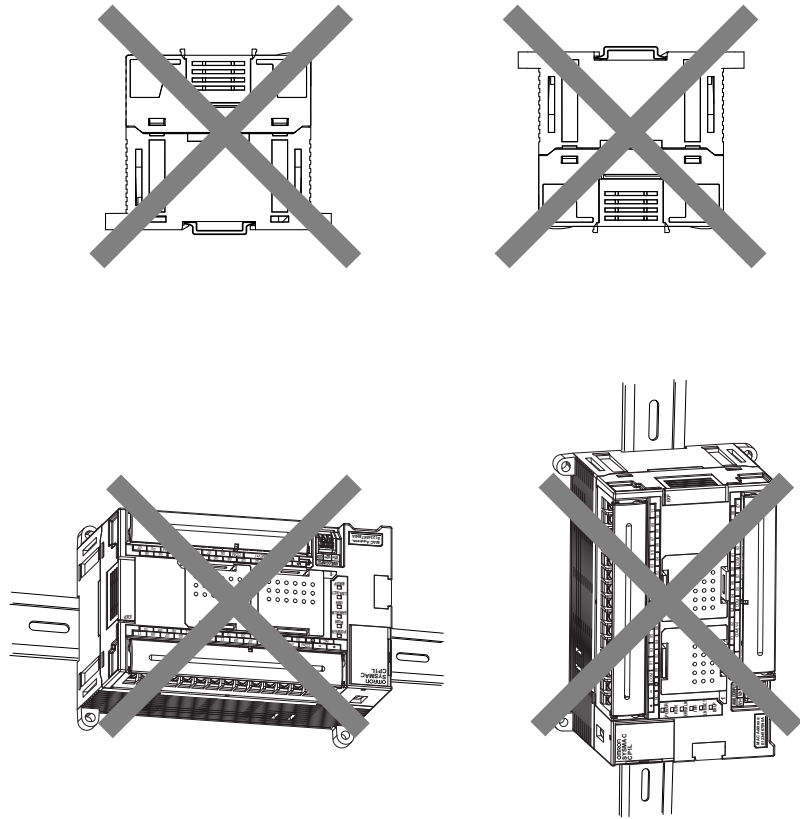


- Ground the mounting plate between the PLC and the mounting surface.
- The CP1L-EL/EM must be installed in the orientation shown below to ensure adequate cooling.

**Mounting in a Panel**



- Do not install the CP1L-EL/EM in any of the following orientations.



## 3-3 Mounting

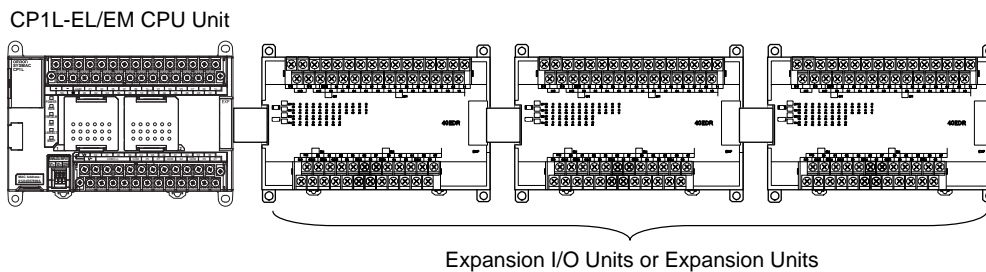
### 3-3-1 Mounting in a Panel

When mounting the CP1L-EL/EM CPU Unit in a panel, use either surface installation or DIN Track installation.

#### Surface Installation

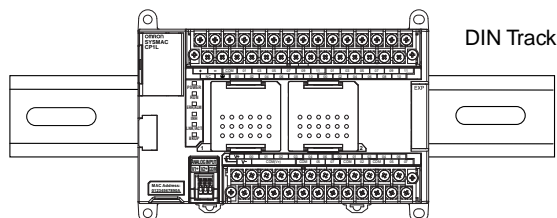
Even if a DIN Track is not used, a CP1L-EL/EM CPU Unit and CP-series Expansion Units or Expansion I/O Units can be mounted using M4 screws.

For restrictions on the number of Expansion Units and Expansion I/O Units that can be connected, refer to *1-2 System Configuration*.



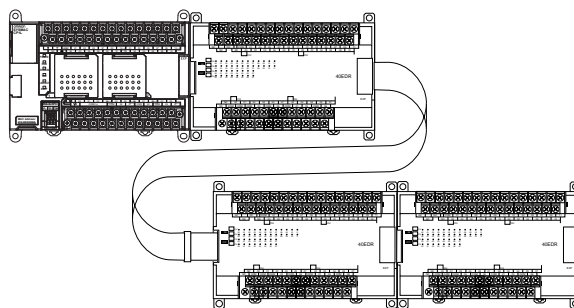
**DIN Track Installation**

The CP1L-EL/EM CPU Unit, Expansion Units, and Expansion I/O Units can be mounted to DIN Track. Secure the DIN Track with screws in at least three places.

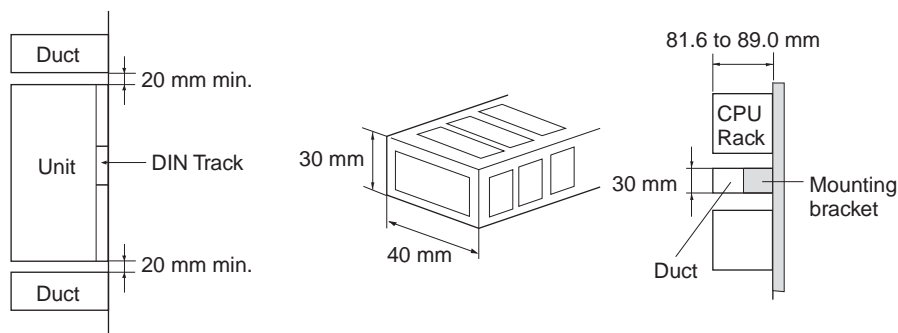
**Using I/O Connecting Cable**

When using Expansion Units and Expansion I/O Units, it is possible to use CP1W-CN811 Connecting Cable to arrange the Units in upper and lower rows. The following restrictions apply:

- I/O Connecting Cable can be used in one place only, and not in multiple places.

**Wiring Ducts**

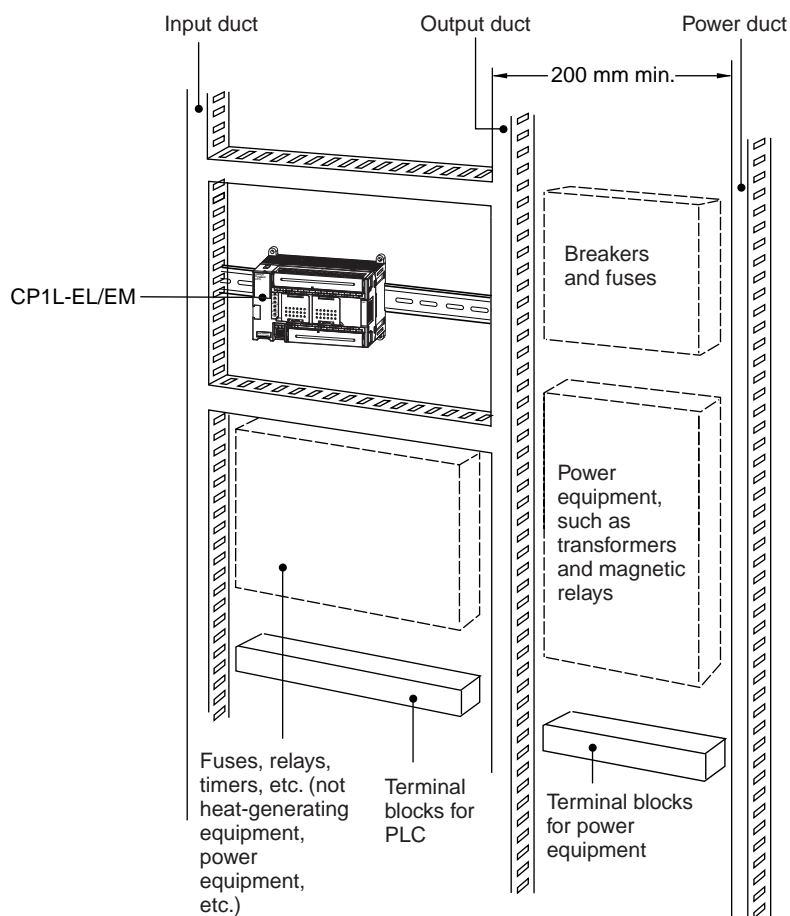
Whenever possible, route I/O wiring through wiring ducts. Install the duct so that it is easy to wire from the I/O Units through the duct. It is handy to have the duct at the same height as the PLC.



**Note** Tighten terminal block screws and cable screws to the following torque.  
M4: 1.2 N·m  
M3: 0.5 N·m

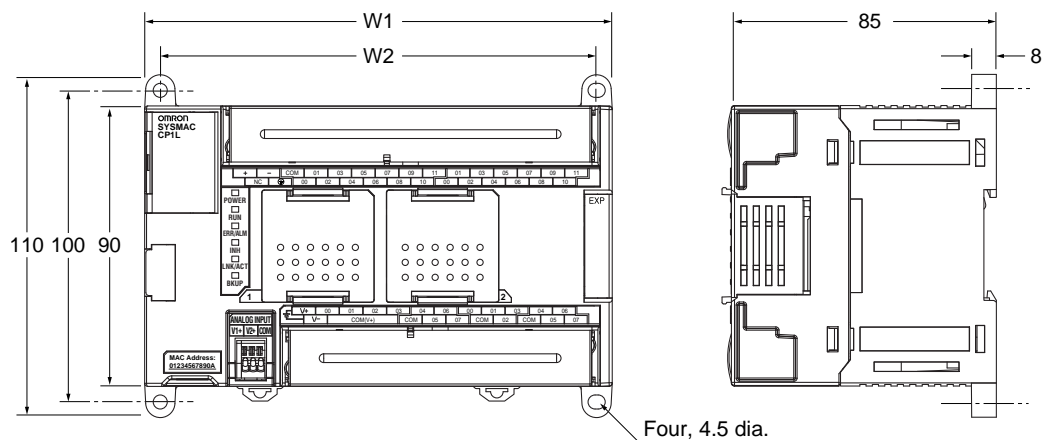
## Routing Wiring Ducts

Install the wiring ducts at least 20 mm between the tops of the PLC and any other objects, (e.g., ceiling, wiring ducts, structural supports, devices, etc.) to provide enough space for air circulation and replacement of Units.



## Dimensions

## External Dimensions



| Model         | W1  | W2  |
|---------------|-----|-----|
| CP1L-EM40D□-□ | 150 | 140 |
| CP1L-EM30D□-□ | 130 | 120 |
| CP1L-EL20D□-□ | 130 | 120 |

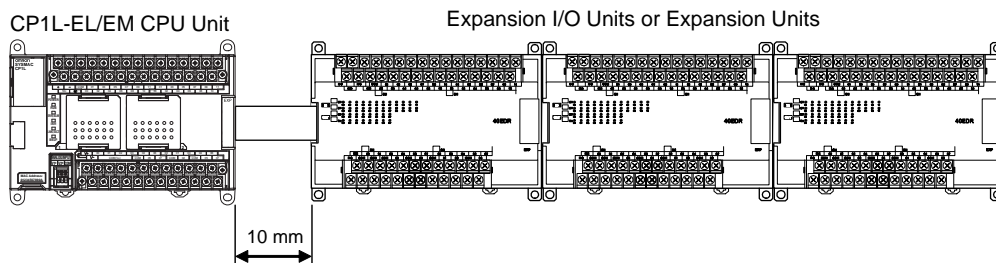
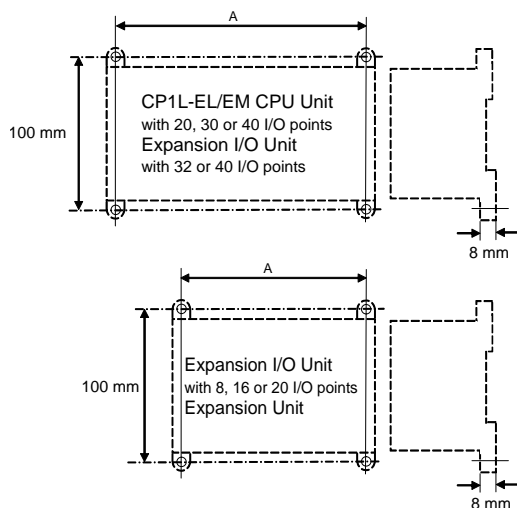
**Mounting Height**

The mounting height is approximately 90 mm.

When a cable is connected to an Option Board, however, the additional height must be factored in. Always allow for the additional height when considering the depth of the control panel in which the PLC is to be mounted.

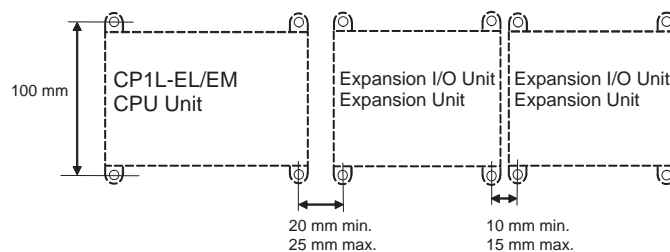
**3-3-2 Connecting Expansion Units and Expansion I/O Units**

Leave approximately 10 mm of space between the CPU Unit and the Expansion Units or Expansion I/O Units.

**Mounting Method**

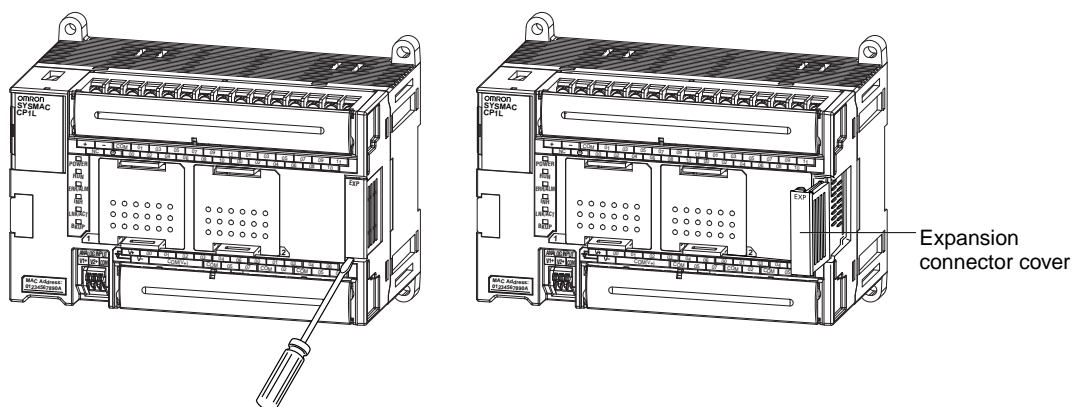
| Unit                     |               | A (mm)   |
|--------------------------|---------------|----------|
| CP1L-EL/EM CPU Unit      | 40 I/O points | 140 ±0.5 |
|                          | 30 I/O points | 120 ±0.5 |
|                          | 20 I/O points | 120 ±0.5 |
| Expansion I/O Unit       | 40 I/O points | 140 ±0.2 |
|                          | 32 outputs    | 140 ±0.2 |
|                          | 20 I/O points | 76 ±0.2  |
|                          | 16 outputs    | 76 ±0.2  |
|                          | 8 inputs      | 56 ±0.2  |
|                          | 8 outputs     | 56 ±0.2  |
| Analog I/O Unit          |               | 76 ±0.2  |
| Temperature Sensor Unit  | TS004         | 140 ±0.2 |
|                          | TS□01         | 76 ±0.2  |
|                          | TS□02         |          |
|                          | TS003         |          |
| CompoBus/S I/O Link Unit |               | 56 ±0.2  |

## Space between Units When Expansion I/O Units Are Connected

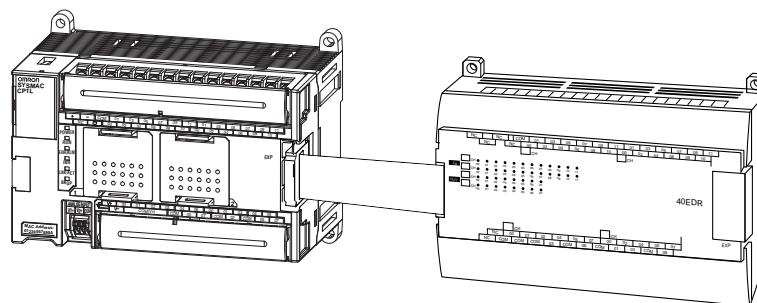


1,2,3...

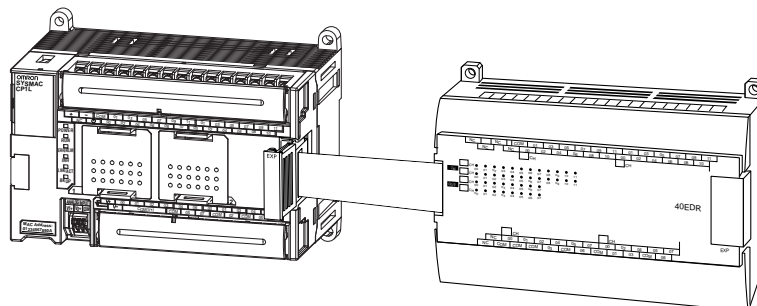
1. Remove the cover from the CPU Unit's or the Expansion I/O Unit's expansion connector. Use a flat-blade screwdriver to remove the cover from the Expansion I/O Connector.



2. Insert the Expansion I/O Unit's connecting cable into the CPU Unit's or the Expansion I/O Unit's expansion connector.

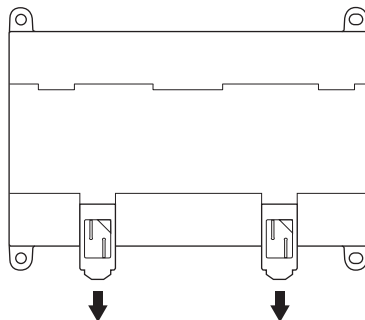


3. Replace the cover on the CPU Unit's or the Expansion I/O Unit's expansion connector.

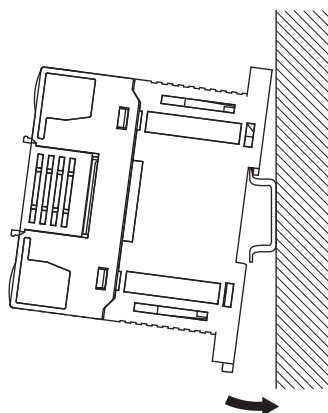


### 3-3-3 DIN Track Installation

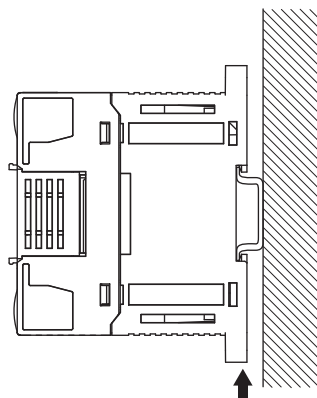
- 1,2,3...**
1. Use a screwdriver to pull down the DIN Track mounting pins from the back of the Units, and mount the Units to the DIN Track.



2. Lower the Units so that they catch on the top of the DIN Track, and then press them forward all the way to the DIN Track at the bottom.



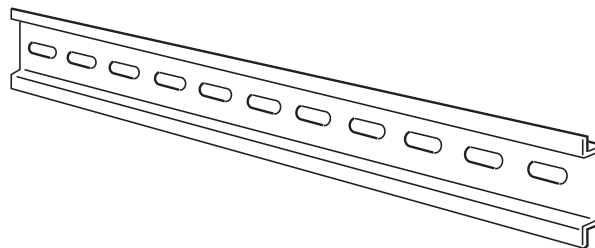
3. Press in all of the DIN Track mounting pins to securely lock the Units in place.



**DIN Track**

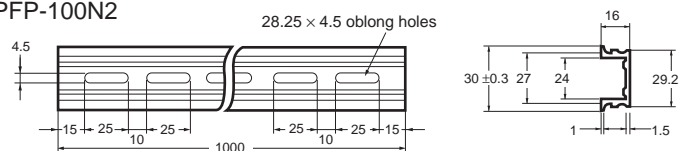
Mount the DIN Track in the control panel with screws in at least three places.

- DIN Track: PFP-50N (50 cm), PFP-100N (100 cm), or PFP-100N2 (100 cm)

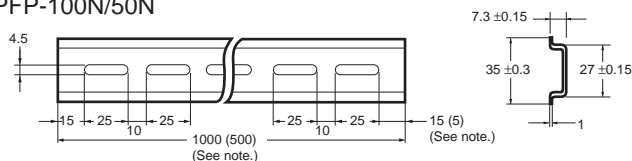


Secure the DIN Track to the control panel using M4 screws separated by 210 mm (6 holes). The tightening torque is 1.2 N·m.

PFP-100N2



PFP-100N/50N



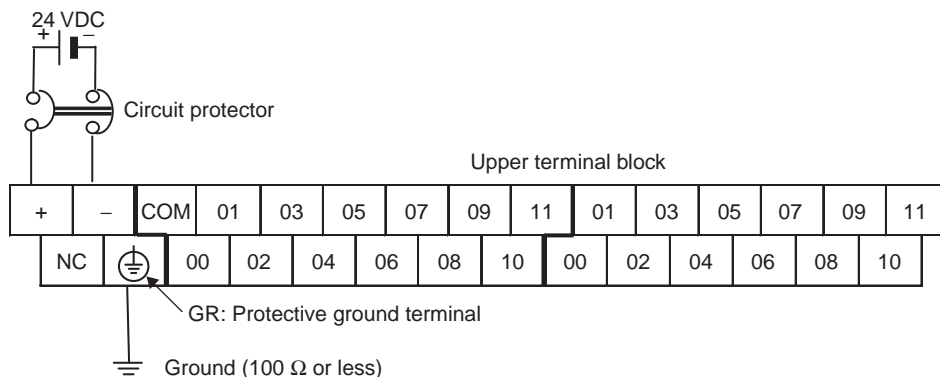
**Note:** PFP-50N dimensions are given in parentheses.

## 3-4 Wiring CP1L-EL/EM CPU Units

### 3-4-1 Wiring Power Supply and Ground Lines

#### CPU Units with DC Power Supply

##### DC Power Supply Wiring



- Use crimp terminals or solid wire for wiring the power supply. Do not connect bare stranded wires directly to terminals.



- M3 self-rising terminal screws are used. Tighten the terminal screws to the torque of 0.5 N·m.
- To prevent noise, use a ground line of 100  $\Omega$  or less.
- Provide a power supply of 20.4 to 26.4 VDC.
- The maximum current consumption is 20 W for CPU Units with 30 or 40 I/O points and 13 W for CPU Units with 20 I/O points.
- When the power supply is turned ON, the inrush current is approximately five times the normal current.
- The GR terminal is a ground terminal. To prevent electrical shock, use a dedicated ground line (2 mm<sup>2</sup> min.) of 100  $\Omega$  or less.

#### Note

- (1) Never reverse the positive and negative leads when wiring the power supply terminals.
- (2) Supply all power to the power supply terminals from the same source.



3-4-2    Wiring Built-in I/O

Wiring Precautions

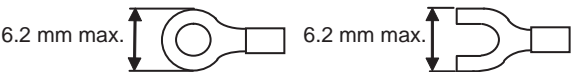
Double-checking I/O Specifications

Double-check the specifications for the I/O Units. In particular, do not apply a voltage that exceeds the input voltage for Input Units or the maximum switching capacity for Output Units. Doing so may result in breakdown, damage, or fire.

When the power supply has positive and negative terminals, always wire them correctly.

Electric Wires

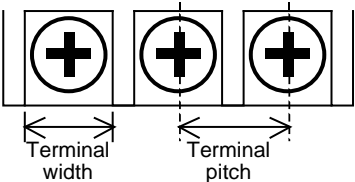
- AWG22 to AWG18 (0.32 to 0.82 mm<sup>2</sup>) power lines are recommended. Use cable with a maximum diameter of 1.61 mm including the insulation covering.
- The current capacity of electric wire depends on factors such as the ambient temperature and insulation thickness, as well as the gauge of the conductor.
- M3 self-rising screws are used for all screw terminals including terminal screws for crimp terminal power supply wiring.
- Use crimp terminals or solid wire for wiring.
- Do not connect bare stranded wires directly to terminals.
- Tighten the terminal block screws to the torque of 0.5 N·m.
- Use crimp terminals (M3) having the dimensions shown below.



Wiring

- Wire the Units so that they can be easily replaced.
- Make sure that the I/O indicators are not covered by the wiring.
- Do not place the I/O wiring in the same conduits or ducts as high-voltage or power lines. Inductive noise can cause errors or damage.
- Tighten the terminal screws to the torque of 0.5 N·m.

| Unit type   | Terminal width | Terminal pitch |
|---|----------------|----------------|
| CPU Units   | 6.4 mm         | 7.6 mm         |
| Expansion I/O Units<br>40ED□/32E□/20EDT□                                | 6.4 mm         | 7.7 mm         |
| Expansion I/O Units<br>AD04□/DA0□□/MAD□□/TS□0□<br>SRT21/20EDR1/16E□/8E□ | 6.8 mm         | 8.4 mm         |



**Note**

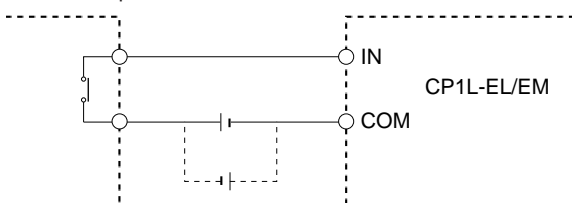
- (1) Never apply a voltage that exceeds the input voltage for Input Units or the maximum switching capacity for Output Units.
- (2) When the power supply has positive and negative terminals, always wire them correctly.
- (3) When required by EC Low Voltage Directive, use reinforced insulation or double insulation on the DC power supply connected to DC-power-supply CPU Units and I/O.  
For the DC power supply connected to a DC-power-supply CPU Unit, use a power supply with a minimum output holding time of 10 ms.
- (4) Do not pull on the cables or bend the cables beyond their natural limit. Doing either of these may break the cables.

**Connecting I/O Devices**

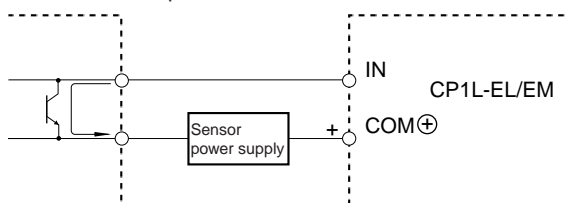
Use the following information for reference when selecting or connecting input devices.

**DC Input Devices****Connectable DC Input Devices (for DC Output Models)**

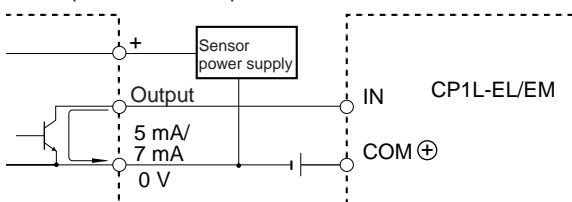
Contact output



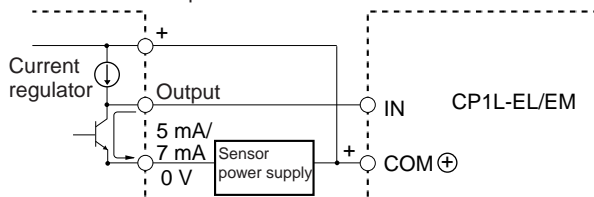
Two-wire DC output



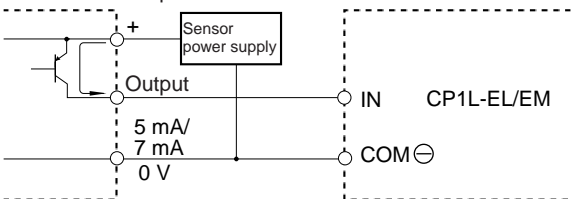
NPN open-collector output



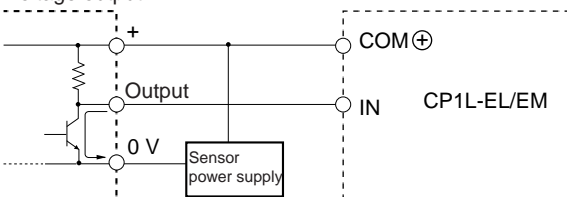
NPN current output



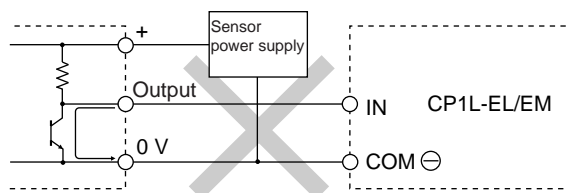
PNP current output



Voltage output



- The circuit below should not be used for I/O devices with a voltage output.



### Precautions when Connecting a Two-wire DC Sensor

When using a two-wire sensor with a 24 VDC input device, check that the following conditions have been met. Failure to meet these conditions may result in operating errors.

1,2,3...

1. Relation between voltage when the PLC is ON and the sensor residual voltage:

$$V_{ON} \leq V_{CC} - V_R$$

2. Relation between current when the PLC is ON and sensor control output (load current):

$$I_{OUT} (\text{min}) \leq I_{ON} \leq I_{OUT} (\text{max})$$

$$I_{ON} = (V_{CC} - V_R - 1.5 [\text{PLC internal residual voltage}]) / R_{IN}$$

When  $I_{ON}$  is smaller than  $I_{OUT} (\text{min})$ , connect a bleeder resistor  $R$ . The bleeder resistor constant can be calculated as follows:

$$R \leq (V_{CC} - V_R) / (I_{OUT} (\text{min}) - I_{ON})$$

$$\text{Power } W \geq (V_{CC} - V_R)^2 / R \times 4 [\text{allowable margin}]$$

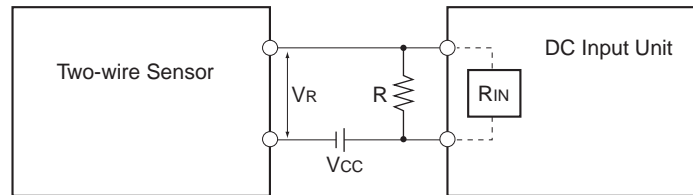
3. Relation between current when the PLC is OFF and sensor leakage current:

$$I_{OFF} \geq I_{leak}$$

Connect a bleeder resistor if  $I_{leak}$  is greater than  $I_{OFF}$ . Use the following equation to calculate the bleeder resistance constant.

$$R \leq R_{IN} \times V_{OFF} / (I_{leak} \times R_{IN} - V_{OFF})$$

$$\text{Power } W \geq (V_{CC} - V_R)^2 / R \times 4 (\text{allowable margin})$$



$V_{CC}$ : Power voltage

$V_{ON}$ : PLC ON voltage

$V_{OFF}$ : PLC OFF voltage

$I_{ON}$ : PLC ON current

$I_{OFF}$ : PLC OFF current

$R_{IN}$ : PLC input impedance

$V_r$ : Sensor output residual voltage

$I_{out}$ : Sensor control output (load current)

$I_{leak}$ : Sensor leakage current

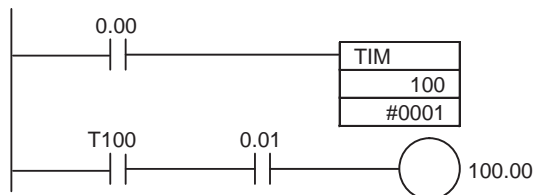
$R$ : Bleeder resistance

4. Precautions on Sensor Inrush Current

An incorrect input may occur due to sensor inrush current if a sensor is turned ON after the PLC has started up to the point where inputs are possible. Determine the time required for sensor operation to stabilize after the sensor is turned ON and take appropriate measures, such as inserting into the program a timer delay after turning ON the sensor.

**Program Example**

In this example, the sensor's power supply voltage is provided to input bit CIO 0.00 and a 100-ms timer delay (the time required for an OMRON Proximity Sensor to stabilize) is created in the program. After the Completion Flag for the timer turns ON, the sensor input on input bit CIO 0.01 will cause output bit CIO 100.00 to turn ON.

**Output Wiring Precautions****Output Short-circuit Protection**

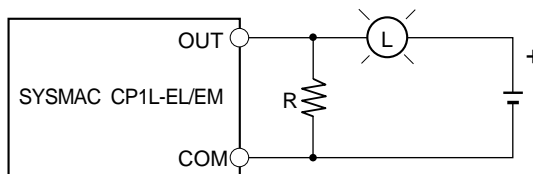
If a load connected to the output terminals is short-circuited, output components and the printed circuit boards may be damaged. To guard against this, incorporate a fuse in the external circuit. Use a fuse with a capacity of about twice the rated output.

**Connecting to a TTL Circuit**

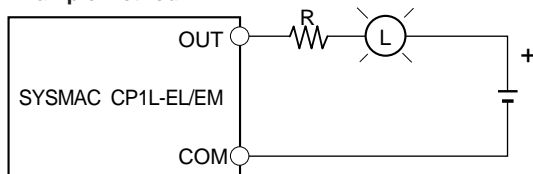
A TTL circuit cannot be connected directly to a transistor output because of the transistor's residual voltage. It is necessary to connect a pull-up resistor and a CMOS IC between the two.

**Inrush Current Considerations**

When connecting a transistor or triac output to a load having a high inrush current (such as an incandescent lamp), steps must be taken to avoid damage to the transistor or triac. Use either of the following methods to reduce the inrush current.

**Example Method 1**

Use a dark current of approximately 1/3 the rated current of the incandescent lamp.

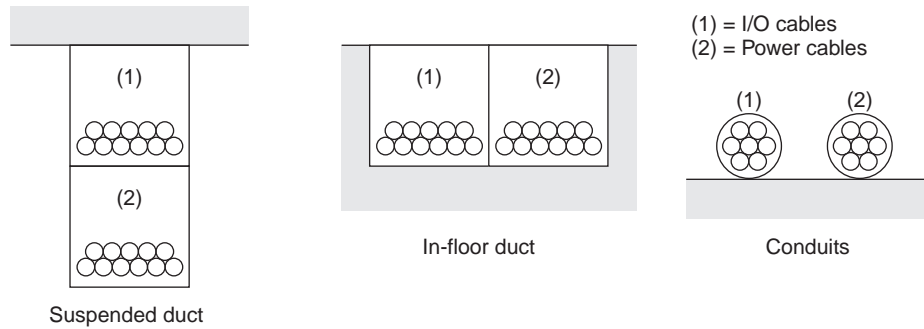
**Example Method 2**

Install a limit resistance.

### 3-4-3 Wiring Safety and Noise Controls

#### I/O Signal Wiring

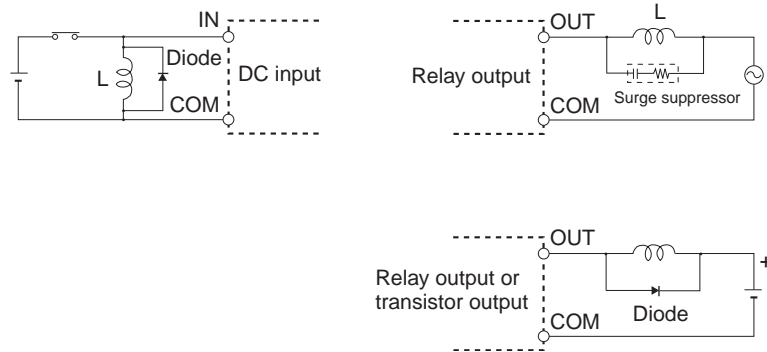
Whenever possible, place I/O signal lines and power lines in separate ducts or conduits both inside and outside of the control panel.



If the I/O wiring and power wiring must be routed in the same duct, use shielded cables and connect the shields to the GR terminal to reduce noise.

#### Inductive Loads

When an inductive load is connected to an I/O Unit, connect a surge suppressor or diode in parallel with the load as shown below.



**Note** Use surge suppressors and diodes with the following specifications.

Surge Suppressor Specifications 

Resistance: 50  $\Omega$   
 Capacitance: 0.47  $\mu\text{F}$   
 Voltage: 200 V

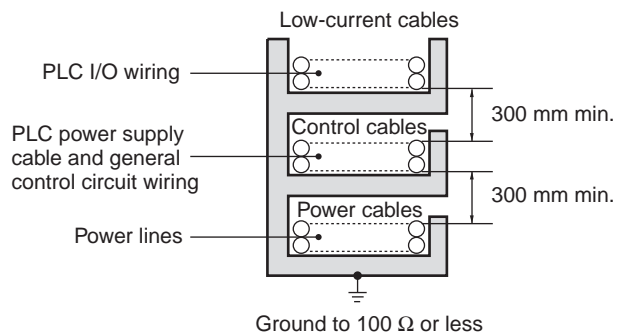
Diode Specifications 

Breakdown voltage: 3 times load voltage min.  
 Mean rectification current: 1 A

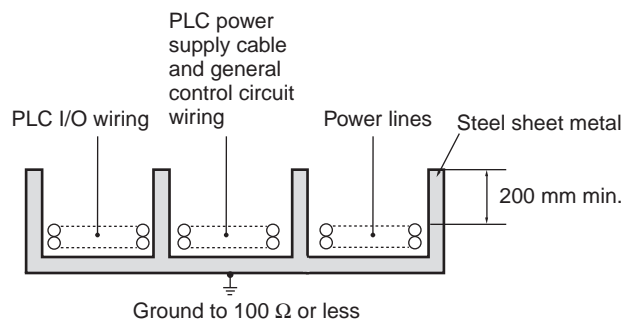
## Noise from External Wiring

Take the following points into account when externally wiring I/O, power supply, and power lines.

- When multi-conductor signal cable is being used, avoid combining I/O wires and other control wires in the same cable.
- If wiring racks are parallel, allow at least 300 mm between them.



- If the I/O wiring and power cables must be placed in the same duct, they must be shielded from each other using grounded steel sheet metal.

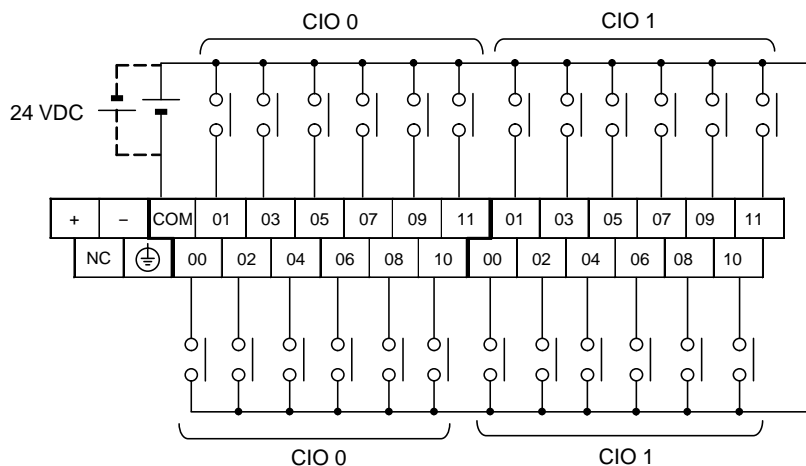


## 3-5 Wiring CPU Unit I/O

### 3-5-1 I/O Wiring for CPU Units with 40 I/O Points

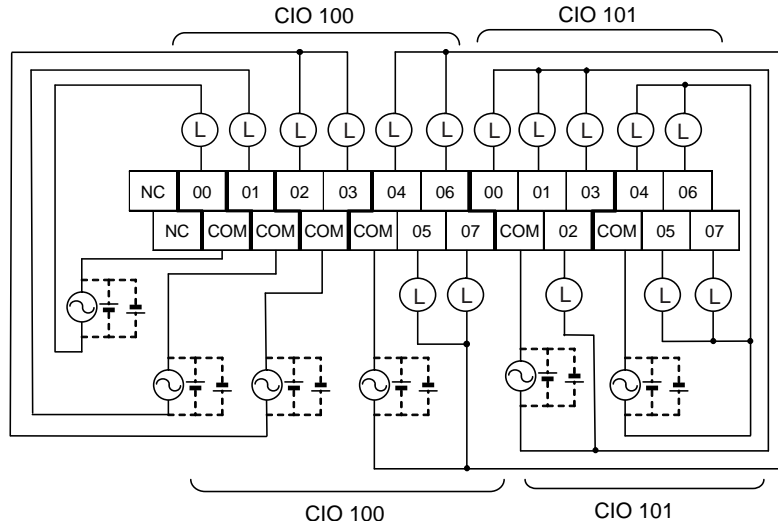
#### Input Wiring (Upper Terminal Block, Removable)

The input circuits have 24 points/common. Use power lines with sufficient current capacity for the COM terminals.

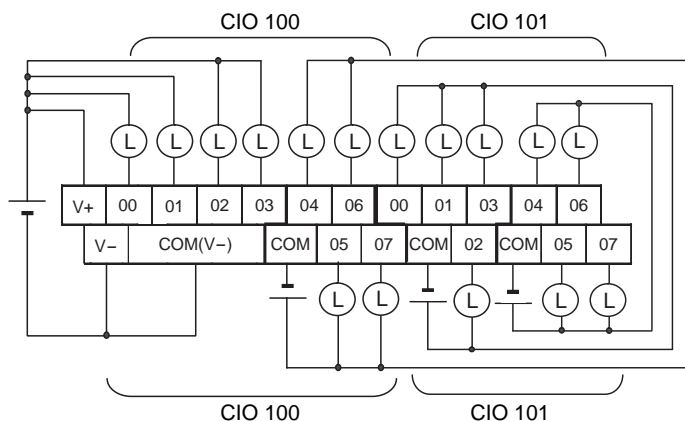


#### Output Wiring (Lower Terminal Block, Removable)

Relay Outputs  
(CP1L-EM40DR-D)

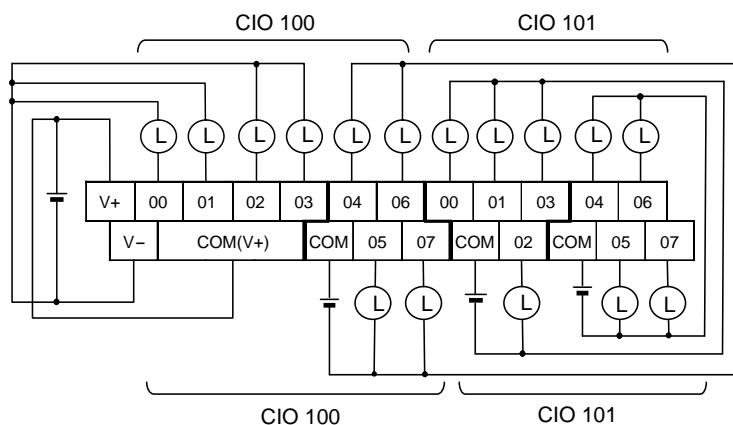


### Sinking Transistor Outputs (CP1L-EM40DT-D)



**Note** COM(V-) has been connected with V- in an inner circuit.

### Sourcing Transistor Outputs (CP1L-EM40DT1-D)

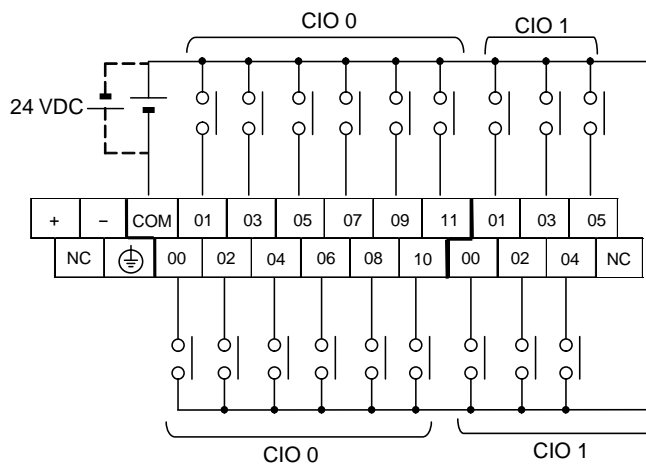


**Note** COM(V+) has been connected with V+ in an inner circuit.

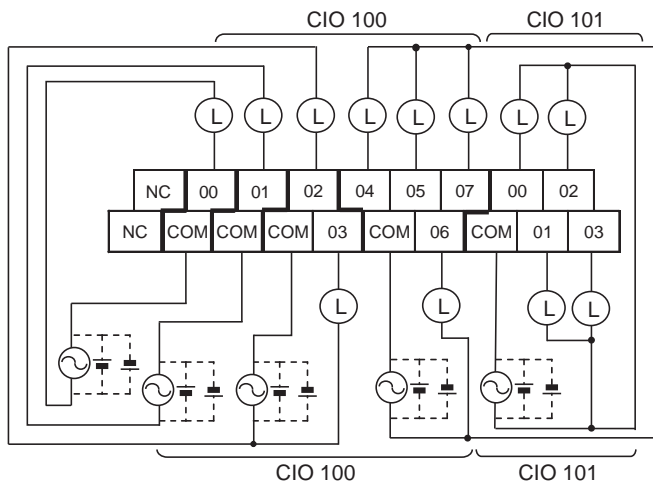
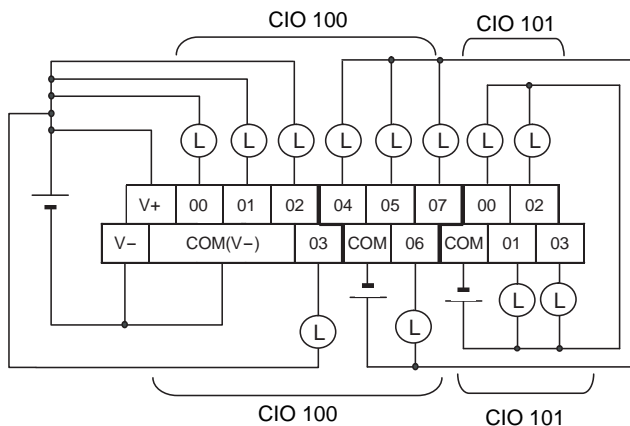
## 3-5-2 I/O Wiring for CPU Units with 30 I/O Points

### Input Wiring (Upper Terminal Block, Removable)

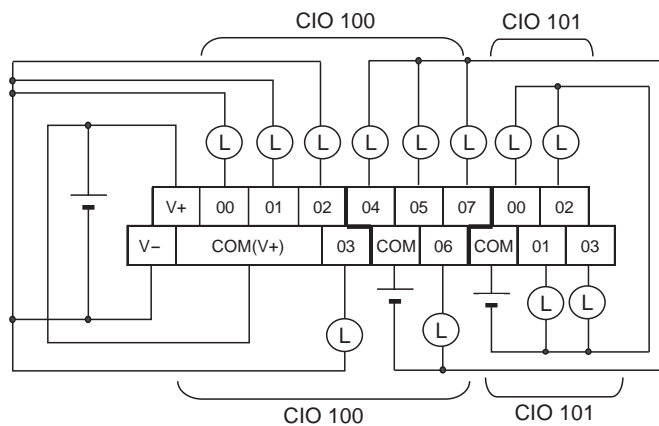
The input circuits have 18 points/common. Use power lines with sufficient current capacity for the COM terminals.





**Output Wiring (Lower Terminal Block, Removable)****Relay Outputs  
(CP1L-EM30DR-D)****Sinking Transistor  
Outputs (CP1L-EM30DT-D)**

**Note** COM(V-) has been connected with V- in an inner circuit.

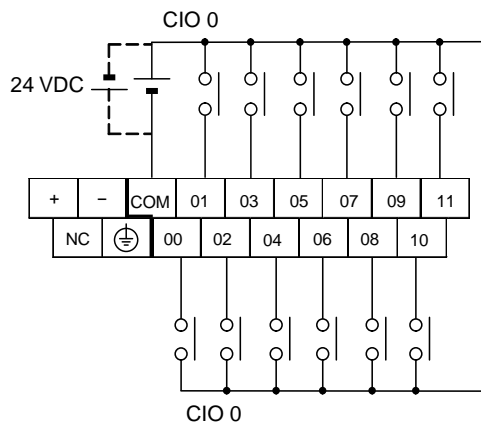
**Sourcing Transistor  
Outputs (CP1L-EM30DT1-D)**

**Note** COM(V+) has been connected with V+ in an inner circuit.

### 3-5-3 I/O Wiring for CPU Units with 20 I/O Points

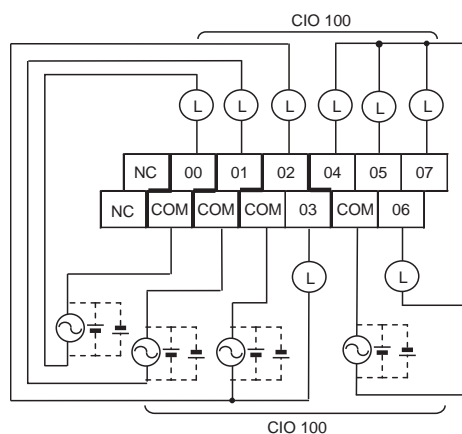
#### Input Wiring (Upper Terminal Block, not Removable)

The input circuits have 12 points/common. Use power lines with sufficient current capacity for the COM terminals.

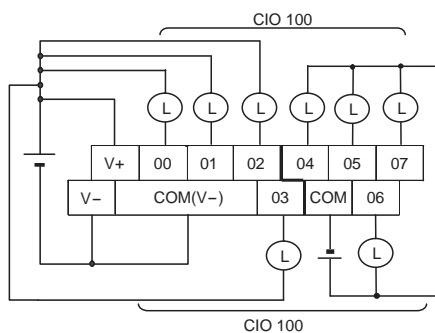


#### Output Wiring (Lower Terminal Block, not Removable)

Relay Outputs  
(CP1L-EL20DR-D)

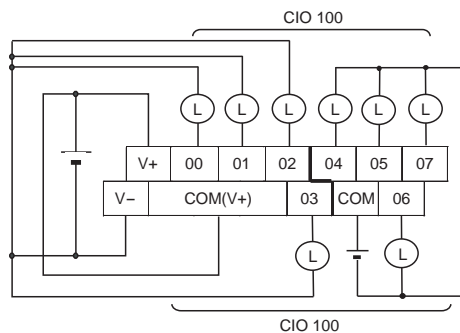


Sinking Transistor  
Outputs (CP1L-EL20DT-D)



**Note** COM(V-) has been connected with V- in an inner circuit.

## Sourcing Transistor Outputs (CP1L-EL20DT1-D)

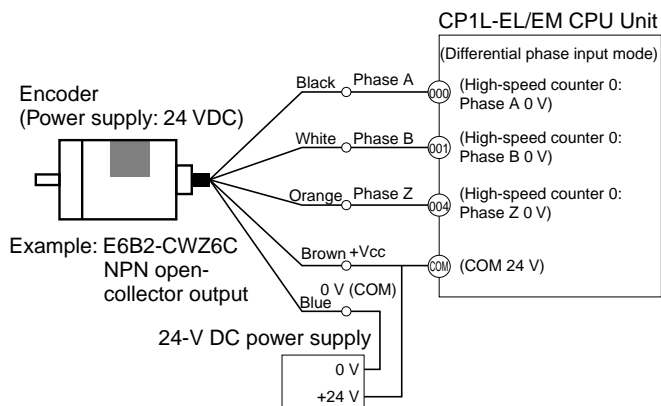


**Note** COM(V+) has been connected with V+ in an inner circuit.

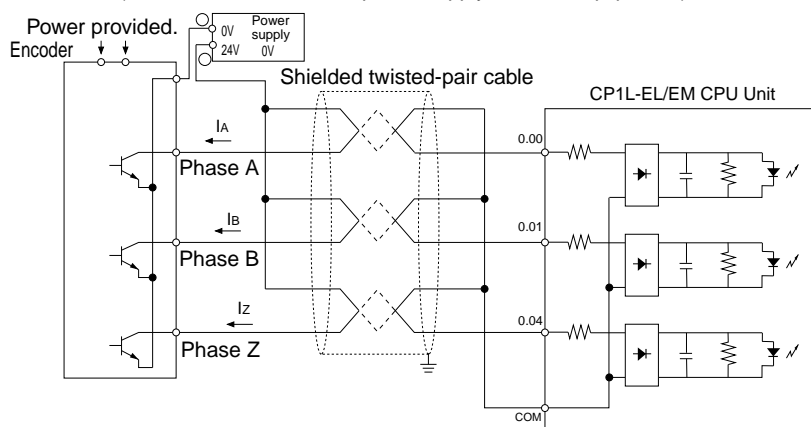
### 3-5-4 Pulse Input Connection Examples

### For a 24-VDC Open-collector Encoder

This example shows the connections to an encoder with phase-A, phase-B, and phase Z inputs.



(Do not use the same I/O power supply as other equipment.)



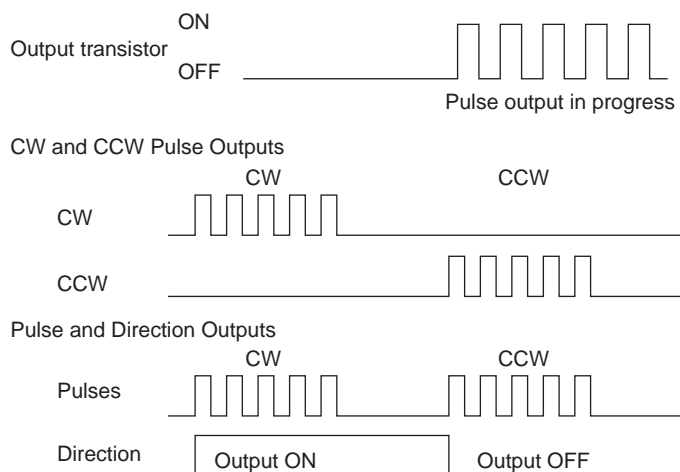
### 3-5-5 Pulse Output Connection Examples

This example shows a connection to a motor driver. Always check the specifications of the motor driver before actually connecting it.

For open-collector output, use a maximum of 3 m of wiring between the CP1L-EL/EM CPU Unit and the motor driver.

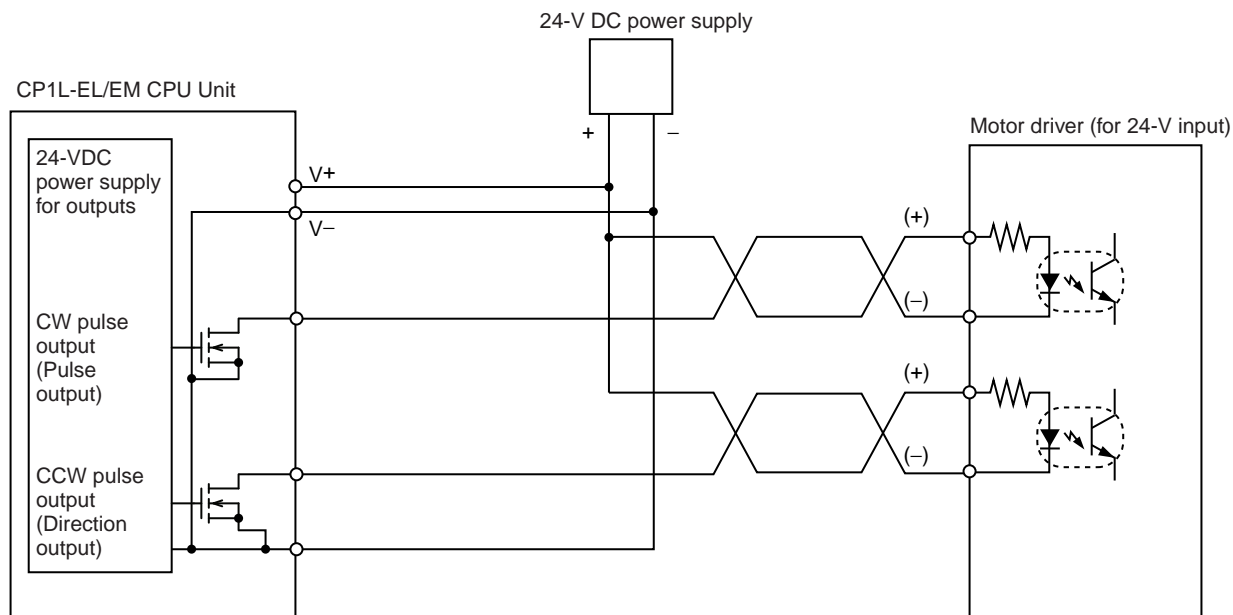
No pulses are output while the pulse output transistor is OFF. For a direction output, OFF indicates that CCW output is in progress.

Do not use the same power supply for both pulse output 24-VDC/5-VDC power and other I/O power.



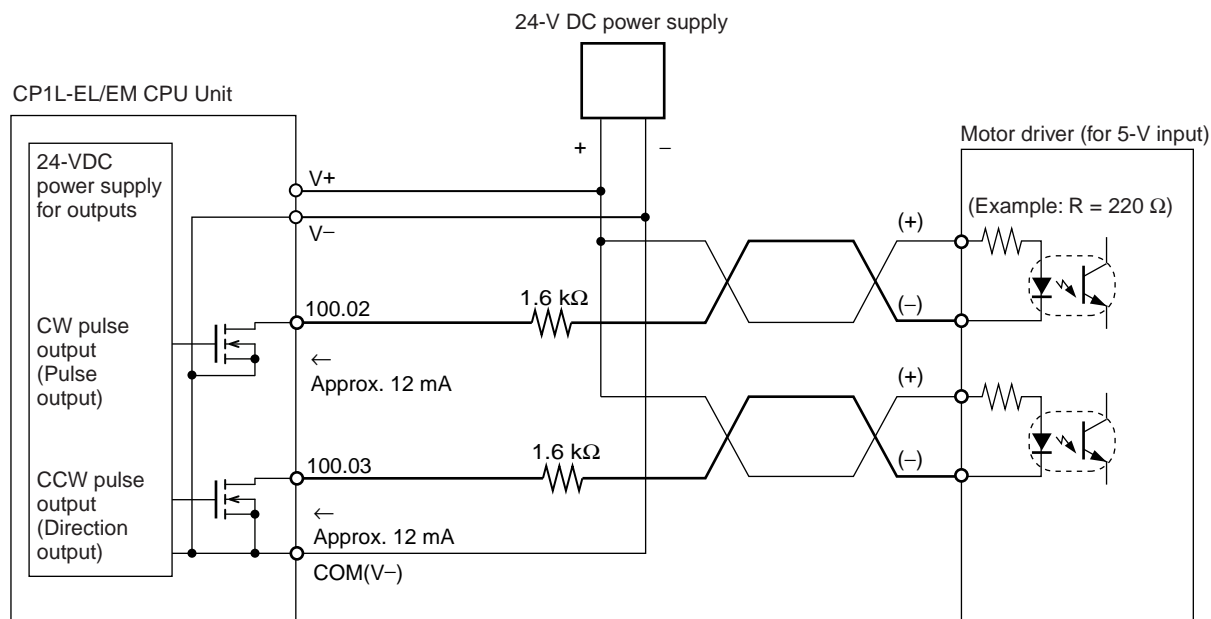
#### CW/CCW Pulse Output and Pulse Plus Direction Output

##### Using a 24-VDC Photocoupler Input Motor Driver (CP1L-E□□□DT-D)



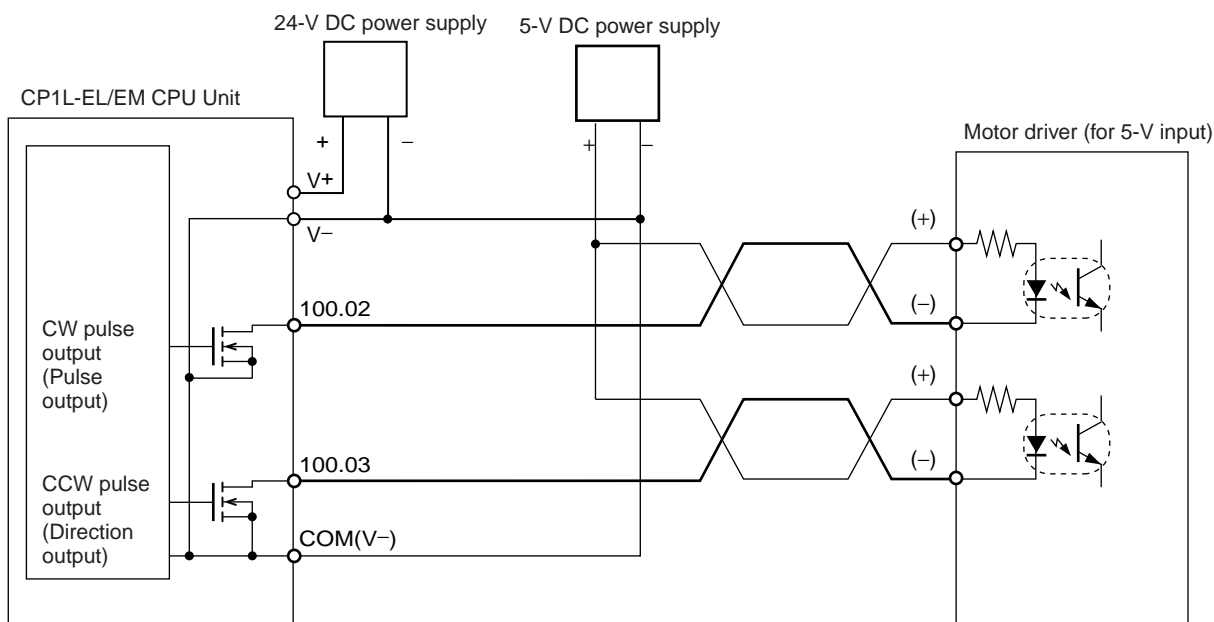
### Using a 5-VDC Photocoupler Input Motor Driver (CP1L-E□□□DT-D)

#### Connection Example 1



In this example, a 5-V input motor driver is used with a 24-VDC power supply. Be careful to ensure that the Position Control Unit output current does not damage the input circuit at the motor driver and yet is sufficient to turn it ON. Take into account the power derating for the 1.6-k $\Omega$  resistance.

#### Connection Example 2



## 3-6 CP-series Expansion I/O Unit Wiring

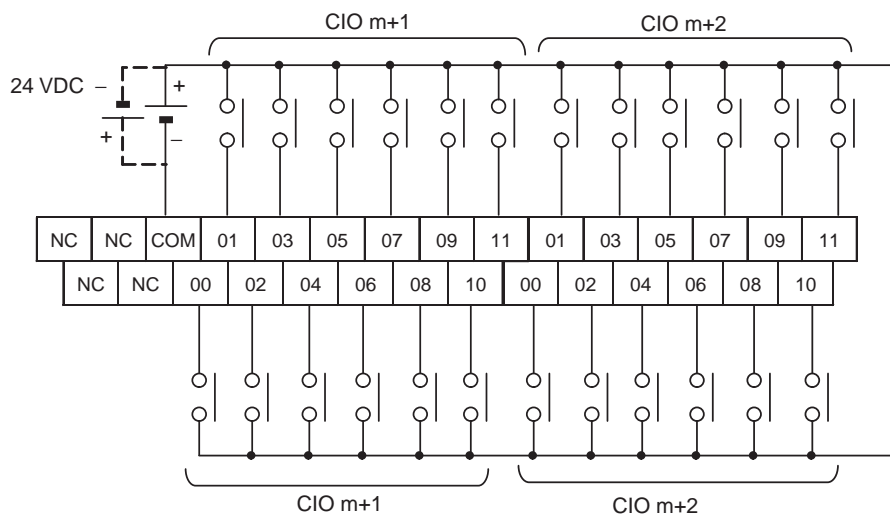
CP-series Expansion I/O Units

|                       | Model       | Inputs              | Outputs                          |
|-----------------------|-------------|---------------------|----------------------------------|
| 40-point I/O Units    | CP1W-40EDR  | 24-VDC<br>24 inputs | 16 relay outputs                 |
|                       | CP1W-40EDT  |                     | 16 transistor outputs (sinking)  |
|                       | CP1W-40EDT1 |                     | 16 transistor outputs (sourcing) |
| 32-point Output Units | CP1W-32ER   | None                | 32 relay outputs                 |
|                       | CP1W-32ET   |                     | 32 transistor outputs (sinking)  |
|                       | CP1W-32ET1  |                     | 32 transistor outputs (sourcing) |
| 20-point I/O Units    | CP1W-20EDT1 | 24-VDC<br>12 inputs | 8 relay outputs                  |
|                       | CP1W-20EDT  |                     | 8 transistor outputs (sinking)   |
|                       | CP1W-20EDT1 |                     | 8 transistor outputs (sourcing)  |
| 16-point Output Units | CP1W-16ER   | None                | 16 relay outputs                 |
|                       | CP1W-16ET   |                     | 16 transistor outputs (sinking)  |
|                       | CP1W-16ET1  |                     | 16 transistor outputs (sourcing) |
| 8-point Input Units   | CP1W-8ED    | 24-VDC<br>8 inputs  | None                             |
| 8-point Output Units  | CP1W-8ER    | None                | 8 relay outputs                  |
|                       | CP1W-8ET    |                     | 8 transistor outputs (sinking)   |
|                       | CP1W-8ET1   |                     | 8 transistor outputs (sourcing)  |

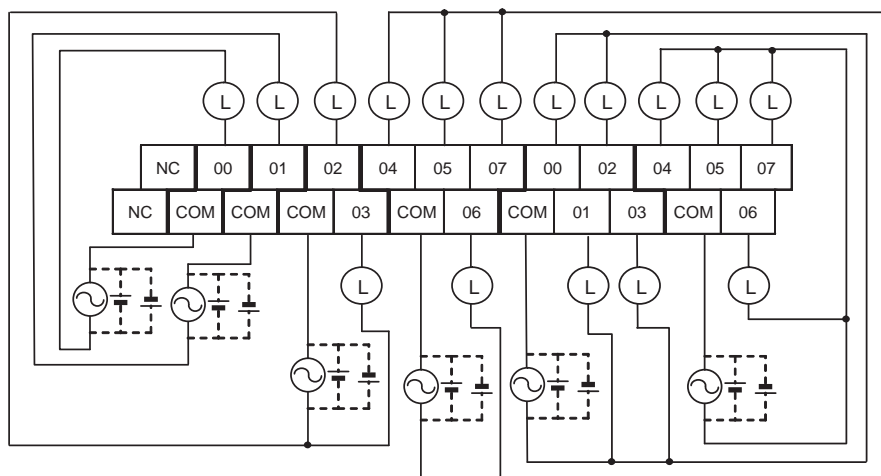
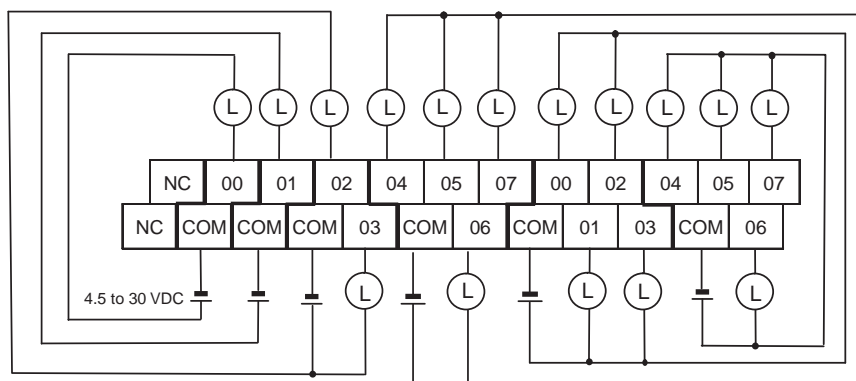
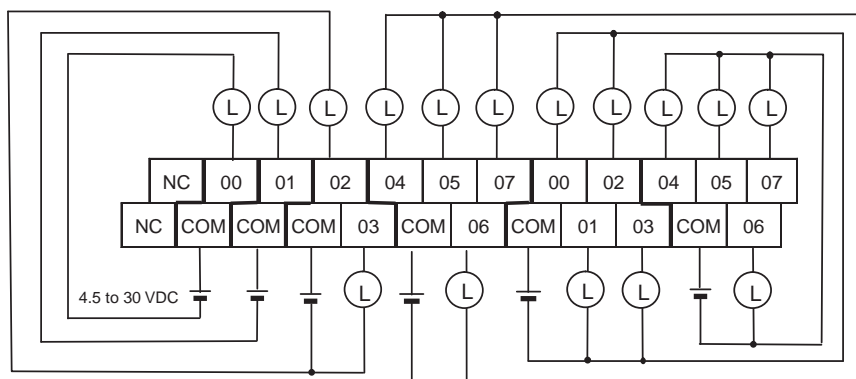
For details on wiring Expansion Units, refer to *SECTION 9 Using Expansion Units and Expansion I/O Units*.

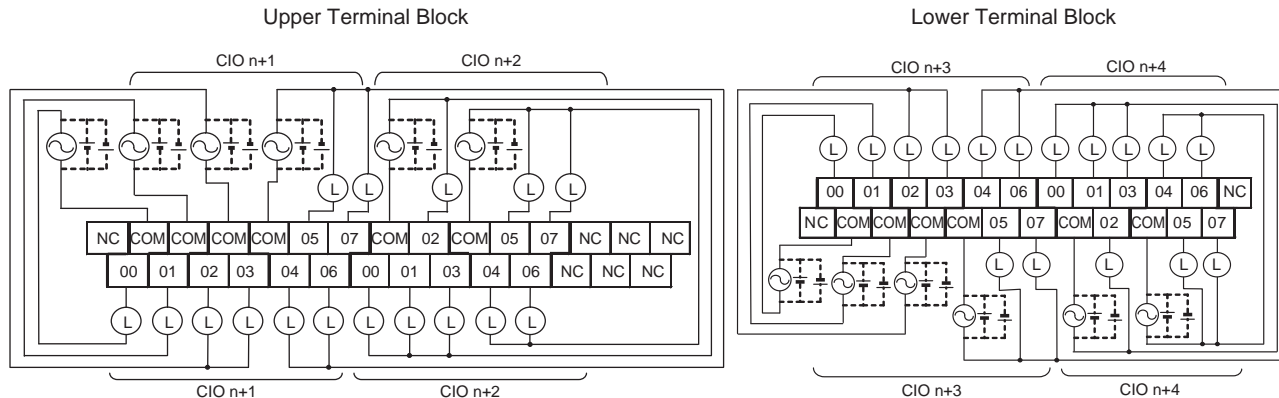
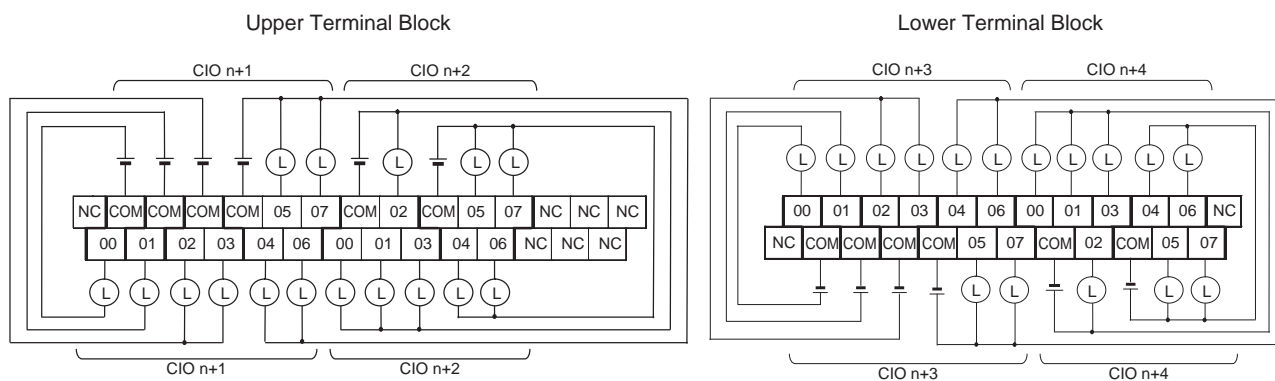
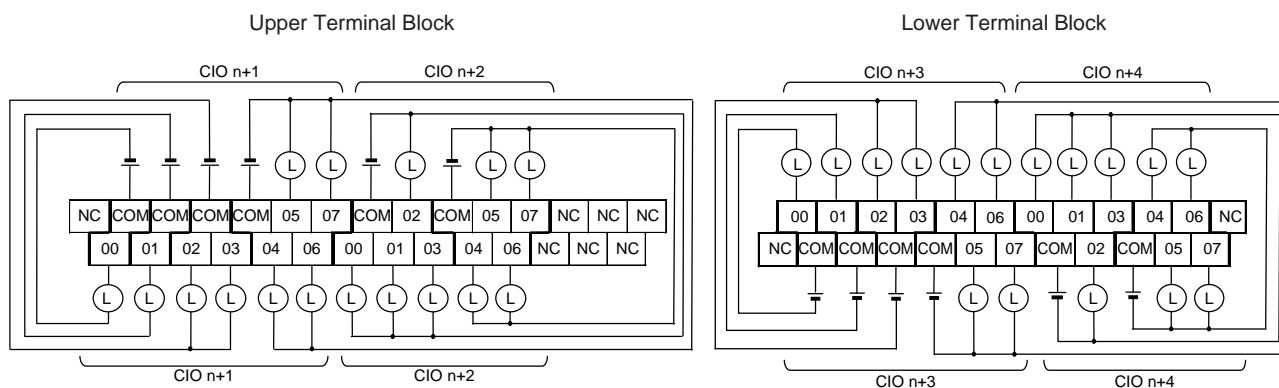
### 40-point I/O Units (CP1W-40ED□□) (Terminal Block is not Removable)

#### Input Wiring

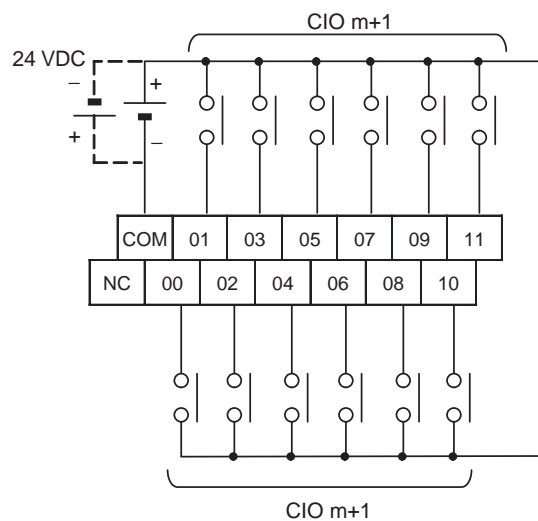
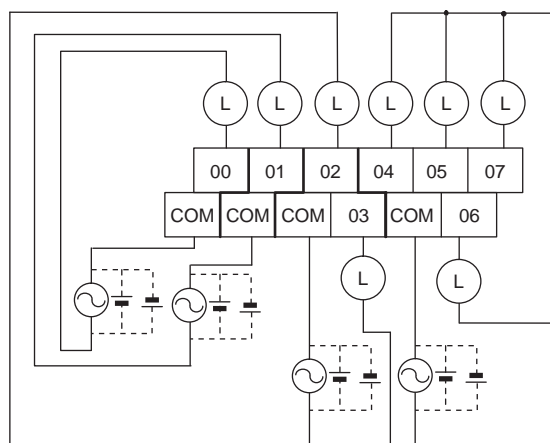
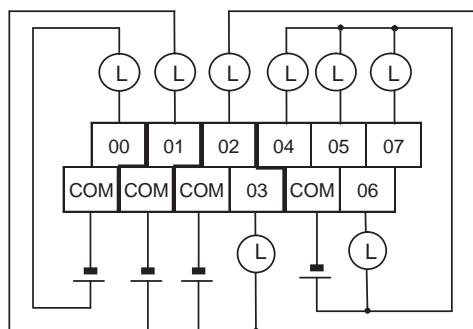


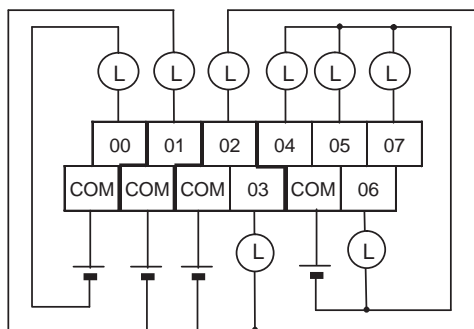
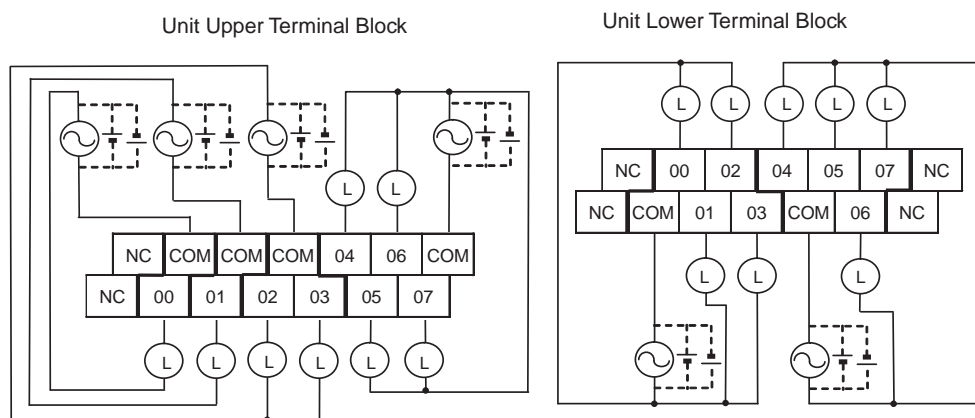
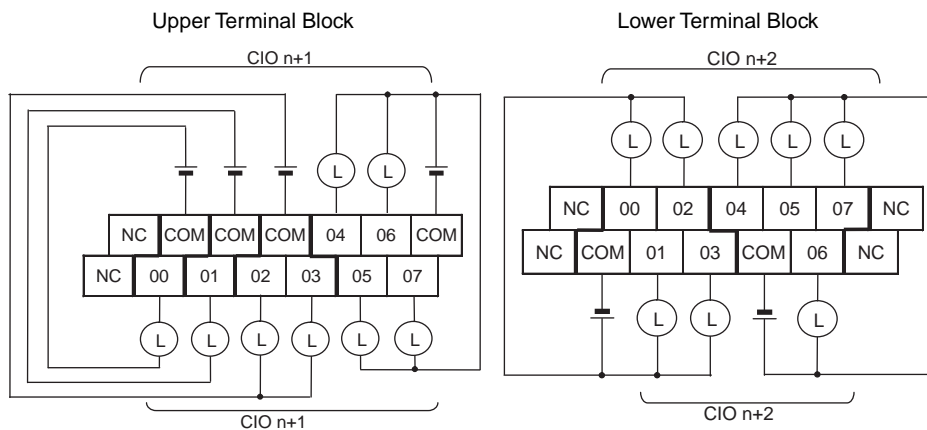
## Output Wiring

**CP1W-40EDR-40EDR (Relay Outputs)****CP1W-40EDT (Sinking Transistor Outputs)****CP1W-40EDT1 (Sourcing Transistor Outputs)**

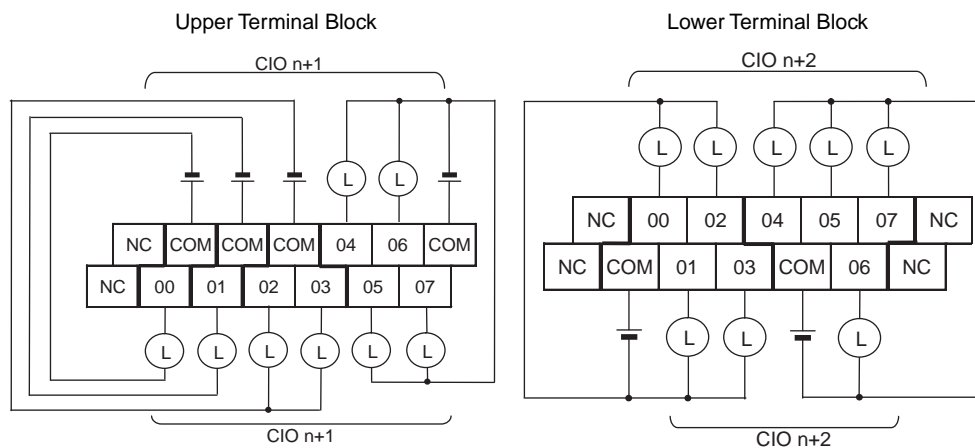
**32-point Output Units (CP1W-32E□□) (Terminal Block is not Removable)****Output Wiring****CP1W-32ER (Relay Outputs)****Output Wiring****CP1W-32ET (Sinking Transistor Outputs)****Output Wiring****CP1W-32ET1 (Sourcing Transistor Outputs)**



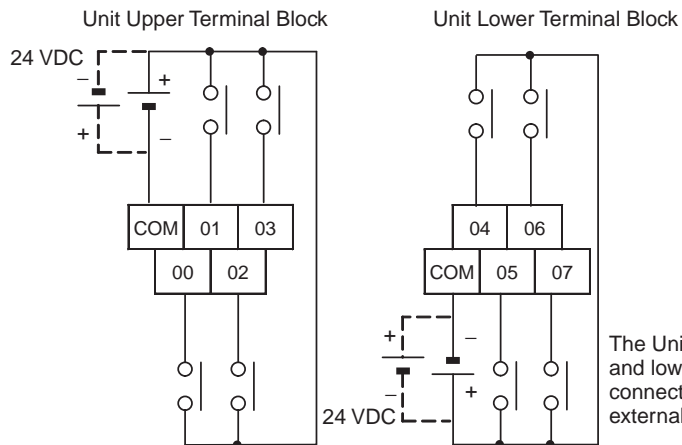
**20-point I/O Units (CP1W-20ED□□) (Terminal Block is not Removable)****Input Wiring****CP1W-20ED□□****Output Wiring****CP1W-20EDR1 (Relay Outputs)****CP1W-20EDT (Sinking Transistor Outputs)**

**CP1W-20EDT1 (Sourcing Transistor Outputs)****16-point Output Units (CP1W-16E□□) (Terminal Block is not Removable)****Output Wiring****CP1W-16ER (Relay Outputs)****Output Wiring****CP1W-16ET (Sinking Transistor Outputs)**

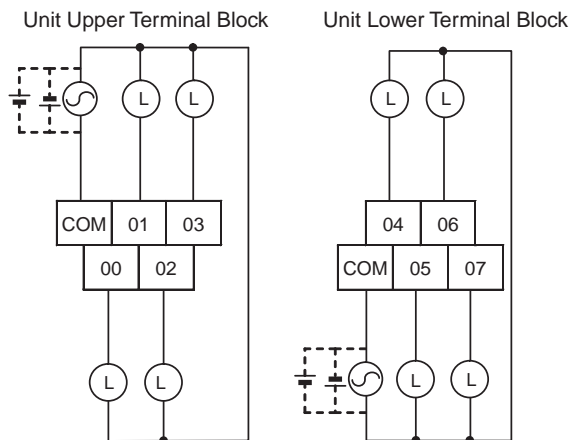
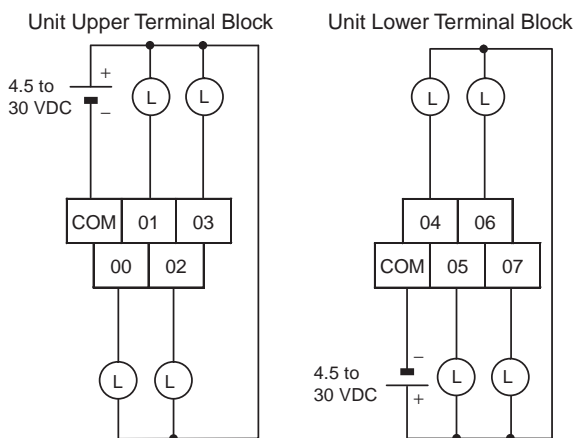
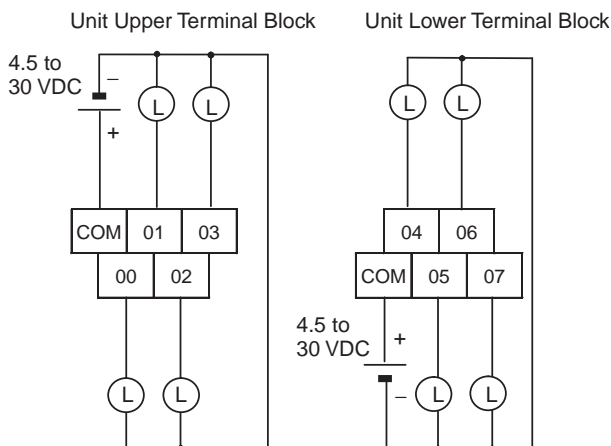
## Output Wiring

**CP1W-16ET1 (Sourcing Transistor Outputs)****8-point Input Units (CP1W-8ED) (Terminal Block is not Removable)**

## Input Wiring



The Unit's upper terminal block COM and lower terminal block COM are connected internally, but connect them externally as well.

**8-point Output Units (CP1W-8E□) (Terminal Block is not Removable)****Output Wiring****CP1W-8ER (Relay Outputs)****Output Wiring****CP1W-8ET (Sinking Transistor Outputs)****Output Wiring****CP1W-8ET1 (Sourcing Transistor Outputs)**

## SECTION 4

# I/O Memory Allocation

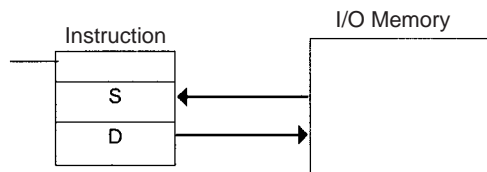
This section describes the structure and functions of the I/O Memory Areas and Parameter Areas.

|        |   |     |
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## 4-1 Overview of I/O Memory Area

### 4-1-1 I/O Memory Area

This region of memory contains the data areas that can be accessed as instruction operands. I/O memory includes the CIO Area, Work Area, Holding Area, Auxiliary Area, DM Area, Timer Area, Counter Area, Task Flag Area, Data Registers, Index Registers, Condition Flag Area, and Clock Pulse Area.



| Area                     |                      |                         | Size                      | Range                                     | Task usage          | Allocation  | Bit access | Word access              | Access                     |        | Change from CX-Programmer | Forcing bit status |
|--------------------------|----------------------|-------------------------|---------------------------|---|---------------------|---|------------|--------------------------|----------------------------|--------|---------------------------|--------------------|
|                          |                      |                         |                           |   |                     |   |            |                          | Read                       | Write  |                           |                    |
| CIO Area                 | I/O Area             | Input Area              | 1,600 bits (100 words)    | CIO 0 to CIO 99                           | Shared by all tasks | CP1L-EL/EM CPU Units and CP-series Expansion Units or Expansion I/O Units | OK         | OK                       | OK                         | OK     | OK                        | OK                 |
|                          |                      | Output Area             | 1,600 bits (100 words)    | CIO 100 to CIO 199                        |                     |   | OK         | OK                       | OK                         | OK     | OK                        | OK                 |
|                          | 1:1 Link Area        |                         | 256 bits (16 words)       | CIO 3000 to CIO 3015                      |                     | 1:1 Links   | OK         | OK                       | OK                         | OK     | OK                        | OK                 |
|                          | Serial PLC Link Area |                         | 1,440 bits (90 words)     | CIO 3100 to CIO 3189                      |                     | Serial PLC Links  | OK         | OK                       | OK                         | OK     | OK                        | OK                 |
|                          | Work Area            |                         | 14,400 bits (900 words)   | CIO 3800 to CIO 6143                      |                     | ---   | OK         | OK                       | OK                         | OK     | OK                        | OK                 |
| Work Area                |                      | 8,192 bits (512 words)  | W000 to W511              | ---                                       |                     | OK  | OK         | OK                       | OK                         | OK     | OK                        |                    |
| Holding Area             |                      | 8,192 bits (512 words)  | H000 to H511 (Note 6)     | ---                                       |                     | OK  | OK         | OK                       | OK                         | OK     | OK                        |                    |
| Auxiliary Area           |                      | 15,360 bits (960 words) | A000 to A959              | ---                                       |                     | OK  | ---        | OK                       | Note 1                     | Note 1 | No                        |                    |
| TR Area                  |                      | 16 bits                 | TR0 to TR15               | ---                                       |                     | OK  | OK         | OK                       | OK                         | No     | No                        |                    |
| Data Memory Area         |                      | 32,768 words            | D00000 to D32767 (Note 7) | ---                                       |                     | No (Note 2)   | OK         | OK                       | OK                         | OK     | No                        |                    |
| Timer Completion Flags   |                      | 4,096 bits              | T0000 to T4095            | Function separately in each task (Note 3) | ---                 | OK  | ---        | OK                       | OK                         | OK     | OK                        |                    |
| Counter Completion Flags |                      | 4,096 bits              | C0000 to C4095            |   | ---                 | OK  | ---        | OK                       | OK                         | OK     | OK                        |                    |
| Timer PVs                |                      | 4,096 words             | T0000 to T4095            |   | ---                 | ---   | OK         | OK                       | OK                         | OK     | No (Note 4)               |                    |
| Counter PVs              |                      | 4,096 words             | C0000 to C4095            |   | ---                 | ---   | OK         | OK                       | OK                         | OK     | No (Note 5)               |                    |
| Task Flag Area           |                      | 32 bits                 | TK0 to TK31               |   | ---                 | OK  | ---        | OK                       | No                         | No     | No                        |                    |
| Index Registers          |                      | 16 registers            | IR0 to IR15               |   | ---                 | OK  | OK         | Indirect addressing only | Specific instructions only | No     | No                        |                    |
| Data Registers           |                      | 16 registers            | DR0 to DR15               |   | ---                 | No  | OK         | OK                       | OK                         | No     | No                        |                    |

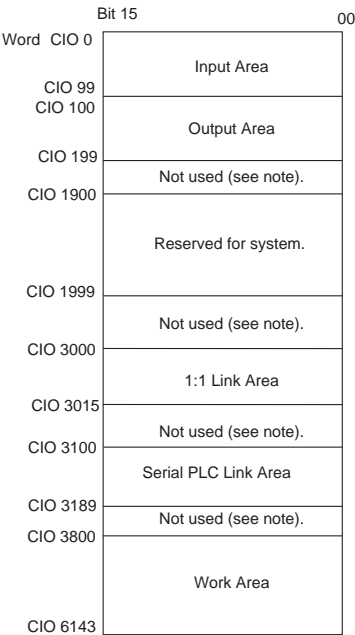
- Note**
1. A0 to A447 are read only and cannot be written. A448 to A959 are read/write.
  2. Bits can be manipulated using TST(350), TSTN(351), SET, SETB(532), RSTB(533), and OUTB(534).

- 3. Index registers and data registers can be used either individually by task or they can be shared by all the tasks (the default is individual use by task).
- 4. Timer PVs can be refreshed indirectly by force-setting/resetting the Timer Completion Flags.
- 5. Counter PVs can be refreshed indirectly by force-setting/resetting the Counter Completion Flags.
- 6. H512 to H1535 are used as a Function Block Holding Area. These words can be used only for function block instances (internally allocated variable area).
- 7. Data Memory Area for CPU Units with 20 I/O Points: D0 to D9999 and D32000 to D32767.

4-1-2 Overview of the Data Areas

■ CIO Area

It is not necessary to input the “CIO” acronym when specifying an address in the CIO Area. The CIO Area is generally used for data exchanges, such as I/O refreshing with PLC Units. Words that are not allocated to Units may be used as work words and work bits in the program.



**Note** The parts of the CIO Area that are labelled “not used” may be used in programming as work bits. In the future, however, unused CIO Area bits may be used when expanding functions. Always use Work Area bits first.

I/O Area (Inputs: CIO 0 to CIO 99, Outputs: CIO 100 to CIO 199)

These words are allocated to built-in I/O terminals of CP1L-EL/EM CPU Units and CP-series Expansion Units or Expansion I/O Units. Input words and output bits that aren’t allocated may be used in programming.

**1:1 Link Area**

These bits are used by the 1:1 Link Master and Slave. They are used for data links between CP1L-EL/EM CPU Units and CPM2□ CPU Units.

**Serial PLC Link Area**

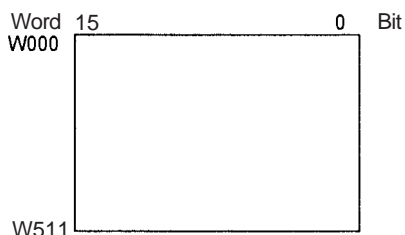
These words are allocated for use for data links (Serial PLC Links) with other CP1L-EL/EM CPU Units or CP1H CPU Units. Addresses not used for Serial PLC Links can be used in programming.

**Internal I/O Area**

These words can be used in programming; they cannot be used for I/O exchange with external I/O terminals. Be sure to use the work words provided in the Work Area before using words in the Internal I/O Area or other unused words in the CIO Area. It is possible that these words will be assigned to new functions in future versions of the CPU Units. The parts of the CIO Area that are labelled "Not used" are functionally identical to the Internal I/O Area.

**Work Area (W)**

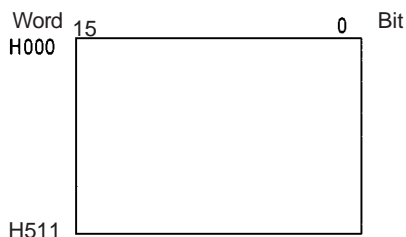
Words in the Work Area can be used in programming; they cannot be used for I/O exchange with external I/O terminals. Use this area for work words and bits before any words in the CIO Area.



**Note** These words should be used first in programming before assigned to new functions in future versions of CP1L-EL/EM CPU Units.

**Holding Area (H)**

Words in the Holding Area can be used in programming. These words retain their content when the PLC is turned ON or the operating mode is switched between PROGRAM mode and RUN or MONITOR mode.

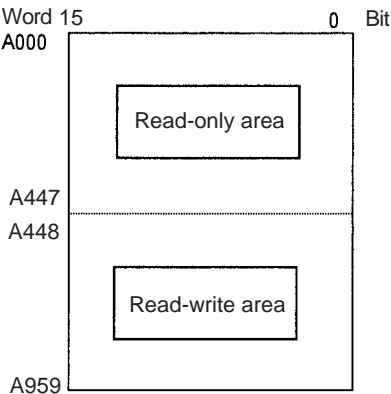


**Note** H512 to H1535 are used as a Function Block Holding Area. These words can be used only for function block instances (internally allocated variable area). These words cannot be specified as instruction operands in the user program.



Auxiliary Area (A)

These words are allocated to specific functions in the system.  
Refer to *Appendix C Auxiliary Area Allocations by Function* and *Appendix D Auxiliary Area Allocations by Address* for details on the Auxiliary Area.

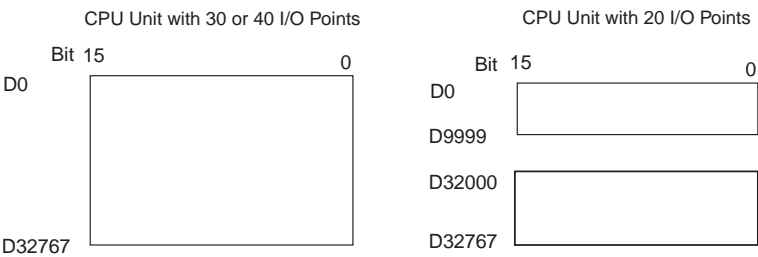


Temporary Relay Area (TR)

The TR Area contains bits that record the ON/OFF status of program branches. Refer to the *CP1H/CP1L Programming Manual* for details.

Data Memory Area (D)

The DM Area is a multi-purpose data area that is normally accessed only in word-units. These words retain their content when the PLC is turned ON or the operating mode is switched between PROGRAM mode and RUN or MONITOR mode.



Timer Area (T)

There are two parts to the Timer Area: the Timer Completion Flags and the timer Present Values (PVs). Up to 4,096 timers with timer numbers T0 to T4095 can be used.

**Timer Completion Flags**

These flags are read as individual bits. A Completion Flag is turned ON by the system when the corresponding timer times out (i.e., when the set time elapses).

**Timer PVs**

The PVs are read and written as words (16 bits). The PVs count up or down as the timer operates.

Counter Area (C)

There are two parts to the Counter Area: the Counter Completion Flags and the Counter Present Values (PVs). Up to 4,096 counters with counter numbers C0 to C4095 can be used.

**Counter Completion Flags**

These flags are read as individual bits. A Completion Flag is turned ON by the system when the corresponding counter counts out (i.e., when the set value is reached).

**Counter PVs**

The PVs are read and written as words (16 bits). The PVs count up or down as the counter operates.

**Condition Flags**

These flags include the Arithmetic Flags, such as the Error Flag and Equals Flag, which indicate the results of instruction execution as well as the Always ON and Always OFF Flags. The Condition Flags are specified with symbols rather than addresses.

**Clock Pulses**

The Clock Pulses are turned ON and OFF by the CPU Unit's internal timer. These bits are specified with symbols rather than addresses.

**Task Flag Area (TK)**

A Task Flag will be ON when the corresponding cyclic task is in executable (RUN) status and OFF when the cyclic task hasn't been executed (INI) or is in standby (WAIT) status.

**Index Registers (IR)**

Index registers (IR0 to IR15) are used to store PLC memory addresses (i.e., absolute memory addresses in RAM) to indirectly address words in I/O memory. The Index Registers can be used separately in each task or they can be shared by all tasks.

**Data Registers (DR)**

Data registers (DR0 to DR15) are used together with Index Registers. When a Data Register is input just before an Index Register, the content of the Data Register is added to the PLC memory address in the Index Register to offset that address. The Data Registers can be used separately in each task or they can be shared by all tasks.

**4-1-3 Clearing and Holding I/O Memory**

| Area                         |                     | Mode changed <sup>1</sup>            |                 | Fatal error generated |                 |                    |                 | PLC power turned ON                                     |                 |  |                 |
|------------------------------|---------------------|--------------------------------------|-----------------|-----------------------|-----------------|--------------------|-----------------|---|-----------------|--|-----------------|
|                              |                     |                                      |                 | Execution of FALS     |                 | Other fatal errors |                 | PLC Setup set to clear IOM Hold Bit status <sup>2</sup> |                 | PLC Setup set to hold IOM Hold Bit status <sup>2</sup> |                 |
|                              |                     | IOM Hold Bit OFF                     | IOM Hold Bit ON | IOM Hold Bit OFF      | IOM Hold Bit ON | IOM Hold Bit OFF   | IOM Hold Bit ON | IOM Hold Bit OFF  | IOM Hold Bit ON | IOM Hold Bit OFF                                       | IOM Hold Bit ON |
| CIO Area                     | I/O Area            | Cleared                              | Retained        | Retained              | Retained        | Cleared            | Retained        | Cleared   | Cleared         | Cleared  | Retained        |
|                              | Serial PC Link Area |                                      |                 |                       |                 |                    |                 |   |                 |  |                 |
|                              | Internal I/O Area   |                                      |                 |                       |                 |                    |                 |   |                 |  |                 |
| Work Area (W)                |                     | Cleared                              | Retained        | Retained              | Retained        | Cleared            | Retained        | Cleared   | Cleared         | Cleared  | Retained        |
| Holding Area (H)             |                     | Retained                             | Retained        | Retained              | Retained        | Retained           | Retained        | Retained  | Retained        | Retained   | Retained        |
| Auxiliary Area (A)           |                     | Status treatment depends on address. |                 |                       |                 |                    |                 |   |                 |  |                 |
| Data Memory Area (D)         |                     | Retained                             | Retained        | Retained              | Retained        | Retained           | Retained        | Retained  | Retained        | Retained   | Retained        |
| Timer Completion Flags (T)   |                     | Cleared                              | Retained        | Retained              | Retained        | Cleared            | Retained        | Cleared   | Cleared         | Cleared  | Retained        |
| Timer PVs (T)                |                     | Cleared                              | Retained        | Retained              | Retained        | Cleared            | Retained        | Cleared   | Cleared         | Cleared  | Retained        |
| Counter Completion Flags (C) |                     | Retained                             | Retained        | Retained              | Retained        | Retained           | Retained        | Retained  | Retained        | Retained   | Retained        |
| Counter PVs (C)              |                     | Retained                             | Retained        | Retained              | Retained        | Retained           | Retained        | Retained  | Retained        | Retained   | Retained        |
| Task Flags (TK)              |                     | Cleared                              | Cleared         | Retained              | Retained        | Cleared            | Cleared         | Cleared   | Cleared         | Cleared  | Cleared         |
| Index Registers (IR)         |                     | Cleared                              | Retained        | Retained              | Retained        | Cleared            | Retained        | Cleared   | Cleared         | Cleared  | Retained        |
| Data Registers (DR)          |                     | Cleared                              | Retained        | Retained              | Retained        | Cleared            | Retained        | Cleared   | Cleared         | Cleared  | Retained        |

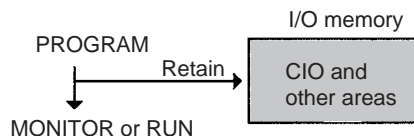
- Note**
1. Mode changed from PROGRAM to RUN/MONITOR or vice-versa.
  2. The PLC Setup's *IOM Hold Bit Status at Startup* setting determines whether the IOM Hold Bit's status is held or cleared when the PLC is turned ON.

## 4-1-4 Hot Start/Hot Stop Functions

### Operating Mode Changes

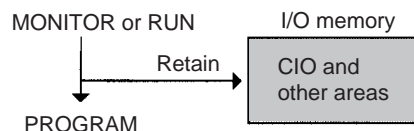
#### Hot Start

Turn ON the IOM Hold Bit to retain all data\* in I/O memory when the CPU Unit is switched from PROGRAM mode to RUN/MONITOR mode to start program execution.



#### Hot Stop

When the IOM Hold Bit is ON, all data\* in I/O memory will also be retained when the CPU Unit is switched from RUN or MONITOR mode to PROGRAM mode to stop program execution.



**Note** \*The following areas of I/O memory will be cleared during mode changes (between PROGRAM and RUN/MONITOR) unless the IOM Hold Bit is ON: the CIO Area (I/O Area, Data Link Area and Internal I/O Areas), Work Area, Timer Completion Flags, and Timer PVs.

#### Auxiliary Area Flags and Words

| Name         | Address | Description   |
|--------------|---------|---|
| IOM Hold Bit | A500.12 | Specifies whether the I/O memory will be retained or not when the CPU Unit operating mode is changed (between PROGRAM and RUN/MONITOR) or when the power is cycled.<br><br>OFF: I/O memory is cleared to 0 when the operating mode is changed.<br><br>ON: I/O memory is retained when the operating mode is changed between PROGRAM and RUN or MONITOR. |

When the IOM Hold Bit is ON, all outputs from Output Units will be maintained when program execution stops. When the program starts again, outputs will have the same status that they had before the program was stopped and instructions will be executed. (When the IOM Hold Bit is OFF, instructions will be executed after the outputs have been cleared.)

### PLC Power ON

In order for all data\* in I/O memory to be retained when the PLC is turned ON, the IOM Hold Bit must be ON and it must be protected in the PLC Setup using the *IOM Hold Bit Status at Startup* parameter.



**Auxiliary Area Flags and Words**

| Name         | Address | Description   |
|--------------|---------|---|
| IOM Hold Bit | A500.12 | Specifies whether the I/O memory will be retained or not when the CPU Unit operating mode is changed (between PROGRAM and RUN/MONITOR) or when the power is cycled.<br><br>OFF: I/O memory is cleared to 0 when the operating mode is changed.<br><br>ON: I/O memory is retained when the operating mode is changed between PROGRAM and RUN or MONITOR. |

**PLC Setup**

| Name                           | Description  | Setting   | Default       |
|--------------------------------|--|---|---------------|
| IOM Hold Bit Status at Startup | To retain all data in I/O memory when the PLC is turned ON, set the <i>IOM Hold Bit at startup</i> parameter to hold the status of the I/O Hold Bit. | OFF: The IOM Hold Bit is cleared to 0 when power is cycled.<br><br>ON: The status of the IOM Hold Bit is retained when power is cycled. | OFF (Cleared) |

**4-2 I/O Area and I/O Allocations**

**Input Bits:** CIO 0.00 to CIO 99.15 (100 words)

**Output Bits:** CIO 100.00 to CIO 199.15 (100 words)

The starting words for inputs and outputs are predetermined for CP1L-EL/EM CPU Unit. Input bits in CIO 0 and CIO 1 and output bits in CIO 100 and CIO 101 are automatically allocated to the built-in I/O on the CPU Unit. CP-series Expansion Units and CP-series Expansion I/O Units are automatically allocated input bits in words starting from CIO 2 and output bits in words starting from CIO 102.

- Allocated Words and Number of Expansion Units and Expansion I/O Units

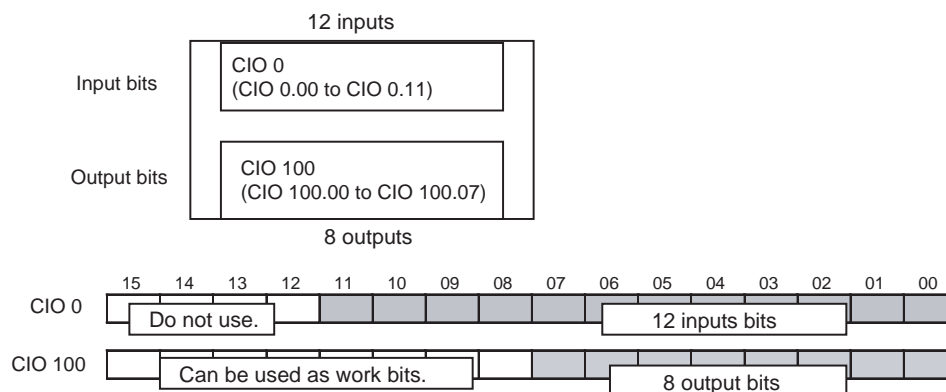
| CPU Unit                    | Allocated words |                     | Number of Expansion Units and Expansion I/O Units connected |
|-----------------------------|-----------------|---------------------|---|
|                             | Input bits      | Output bits         |   |
| CPU Unit with 20 I/O points | CIO 0           | CIO 100             | 1   |
| CPU Unit with 30 I/O points | CIO 0 and CIO 1 | CIO 100 and CIO 101 | 3   |
| CPU Unit with 40 I/O points | CIO 0 and CIO 1 | CIO 100 and CIO 101 | 3   |

For example, with a CPU Unit with 40 I/O points, the input bits in CIO 0 and CIO 1 and the outputs bits in CIO 100 and CIO 101 would be allocated to the built-in I/O of the CPU Unit. Input bits in CIO 2 and higher and outputs bits in CIO 102 and higher would be automatically allocated in order to any Expansion Units or Expansion I/O Units connected to the CPU Unit.

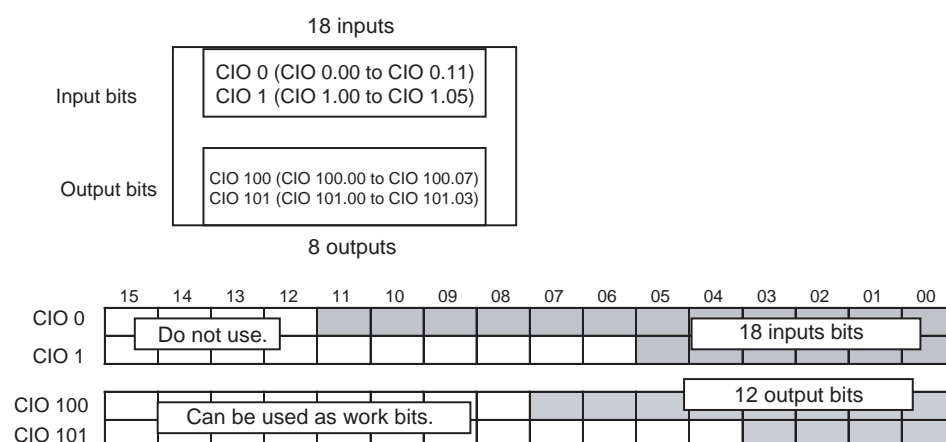
When the power to the CPU Unit is turned ON, the CPU Unit checks for any Expansion Units and Expansion I/O Units connected to it and automatically allocates I/O bits. If the order in which the Units are connected is changed, the the bits used in the ladder program will no longer match the bits allocated to the actual Units. Always review the ladder program whenever changing the order in which Units are connected.

## 4-2-1 I/O Bits Allocated to CPU Units

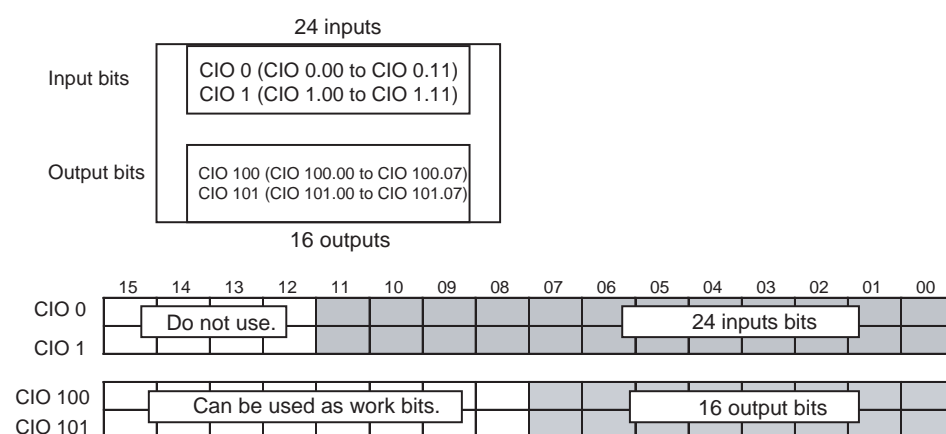
### CPU Unit with 20 I/O Points



### CPU Unit with 30 I/O Points



### CPU Unit with 40 I/O Points



For a CPU Unit with 40 I/O points (shown above), a total of 24 input bits are allocated to the input terminal block. The bits that are allocated are input bits CIO 0.00 to CIO 0.11 (i.e., bits 00 to 11 in CIO 0) and input bits CIO 1.00 to CIO 1.11 (i.e., bits 00 to 11 in CIO 1).

In addition, a total of 16 output bits are allocated to the output terminal block. The bits that are allocated are output bits CIO 100.00 to CIO 100.07 (i.e., bits 00 to 07 in CIO 0) and output bits CIO 101.00 to CIO 101.07 (i.e., bits 00 to 07 in CIO 1).

The upper bits (bits 12 to 15) not used in the input words cannot be used as work bits. Only the bits not used in the output words can be used as work bits.

#### 4-2-2 I/O Bits Allocated to Expansion I/O Units

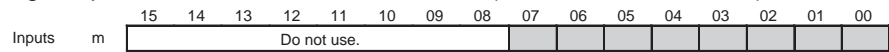
There are Expansion I/O Units for expanding inputs, for expanding outputs, and for expanding both input and outputs. I/O bits starting from bit 00 in the next word after the word allocated to the previous Expansion Unit, Expansion I/O Unit, or CPU Unit are automatically allocated. This word is indicated as "CIO m" for input words and as "CIO n" for output words.

| Unit                 |                      |             | Input bits  |              |  | Output bits |              |  |
|----------------------|----------------------|-------------|-------------|--------------|--|-------------|--------------|--|
|                      |                      |             | No. of bits | No. of words | Addresses  | No. of bits | No. of words | Addresses  |
| Unit with 8 inputs   |                      | CP1W-8ED    | 8 bits      | 1 word       | CIO m (bits 00 to 07)                            | ---         | None         | None   |
| Unit with 8 outputs  | Relays               | CP1W-8ER    | ---         | None         | None   | 8 bits      | 1 word       | CIO n (bits 00 to 07)  |
|                      | Sinking transistors  | CP1W-8ET    | ---         | None         | None   | 8 bits      | 1 word       | CIO n (bits 00 to 07)  |
|                      | Sourcing transistors | CP1W-8ET1   | ---         | None         | None   | 8 bits      | 1 word       | CIO n (bits 00 to 07)  |
| Unit with 16 outputs | Relays               | CP1W-16ER   | ---         | None         | None   | 16 bits     | 2 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)   |
|                      | Sinking transistors  | CP1W-16ET   | ---         | None         | None   | 16 bits     | 2 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)   |
|                      | Sourcing transistors | CP1W-16ET1  | ---         | None         | None   | 16 bits     | 2 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)   |
| Unit with 20 I/O     | Relays               | CP1W-20EDR1 | 12 bits     | 1 word       | CIO m (bits 00 to 11)                            | 8 bits      | 1 word       | CIO n (bits 00 to 07)  |
|                      | Sinking transistors  | CP1W-20EDT  | 12 bits     | 1 word       | CIO m (bits 00 to 11)                            | 8 bits      | 1 word       | CIO n (bits 00 to 07)  |
|                      | Sourcing transistors | CP1W-20EDT1 | 12 bits     | 1 word       | CIO m (bits 00 to 11)                            | 8 bits      | 1 word       | CIO n (bits 00 to 07)  |
| Unit with 32 outputs | Relays               | CP1W-32ER   | ---         | None         | None   | 32 bits     | 4 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)<br>CIO n+2 (bits 00 to 07)<br>CIO n+3 (bits 00 to 07) |
|                      | Sinking transistors  | CP1W-32ET   | ---         | None         | None   | 32 bits     | 4 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)<br>CIO n+2 (bits 00 to 07)<br>CIO n+3 (bits 00 to 07) |
|                      | Sourcing transistors | CP1W-32ET1  | ---         | None         | None   | 32 bits     | 4 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)<br>CIO n+2 (bits 00 to 07)<br>CIO n+3 (bits 00 to 07) |
| Unit with 40 I/O     | Relays               | CP1W-40EDR  | 24 bits     | 2 words      | CIO m (bits 00 to 11)<br>CIO m+1 (bits 00 to 11) | 16 bits     | 2 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)   |
|                      | Sinking transistors  | CP1W-40EDT  | 24 bits     | 2 words      | CIO m (bits 00 to 11)<br>CIO m+1 (bits 00 to 11) | 16 bits     | 2 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)   |
|                      | Sourcing transistors | CP1W-40EDT1 | 24 bits     | 2 words      | CIO m (bits 00 to 11)<br>CIO m+1 (bits 00 to 11) | 16 bits     | 2 words      | CIO n (bits 00 to 07)<br>CIO n+1 (bits 00 to 07)   |

### ■ I/O Bit Addresses

#### Units 8 Input Points (CP1W-8ED)

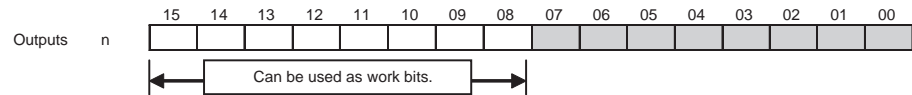
Eight input bits are allocated in one word (bits 00 to 07 in CIO m).



Only one word (8 bits) is allocated to an 8-input Expansion Input Unit. No output words are allocated. Input bits 08 to 15 are always cleared by the system and cannot be used as work bits.

#### Units with 8 Output Points (CP1W-8E□□)

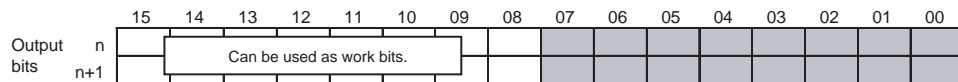
Eight output bits are allocated in one word (bits 00 to 07 in CIO n+1).



Only one word (8 bits) is allocated to an 8-output Expansion Output Unit. No input words are allocated. Output bits 08 to 15 can be used as work bits.

#### Units with 16 Output Points (CP1W-16E□□)

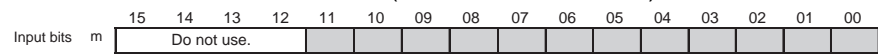
Sixteen output bits in two words are allocated in two words (bits 00 to 07 in CIO n and bits 00 to 07 in CIO n+1).



Two words (16 bits) are allocated to a 16-output Expansion Output Unit. No input words are allocated. Output bits 08 to 15 can be used as work bits.

#### Units with 20 I/O Points (CP1W-20ED□□)

Twelve input bits are allocated in one word (bits 00 to 11 in CIO m). Eight output bits are allocated in one word (bits 00 to 07 in CIO n).

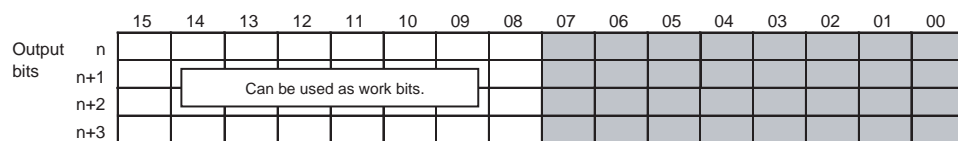


One input word (12 bits) and one output word (8 bits) are allocated for a 20-point Expansion I/O Unit.

Input bits 12 to 15 are always cleared by the system and cannot be used as work bits. Output bits 08 to 15, however, can be used as work bits.

#### Units with 32 Output Points (CP1W-32E□□)

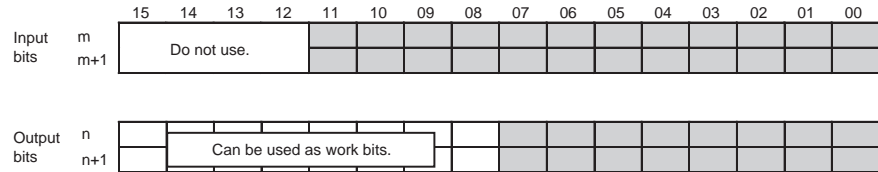
Thirty-two output bits are allocated in four words (bits 00 to 07 in CIO n, bits 00 to 07 in CIO n+1, bits 00 to 07 in CIO n+2 and bits 00 to 07 in CIO n+3).



Four words (32 bits) are allocated to a 32-output Expansion Output Unit. No input words are allocated. Output bits 08 to 15 can be used as work bits.

**Units with 40 I/O Points (CP1W-40ED□□)**

Twenty-four input bits in two words are allocated (bits 00 to 11 in CIO m and bits 00 to 11 CIO m+1). Sixteen output bits in two words are allocated (bits 00 to 07 in CIO n and bits 00 to 07 in CIO n+1).

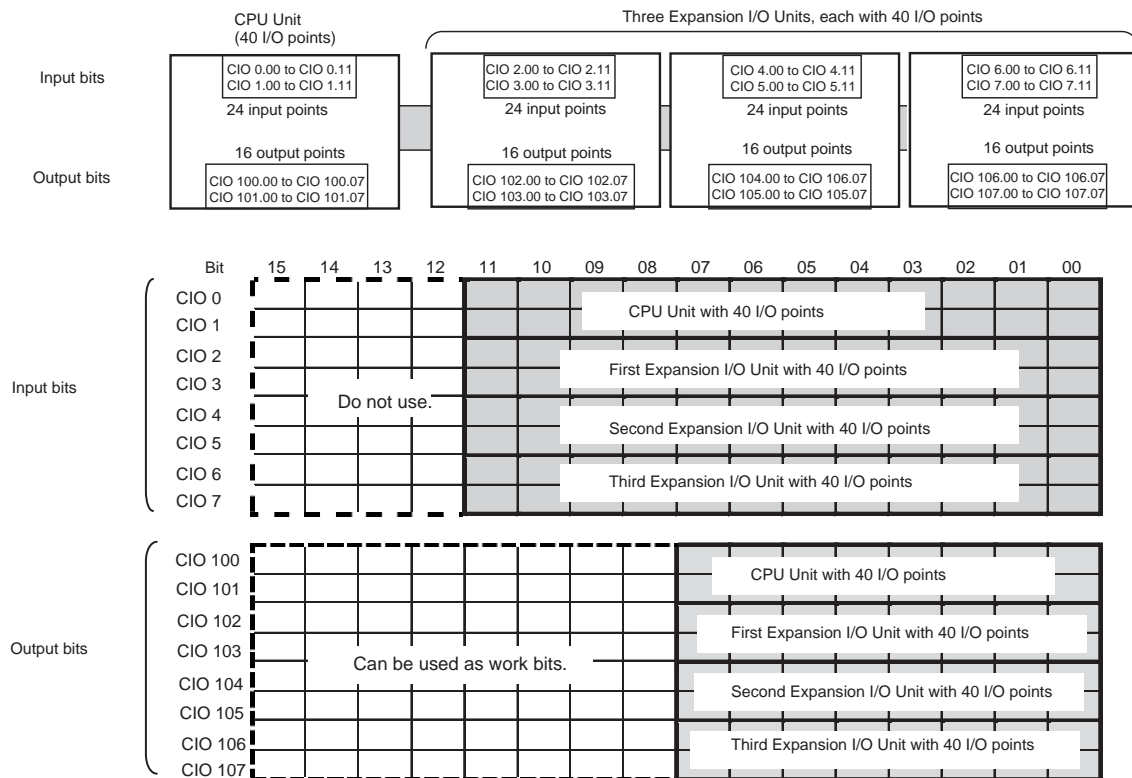


Two input words (24 bits) and two output words (16 bits) are allocated to a 40-point Expansion I/O Unit. Input bits 12 to 15 cannot be used as work bits. Output bits 08 to 15, however, can be used as work bits.

**4-2-3 I/O Allocation Examples with Expansion I/O Units****Example 1: Maximum I/O Capacity**

The configuration shown in this example is for the maximum I/O capacity. It consists of a CPU Unit with 40 I/O points and three Expansion I/O Units, each with 40 I/O points. Up to three Expansion I/O Units can be connected to a CPU Unit with either 30 or 40 I/O points.

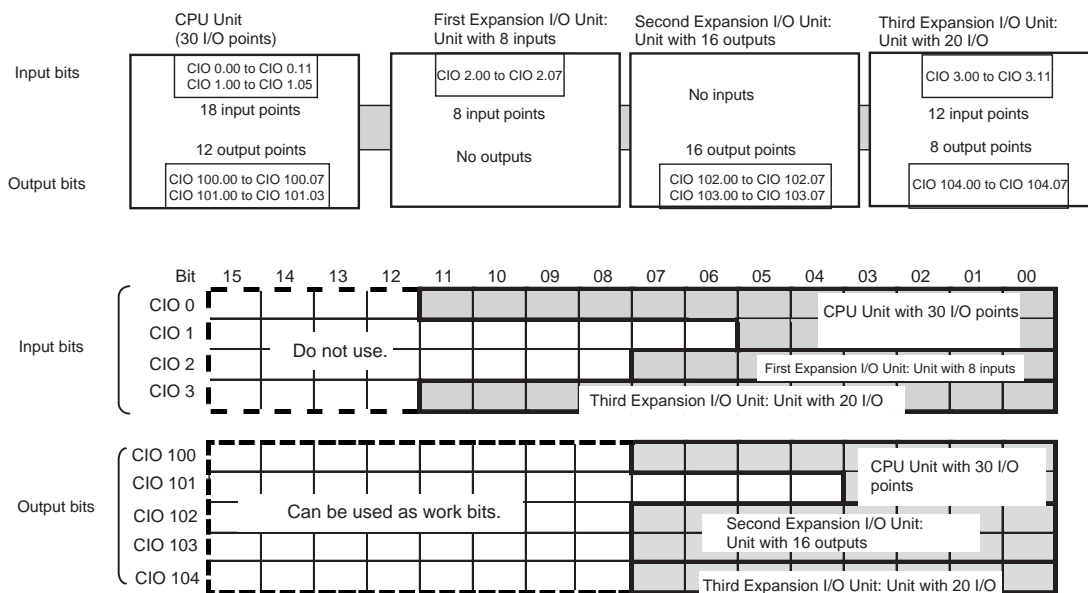
When Expansion I/O Units with 40 I/O points are connected, control is possible for up to 160 I/O points, including 96 inputs and 64 outputs.





### Example 2: Connecting Expansion I/O Units with Only Inputs or Only Outputs

If Expansion I/O Units with only inputs or only outputs are connected, the input or output word not used by an Expansion I/O Unit is allocated to the next Unit that requires it.



#### 4-2-4 I/O Word Allocations to Expansion Units

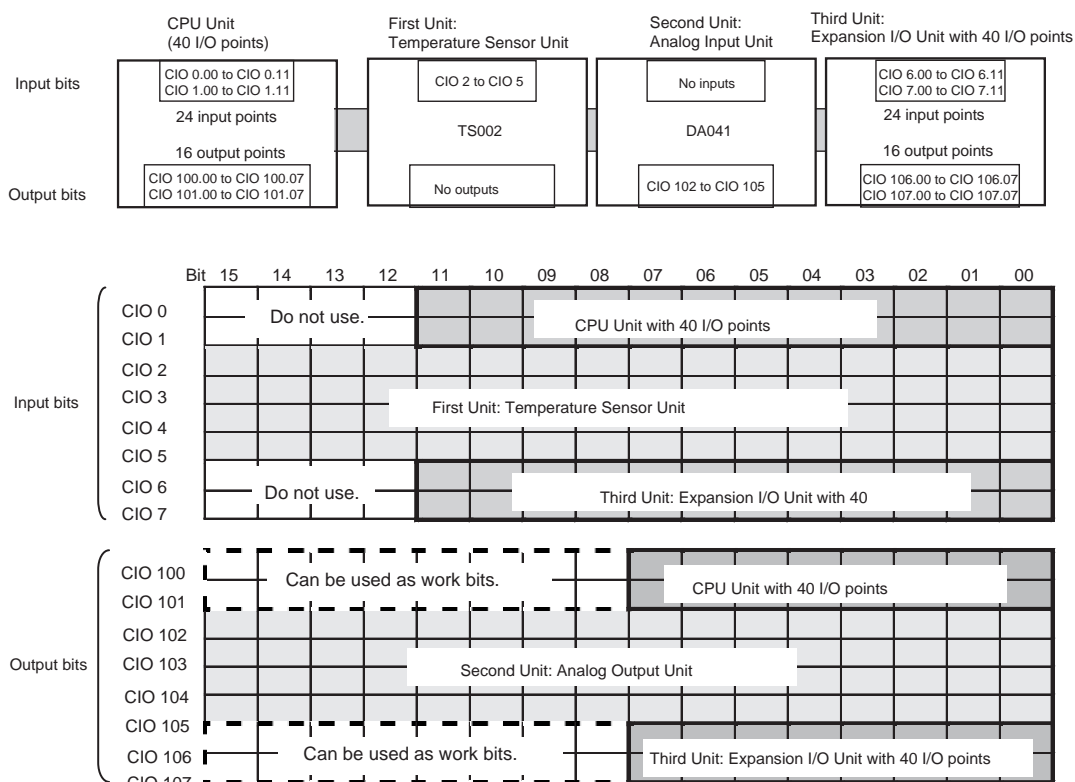
| Unit                      |            | Input words |                  | Output words |                  |
|---------------------------|------------|-------------|------------------|--------------|------------------|
| Analog I/O Units          | CP1W-MAD11 | 2 words     | CIO m to CIO m+1 | 1 word       | CIO n            |
|                           | CP1W-MAD42 | 4 words     | CIO m to CIO m+3 | 2 words      | CIO n to CIO n+1 |
|                           | CP1W-MAD44 | 4 words     | CIO m to CIO m+3 | 4 words      | CIO n to CIO n+3 |
| Analog Input Units        | CP1W-AD041 | 4 words     | CIO m to CIO m+3 | 2 words      | CIO n to CIO n+1 |
|                           | CP1W-AD042 |             |                  |              |                  |
| Analog Output Units       | CP1W-DA021 | None        | ---              | 2 words      | CIO n to CIO n+1 |
|                           | CP1W-DA041 | None        | ---              | 4 words      | CIO n to CIO n+3 |
|                           | CP1W-DA042 |             |                  |              |                  |
| Temperature Sensor Units  | CP1W-TS001 | 2 words     | CIO m to CIO m+1 | None         | ---              |
|                           | CP1W-TS002 | 4 words     | CIO m to CIO m+3 | None         | ---              |
|                           | CP1W-TS003 | 4 words     | CIO m to CIO m+3 | None         | ---              |
|                           | CP1W-TS004 | 2 words     | CIO m to CIO m+1 | 1 word       | CIO n            |
|                           | CP1W-TS101 | 2 words     | CIO m to CIO m+1 | None         | ---              |
|                           | CP1W-TS102 | 4 words     | CIO m to CIO m+3 | None         | ---              |
| CompoBus/S I/O Link Units | CP1W-SRT21 | 1 word      | CIO m            | 1 word       | CIO n            |

m: Indicates the next input word after the input word allocated to the Expansion Unit, Expansion I/O Unit, or CPU Unit to the left of the current Unit.

n: Indicates the next output word after the output word allocated to the Expansion Unit, Expansion I/O Unit, or CPU Unit to the left of the current Unit.

### ■ I/O Word Allocations to Expansion Units

#### CPU Unit with 40 I/O Points + TS002 + DA041 + 40ED

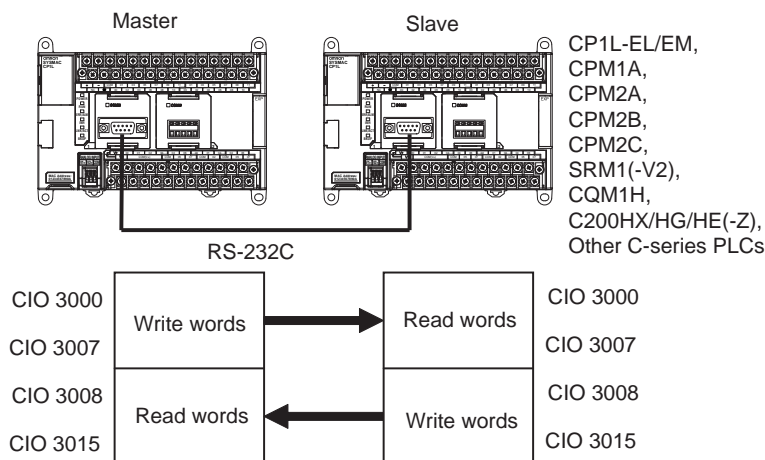


## 4-3 1:1 Link Area

The 1:1 Link Area contains 256 bits (16 words) with addresses ranging from CIO 3000.00 to CIO 3015.15 (CIO 3000 to CIO 3015).

These bits are used to create 1:1 links (i.e., shared data link areas) by connecting the RS-232C ports of two PLCs, including the CP1L-EL/EM, CPM1A, CPM2A, CPM2B, CPM2C, SRM1(-V2), CQM1H, and C200HX/HG/HE(-Z).

1:1 Links



Refer to 8-3-6 1:1 Links for information on using 1:1 links.

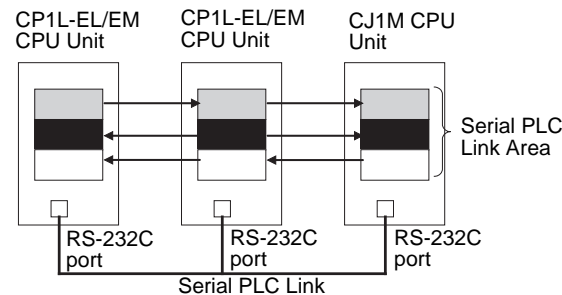
## 4-4 Serial PLC Link Area

The Serial PLC Link Area contains 1,440 bits (90 words) with addresses ranging from CIO 3100.00 to CIO 3189.15 (CIO 3100 to CIO 3189).

Words in the Serial PLC Link Area can be used for data links with other PLCs. Serial PLC Links exchange data among CPU Units via the built-in RS-232C ports, with no need for special programming.

The Serial PLC Link allocations are set automatically by means of the following PLC Setup in the Polling Unit.

- Serial PLC Link Mode
- Number of Serial PLC Link transfer words
- Maximum Serial PLC Link unit number



Addresses not used for Serial PLC Links can be used in programming, the same as the Work Area.

### Forcing Bit Status

Bits in the Serial PLC Link Area can be force-set and force-reset.

### Serial PLC Link Area Initialization

The contents of the Serial PLC Link Area will be cleared in the following cases:

1. When the operating mode is changed from PROGRAM mode to RUN/MONITOR mode or vice-versa and the IOM Hold Bit is OFF
2. When the power is cycled
3. When the Serial PLC Link Area is cleared from the CX-Programmer
4. When PLC operation is stopped when a fatal error other than an FALS(007) error occurs (The contents of the Serial PLC Link Area will be retained when FALS(007) is executed.)

## 4-5 Internal Work Area

The Internal Work Area contains 512 words with addresses ranging from W0 to W511. These words can be used in programming as work words.

There are unused words in the CIO Area (CIO 3800 to CIO 6143) that can also be used in the program, but use any available words in the Work Area first because the unused words in the CIO Area may be allocated to other applications when functions are expanded.

### Forcing Bit Status

Bits in the Work Area can be force-set and force-reset.

### Work Area Initialization

The contents of the Work Area will be cleared in the following cases:

1. When the operating mode is changed from PROGRAM to RUN or MONITOR mode or vice-versa and the IOM Hold Bit is OFF
2. When the power is cycled
3. When the Work Area is cleared from the CX-Programmer.
4. When PLC operation is stopped when a fatal error other than an FALS(007) error occurs. (The contents of the Work Area will be retained when FALS(007) is executed.)

## 4-6 Holding Area (H)

The Holding Area contains 512 words with addresses ranging from H0 to H511 (bits H0.00 to H511.15). These words can be used in programming.

### Holding Area Initialization

Data in the Holding Area is not cleared when the power is cycled or the PLC's operating mode is changed from PROGRAM mode to RUN or MONITOR mode or vice-versa.

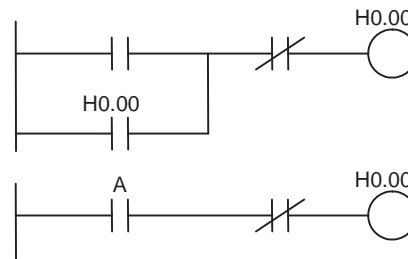
A Holding Area bit will be cleared if it is programmed between IL(002) and ILC(003) and the execution condition for IL(002) is OFF. To keep a bit ON even when the execution condition for IL(002) is OFF, turn ON the bit with the SET instruction just before IL(002).

### Self-maintaining Bits

When a self-maintaining bit is programmed with a Holding Area bit, the self-maintaining bit won't be cleared even when the power is reset.

#### Note

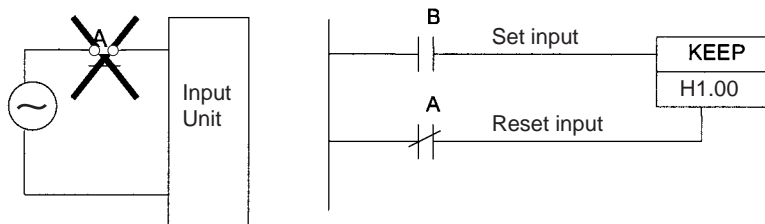
1. If a Holding Area bit is not used for the self-maintaining bit, the bit will be turned OFF and the self-maintaining bit will be cleared when the power is reset.
2. If a Holding Area bit is used but not programmed as a self-maintaining bit as in the following diagram, the bit will be turned OFF by execution condition A when the power is reset.



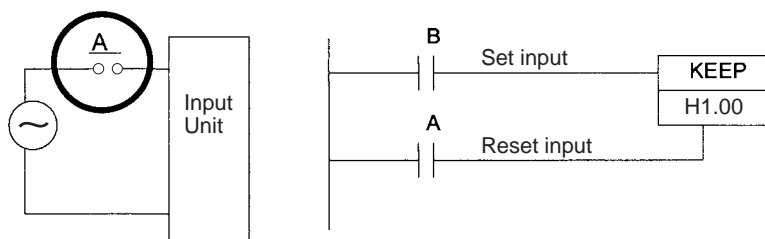
3. H512 to H1535 are used as a Function Block Holding Area. These words can be used only for function block instances (internally allocated variable area). These words cannot be specified as instruction operands in the user program.

### Precautions

When a Holding Area bit is used in a KEEP(011) instruction, never use a normally closed condition for the reset input if the input device uses an AC power supply. When the power supply goes OFF or is temporarily interrupted, the input will go OFF before the PLC's internal power supply and the Holding Area bit will be reset.



Instead, use a configuration like the one shown below.



There are no restrictions in the order of using bit address or in the number of N.C. or N.O. conditions that can be programmed.

## 4-7 Auxiliary Area (A)

The Auxiliary Area contains 960 words with addresses ranging from A0 to A959). These words are preassigned as flags and control bits to monitor and control operation.

A0 through A447 are read-only, but A448 through A959 can be read or written from the program or the CX-Programmer.

Refer to *Appendix C Auxiliary Area Allocations by Function* and *Appendix D Auxiliary Area Allocations by Address* for Auxiliary Area functions.

### Forcing Bit Status

Read/write bits in the Auxiliary Area cannot be force-set and force-reset continuously.

## 4-8 TR (Temporary Relay) Area

The TR Area contains 16 bits with addresses ranging from TR0 to TR15. These temporarily store the ON/OFF status of an instruction block for branching and are used only with mnemonics. TR bits are useful when there are several output branches and interlocks cannot be used.

The TR bits can be used as many times as required and in any order required as long as the same TR bit is not used twice in the same instruction block.

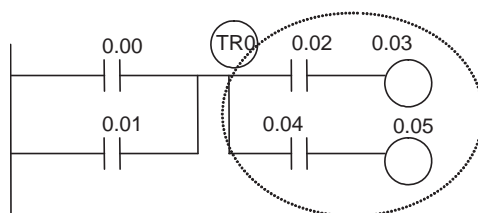
TR bits can be used only with the OUT and LD instructions. OUT instructions (OUT TR0 to OUT TR15) store the ON/OFF status of a branch point and LD instructions recall the stored ON/OFF status of the branch point.

### Forcing Bit Status

TR bits cannot be changed from the CX-Programmer.

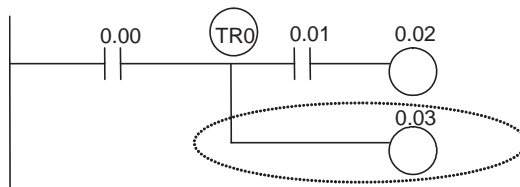
### Examples

In this example, a TR bit is used when two outputs have been directly connected to a branch point.



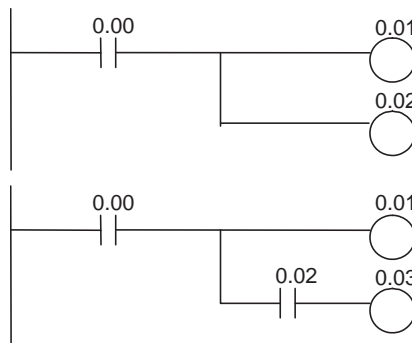
| Instruction | Operand |
|-------------|---------|
| LD          | 0.00    |
| OR          | 0.01    |
| OUT         | TR 0    |
| AND         | 0.02    |
| OUT         | 0.03    |
| LD          | TR 0    |
| AND         | 0.04    |
| OUT         | 0.05    |

In this example, a TR bit is used when an output is connected to a branch point without a separate execution condition.



| Instruction | Operand |
|-------------|---------|
| LD          | 0.00    |
| OUT         | TR 0    |
| AND         | 0.01    |
| OUT         | 0.02    |
| LD          | TR 0    |
| OUT         | 0.03    |

**Note** A TR bit is not required when there are no execution conditions after the branch point or there is an execution condition only in the last line of the instruction block.



| Instruction | Operand |
|-------------|---------|
| LD          | 0.00    |
| OUT         | 0.01    |
| OUT         | 0.02    |

| Instruction | Operand |
|-------------|---------|
| LD          | 0.00    |
| OUT         | 0.01    |
| AND         | 0.02    |
| OUT         | 0.03    |

## 4-9 Timers and Counters

### 4-9-1 Timer Area (T)

The 4,096 timer numbers (T0000 to T4095) are shared by the TIM, TIMX(550), TIMH(015), TIMHX(551), TMHH(540), TIMHHX(552), TTIM(087), TTIMX(555), TIMW(813), TIMWX(816), TMHW(815), and TIMHWX(817) instructions. Timer Completion Flags and present values (PVs) for these instructions are accessed with the timer numbers.

The TIML(542), TIMLX(553), MTIM(543), and MTIMX(554) instructions do not use timer numbers.

When a timer number is used in an operand that requires bit data, the timer number accesses the Completion Flag of the timer. When a timer number is used in an operand that requires word data, the timer number accesses the PV of the timer. Timer Completion Flags can be used as often as necessary as normally open and normally closed conditions and the values of timer PVs can be read as normal word data.

The refresh method for timer PVs can be set from the CX-Programmer to either BCD or binary.

**Note** It is not recommended to use the same timer number in two timer instructions because the timers will not operate correctly if they are timing simultaneously. (If two or more timer instructions use the same timer number, an error will be generated during the program check, but the timers will operate as long as the instructions are not executed in the same cycle.)

The following table shows when timers will be reset or maintained.

| Instruction name                            | Effect on PV and Completion Flag |                           |                         | Operation in Jumps and Interlocks                |   |
|---|----------------------------------|---------------------------|-------------------------|--|---|
|   | Mode change <sup>1</sup>         | PLC start-up <sup>2</sup> | CNR(545)/CN RX(547)     | Jumps (JMP-JME) or Tasks on standby <sup>4</sup> | Interlocks (IL-ILC)                     |
| TIMER: TIM/TIMX(550)                        | PV → 0<br>Flag → OFF             | PV → 0<br>Flag → OFF      | PV → 9999<br>Flag → OFF | PVs refreshed in operating timers                | PV → SV<br>(Reset to SV.)<br>Flag → OFF |
| HIGH-SPEED TIMER: TIMH(015)/TIMHX(551)      |                                  |                           |                         |  |   |
| ONE-MS TIMER: TMHH(540)/TMHHX(552)          |                                  |                           |                         |  |   |
| ACCUMULATIVE TIMER: TTIM(087)/TTIMX(555)    |                                  |                           |                         | PV Maintained                                    | PV Maintained                           |
| TIMER WAIT: TIMW(813)/TIMWX(816)            |                                  |                           |                         | PVs refreshed in operating timers                | ---                                     |
| HIGH-SPEED TIMER WAIT: TMHW(815)/TMHWX(817) |                                  |                           |                         |  | ---                                     |

- Note**
1. If the IOM Hold Bit (A500.12) is ON, the PV and Completion Flag will be retained when a fatal error occurs (including execution of FALS instructions) or the operating mode is changed from PROGRAM mode to RUN or MONITOR mode or vice-versa. The PV and Completion Flag will be cleared when power is cycled.
  2. If the IOM Hold Bit (A50012) is ON and the PLC Setup's *IOM Hold Bit Status at Startup* setting is set to protect the IOM Hold Bit, the PV and Completion Flag will be retained when the PLC's power is cycled.
  3. Since the TIML(542), TIMLX(553), MTIM(543), and MTIMX(554) instructions do not use timer numbers, they are reset under different conditions. Refer to the descriptions of these instructions for details.

4. The present value of TIM, TIMX(550), TIMH(015), TIMHX(551), TMHH(540), TMHHX(552), TIMW(813), TIMWX(816), TMHW(815) and TMHWX(817) timers programmed with timer numbers 0000 to 2047 will be updated even when jumped between JMP and JME instructions or when in a task that is on standby. The present value of timers programmed with timer numbers 2048 to 4095 will be held when jumped or when in a task that is on standby.

**Forcing Bit Status**

Timer Completion Flags can be force-set and force-reset.

Timer PVs cannot be force-set or force-reset, although the PVs can be refreshed indirectly by force-setting/resetting the Completion Flag.

**Restrictions**

There are no restrictions in the order of using timer numbers or in the number of N.C. or N.O. conditions that can be programmed. Timer PVs can be read as word data and used in programming.

**4-9-2 Counter Area (C)**

The 4,096 counter numbers (C0000 to C4095) are shared by the CNT, CNTX(546), CNTR(012), CNTRX(548), CNTW(814), and CNTWX(818) instructions. Counter Completion Flags and present values (PVs) for these instructions are accessed with the counter numbers.

When a counter number is used in an operand that requires bit data, the counter number accesses the Completion Flag of the counter. When a counter number is used in an operand that requires word data, the counter number accesses the PV of the counter.

The refresh method for counter PVs can be set from the CX-Programmer to either BCD or binary. (Refer to the previous page).

It is not recommended to use the same counter number in two counter instructions because the counters will not operate correctly if they are counting simultaneously. If two or more counter instructions use the same counter number, an error will be generated during the program check, but the counters will operate as long as the instructions are not executed in the same cycle.

The following table shows when counter PVs and Completion Flags will be reset.

| Instruction name                               | Effect on PV and Completion Flag |             |             |             |                     |                     |
|--|----------------------------------|-------------|-------------|-------------|---------------------|---------------------|
|  | Reset                            | Mode change | PLC startup | Reset Input | CNR(545)/CN RX(547) | Interlocks (IL-ILC) |
| COUNTER:<br>CNT/CNTX(546)                      | PV → 0<br>Flag → OFF             | Maintained  | Maintained  | Reset       | Reset               | Maintained          |
| REVERSIBLE<br>COUNTER:<br>CNTR(012)/CNTRX(548) |                                  |             |             |             |                     |                     |
| COUNTER WAIT:<br>CNTW(814)/CNTWX(818)          |                                  |             |             |             |                     |                     |

**Forcing Bit Status**

Counter Completion Flags can be force-set and force-reset.

Counter PVs cannot be force-set or force-reset, although the PVs can be refreshed indirectly by force-setting/resetting the Completion Flag.

**Restrictions**

There are no restrictions in the order of using counter numbers or in the number of N.C. or N.O. conditions that can be programmed. Counter PVs can be read as word data and used in programming.

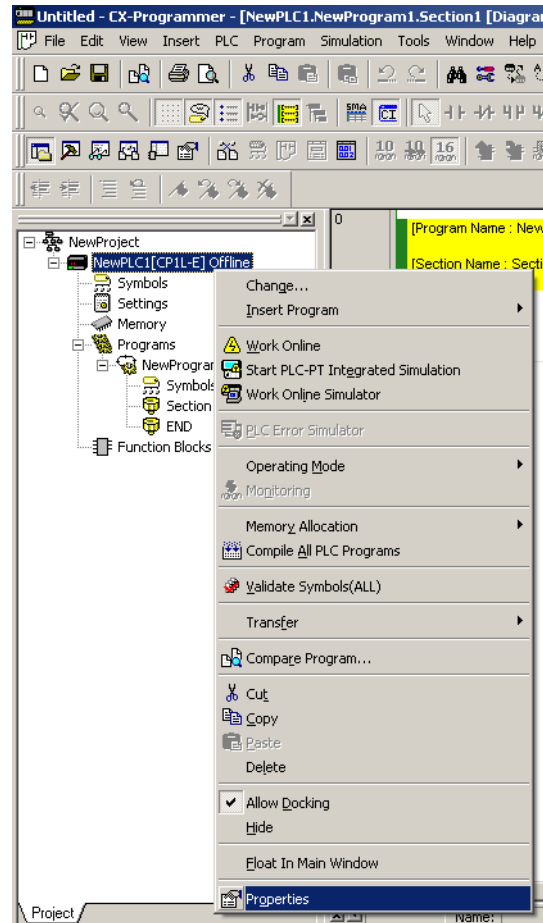


### 4-9-3 Changing the BCD or Binary Mode for Counters and Timers

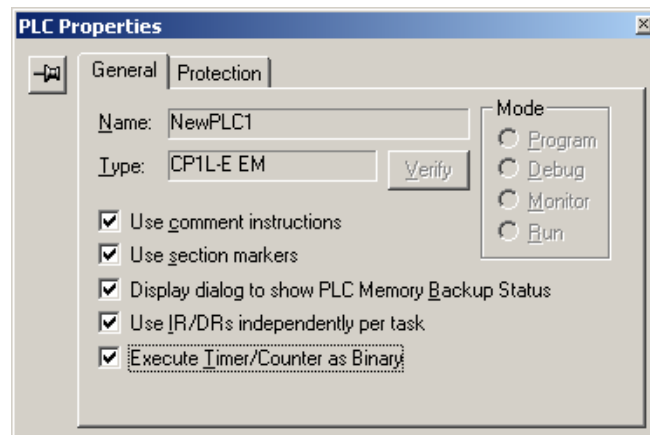
The refresh method for set values and present values for timers and counters can be changed from BCD mode (0000 to 9999) to binary method (0000 to FFFF) using the CX-Programmer

This setting is made in common for all tasks for all timers and counters.

1. Right-click **New PLC** in the project tree and select **Properties**.

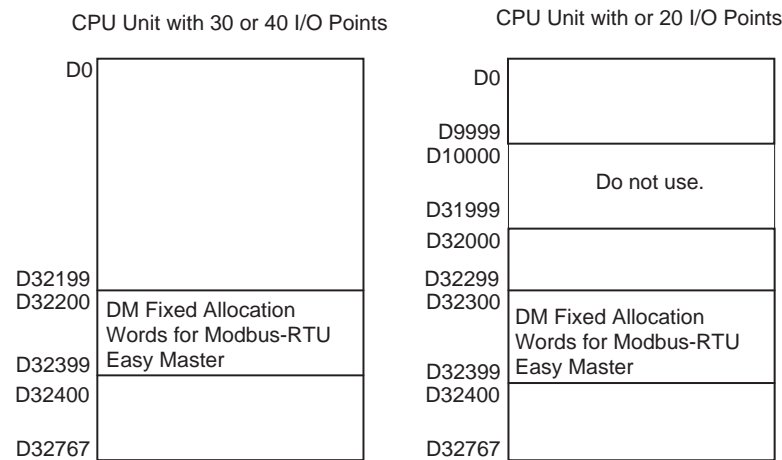


2. Select the *Execute Timer/Counter as Binary* Option in the PLC Properties Dialog Box. The timers and counters for all tasks will be executed in binary mode.



4-10 Data Memory Area (D)

CPU Units with 30 or 40 I/O points: D0 to D32767  
CPU Units with 20 I/O points: D0 to D9999 and D32000 to D32767



This data area is used for general data storage and manipulation and is accessible only by word.

Data in the DM Area is retained when the PLC's power is cycled or the PLC's operating mode is changed from PROGRAM mode to RUN/MONITOR mode or vice-versa.

Although bits in the DM Area cannot be accessed directly, the status of these bits can be accessed with the BIT TEST instructions, TST(350) and TSTN(351).

Forcing Bit Status

Bits in the DM Area cannot be force-set or force-reset.

Indirect Addressing

Words in the DM Area can be indirectly addressed in two ways: binary-mode and BCD-mode.

Binary-mode Addressing (@D)

When a "@" character is input before a DM address, the content of that DM word is treated as binary and the instruction will operate on the DM word at that binary address. The entire DM Area (D0 to D32767) can be indirectly addressed with hexadecimal values 0000 to 7FFF.



BCD-mode Addressing (\*D)

When a "\*" character is input before a DM address, the content of that DM word is treated as BCD and the instruction will operate on the DM word at that BCD address. Only part of the DM Area (D0 to D9999) can be indirectly addressed with BCD values 0000 to 9999.



**Note** (1) If an address between D10000 and D31999 is specified as an operand for a CPU Unit with 20 I/O Points, an illegal area access error will occur.

- (2) If two-word data is accessed from the last address in the DM Area (D9999 for the CP1L-EL20D□-□ and D32767 for other CPU Units), the Access Error Flag (P\_AER) will turn ON and the data at D9999 or D32767 will not be read or written.

#### DM Fixed Allocation Words for Modbus-RTU Easy Master

The following DM area words are used as command and response storage areas for the Modbus-RTU Easy Master function.

D32200 to D32299: Serial port 1 on CP1L CPU Unit with EM CPU type

D32300 to D32399: Serial port 2 on CP1L CPU Unit with EM CPU type and serial port 1 on CP1L CPU Unit with EL CPU type

For use of these areas, refer to 8-3-3 *Modbus-RTU Easy Master Function*.

## 4-11 Index Registers

The sixteen Index Registers (IR0 to IR15) are used for indirect addressing. Each Index Register can hold a single PLC memory address, which is the absolute memory address of a word in I/O memory. Use MOVR(560) to convert a regular data area address to its equivalent PLC memory address and write that value to the specified Index Register. (Use MOVW(561) to set the PLC memory address of a timer/counter PV in an Index Register.)

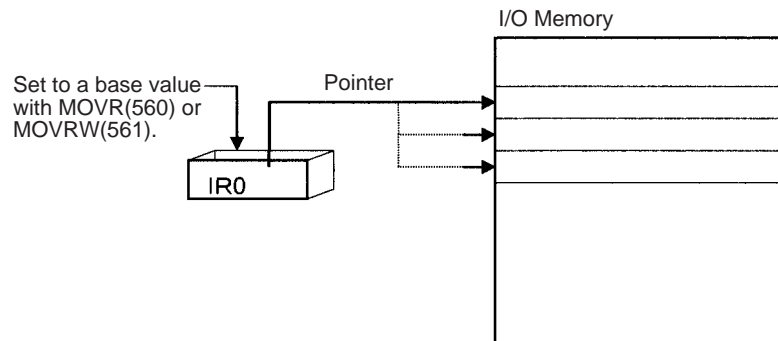
**Note** Refer to *Appendix E Memory Map* for more details on PLC memory addresses.

#### Indirect Addressing

When an Index Register is used as an operand with a “,” prefix, the instruction will operate on the word indicated by the PLC memory address in the Index Register, not the Index Register itself. Basically, the Index Registers are I/O memory pointers.

- All addresses in I/O memory (except Index Registers, Data Registers, and Condition Flags) can be specified seamlessly with PLC memory addresses. It isn't necessary to specify the data area. I/O memory addresses for IR, DR, and Condition Flags, however, cannot be held.
- In addition to basic indirect addressing, the PLC memory address in an Index Register can be offset with a constant or Data Register, auto-incremented, or auto-decremented. These functions can be used in loops to read or write data while incrementing or decrementing the address by one each time that the instruction is executed.

With the offset and increment/decrement variations, the Index Registers can be set to base values with MOVR(560) or MOVW(561) and then modified as pointers in each instruction.



**Note** (1) It is possible to specify regions outside of I/O memory and generate an Illegal Access Error when indirectly addressing memory with Index Registers. Refer to *Appendix E Memory Map* for details on the limits of PLC memory addresses.

- (2) When an Instruction Execution Error or an Illegal Access Error is generated during the execution of a certain instruction, the auto-increment/decrement for the rest Index Registers of the instruction will not execute.
- (3) An Illegal Access Error will be generated when indirectly addressing memory in D10000 to D31999 with Index Registers for CPU Units with 20 I/O Points.

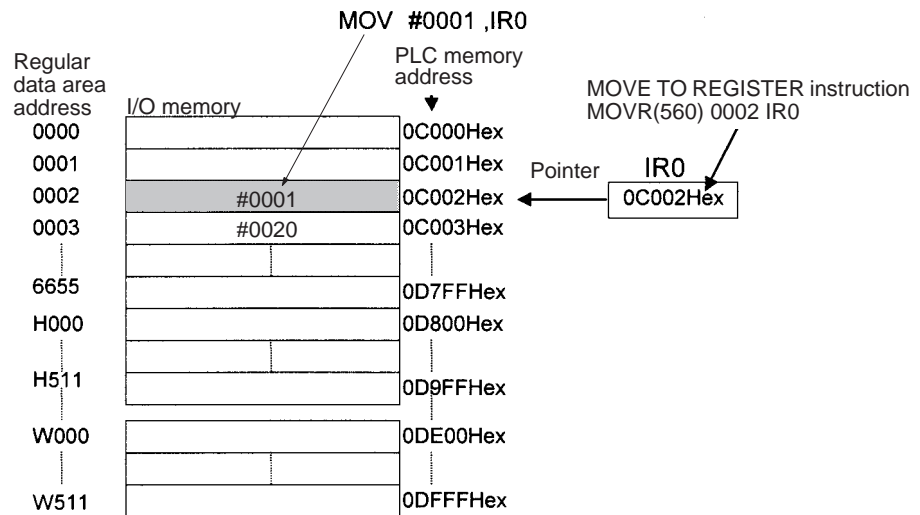
The following table shows the variations available when indirectly addressing I/O memory with Index Registers. (IR□ represents an Index Register from IR0 to IR15.)

| Variation                                | Function  | Syntax   | Example       |   |
|--|---|--|---------------|---|
| Indirect addressing                      | The content of IR□ is treated as the PLC memory address of a bit or word.   | ,IR□   | LD ,IR0       | Loads the bit at the PLC memory address contained in IR0.   |
| Indirect addressing with constant offset | The constant prefix is added to the content of IR□ and the result is treated as the PLC memory address of a bit or word.<br>The constant may be any integer from -2,048 to 2,047. | Constant ,IR□<br>(Include a + or - in the constant.)   | LD +5,IR0     | Adds 5 to the contents of IR0 and loads the bit at that PLC memory address.                           |
| Indirect addressing with DR offset       | The content of the Data Register is added to the content of IR□ and the result is treated as the PLC memory address of a bit or word.   | DR□,IR□  | LD<br>DR0,IR0 | Adds the contents of DR0 to the contents of IR0 and loads the bit at that PLC memory address.         |
| Indirect addressing with auto-increment  | After referencing the content of IR□ as the PLC memory address of a bit or word, the content is incremented by 1 or 2.  | Increment by 1:<br>,IR□+<br>Increment by 2:<br>,IR□++  | LD , IR0++    | Loads the bit at the PLC memory address contained in IR0 and then increments the content of IR0 by 2. |
| Indirect addressing with auto-decrement  | The content of IR□ is decremented by 1 or 2 and the result is treated as the PLC memory address of a bit or word.   | Decrement by 1:<br>,-IR□<br>Decrement by 2:<br>,- -IR□ | LD , - -IR0   | Decrement the content of IR0 by 2 and then loads the bit at that PLC memory address.                  |

**Example**

This example shows how to store the PLC memory address of a word (CIO 2) in an Index Register (IR0), use the Index Register in an instruction, and use the auto-increment variation.

|           |       |        |  |
|-----------|-------|--------|--|
| MOVR(560) | 2     | IR0    | Stores the PLC memory address of CIO 2 in IR0.                                 |
| MOV(021)  | #0001 | ,IR0   | Writes #0001 to the PLC memory address contained in IR0.                       |
| MOV(021)  | #0020 | +1,IR0 | Reads the content of IR0, adds 1, and writes #0020 to that PLC memory address. |



**Note** The PLC memory addresses are listed in the diagram above, but it isn't necessary to know the PLC memory addresses when using Index Registers.

Since some operands are treated as word data and others are treated as bit data, the meaning of the data in an Index Register will differ depending on the operand in which it is used.

**1,2,3...****1. Word Operand:**

```
MOVR(560)  0000    IR2
MOV(021)   D0      ,IR2
```

When the operand is treated as a word, the contents of the Index Register are used "as is" as the PLC memory address of a word.

In this example MOVR(560) sets the PLC memory address of CIO 2 in IR2 and the MOV(021) instruction copies the contents of D0 to CIO 2.

**2. Bit Operand:**

```
MOVR(560)  000013 ,IR2
SET        +5 ,IR2
```

When the operand is treated as a bit, the leftmost 7 digits of the Index Register specify the word address and the rightmost digit specifies the bit number. In this example, MOVR(560) sets the PLC memory address of CIO 13 (0C00D hex) in IR2. The SET instruction adds +5 from bit 13 (D hex) to this PLC memory address, so it turns ON bit CIO 1.02.

**Index Register Initialization**

The Index Registers will be cleared in the following cases:

1. When the operating mode is changed from PROGRAM to RUN or MONITOR mode or vice-versa
2. When the power is cycled

**Setting Index Registers**

Always set the required value in an index register before using it. The contents of an index register will be unpredictable if it is not set in advance.

The contents of an index register is also unpredictable after an interrupt task is started. When using index registers inside an interrupt task, use MOVR(560) (for anything but timer/counter PVs) or MOVW(561) (for timer/counter PVs) to set the required value.

**Direct Addressing**

When an Index Register is used as an operand without a “,” prefix, the instruction will operate on the contents of the Index Register itself (a two-word or “double” value). Index Registers can be directly addressed only in the instructions shown in the following table. Use these instructions to operate on the Index Registers as pointers.

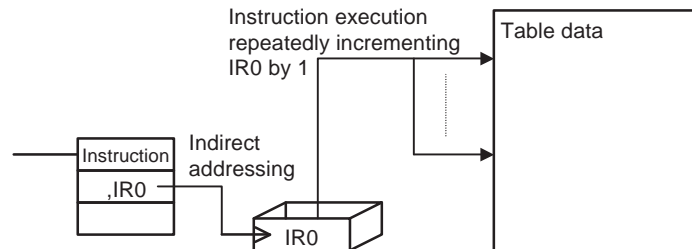
The Index Registers cannot be directly addressed in any other instructions, although they can usually be used for indirect addressing.

| Instruction group                  | Instruction name                            | Mnemonic  |
|------------------------------------|---|-----------|
| Data Movement Instructions         | MOVE TO REGISTER                            | MOVR(560) |
|                                    | MOVE TIMER/COUNTER PV TO REGISTER           | MOVW(561) |
|                                    | DOUBLE MOVE                                 | MOVL(498) |
|                                    | DOUBLE DATA EXCHANGE                        | XCGL(562) |
| Table Data Processing Instructions | SET RECORD LOCATION                         | SETR(635) |
|                                    | GET RECORD NUMBER                           | GETR(636) |
| Increment/Decrement Instructions   | DOUBLE INCREMENT BINARY                     | ++L(591)  |
|                                    | DOUBLE DECREMENT BINARY                     | --L(593)  |
| Comparison Instructions            | DOUBLE EQUAL                                | =L(301)   |
|                                    | DOUBLE NOT EQUAL                            | <>L(306)  |
|                                    | DOUBLE LESS THAN                            | <L(311)   |
|                                    | DOUBLE LESS THAN OR EQUAL                   | <=L(316)  |
|                                    | DOUBLE GREATER THAN                         | >L(321)   |
|                                    | DOUBLE GREATER THAN OR EQUAL                | >=L(326)  |
|                                    | DOUBLE COMPARE                              | CMPL(060) |
| Symbol Math Instructions           | DOUBLE SIGNED BINARY ADD WITHOUT CARRY      | +L(401)   |
|                                    | DOUBLE SIGNED BINARY SUBTRACT WITHOUT CARRY | -L(411)   |

The SRCH(181), MAX(182), and MIN(183) instructions can output the PLC memory address of the word with the desired value (search value, maximum, or minimum) to IR0. In this case, IR0 can be used in later instructions to access the contents of that word.

### 4-11-1 Using Index Registers

Processing of multiple (identical) instructions such as consecutive addresses for table data can be merged into one instruction by combining repetitive processing (e.g., FOR(513) and NEXT(514) instructions) with indirect addressing using Index Registers, thereby simplifying programming.



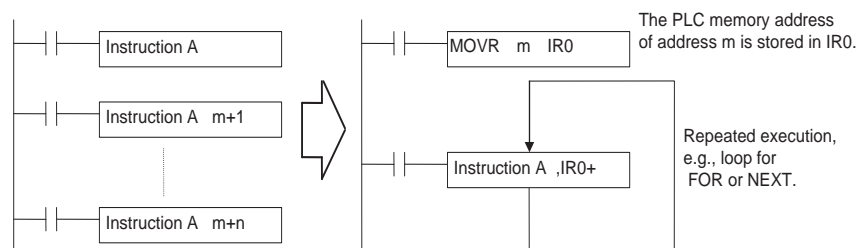
The Index operation uses the following procedure.

1. PLC memory addresses for the addresses in the Index Registers are stored using a MOVR instruction.
2. Operation is then executed by indirectly addressing Index Registers to the operand for Instruction A.
3. The addresses are moved using processing such as adding, subtracting, incrementing, or decrementing the Index Register (see note).
4. Steps 2 and 3 are processed repeatedly until the conditions are met.

**Note** Adding, subtracting incrementing, or decrementing for the Index Register is performed using one of the following methods.

- Each Type of Indirect Addressing for Index Registers:  
Auto-increment ( $,IR\Box+$  or  $,IR\Box++$ ), auto-decrement ( $,-IR\Box$  or  $,-IR\Box--$ ), constant offset (constant  $,IR\Box$ ), and DR offset ( $DR\Box,IR\Box$ ) for Index Registers
- Instructions for Direct Addressing of Index Registers:  
DOUBLE SIGNED BINARY ADD WITHOUT CARRY (+L), DOUBLE SIGNED BINARY SUBTRACT WITHOUT CARRY (-L), DOUBLE INCREMENT BINARY (++L), DOUBLE DECREMENT BINARY (--L)

Example:



If, for example, instruction A above is a comparison instruction, table data could be read from start to the end of the table to compare all of the data with a specific value. In this way, blocks of user-defined processing can be freely created depending by applying Index Registers.

### ■ Example Using Index Registers

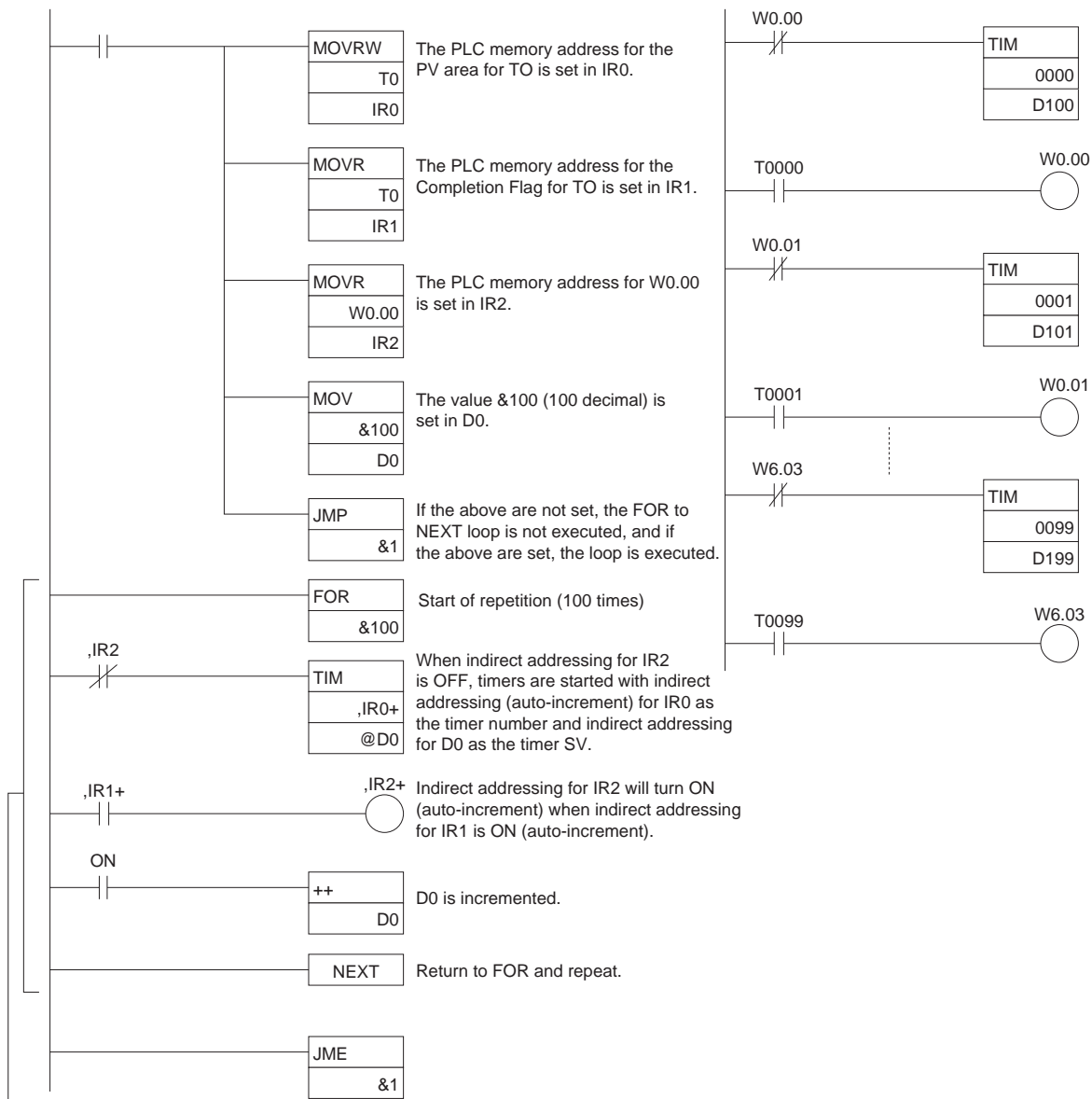
In the following example, TIM instructions for timer numbers 0 to 99 use set values in D100 to D199. This can be achieved by using one TIM instruction, using an index register for the timer number, using another index register for the Completion Flags, and repeatedly executing the TIM instruction to start the timers.

The PLC memory addresses for each T0's PV, Completion Flag, and W0.00 are set in Index Registers IR0, IR1, and IR2 using a MOVRW or MOVR instruction.

- The TIM instruction is executed for the timer number (timer PV) that IR0+ indirectly addresses.
- The Timer Completion Flag that is indirectly addressed for IR1+ turns ON when the time elapses. When the ON status is received, bits in the work area that are indirectly addressed for IR2+ are turned ON.
- The contents of IR0+, IR1+, and IR2+ are automatically incremented by one after accessing the values using indirect addressing.
- D0 is incremented.

Repeated





Repeat execution of TIM instructions 100 times while incrementing each value for IR0 (timer number, PV), IR1 (Completion Flag), IR2 (W0.00 on), and @D0, and start T0 to T99.

## 4-11-2 Precautions for Using Index Registers

### Precautions

Do not use a Index Register until a PLC memory address has been set in the register. The pointer operation will be unreliable if the registers are used without setting their values.

The values in Index Registers are unpredictable at the start of an interrupt task. When an Index Register will be used in an interrupt task, always set a PLC memory address in the Index Register with MOVR(560) or MOVRW(561) before using the register in that task.

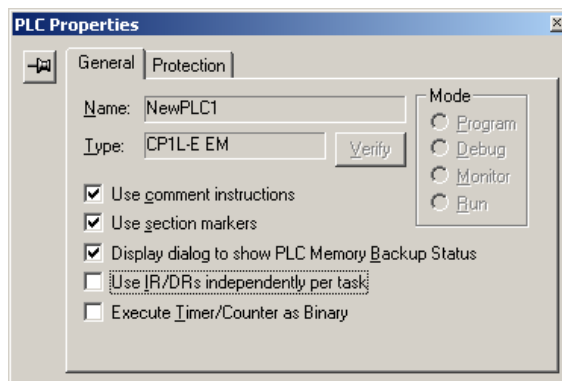
Each Index Register task is processed independently, so they do not affect each other. For example, IR0 used in Task 1 and IR0 used in Task 2 are different. Consequently, each Index Register task has 16 Index Registers.

### Limitations when Using Index Registers

- It is only possible to read the Index Register for the last task executed within the cycle from the CX-Programmer. If using Index Registers with the same number to perform multiple tasks, it is only possible with the CX-Programmer to read the Index Register value for the last task performed within the cycle from the multiple tasks, nor is it possible to write the Index Register value from the CX-Programmer.
- It is not possible to either read or write to the Index Registers using Host Link commands or FINS commands.
- A setting can be made from the CX-Programmer to share Index Registers between tasks. This setting will be enabled uniformly for all Index Registers and Data Registers.

### Sharing Index Registers

The following setting can be made from the PLC Properties Dialog Box on the CX-Programmer to control sharing Index and Data Registers between tasks.

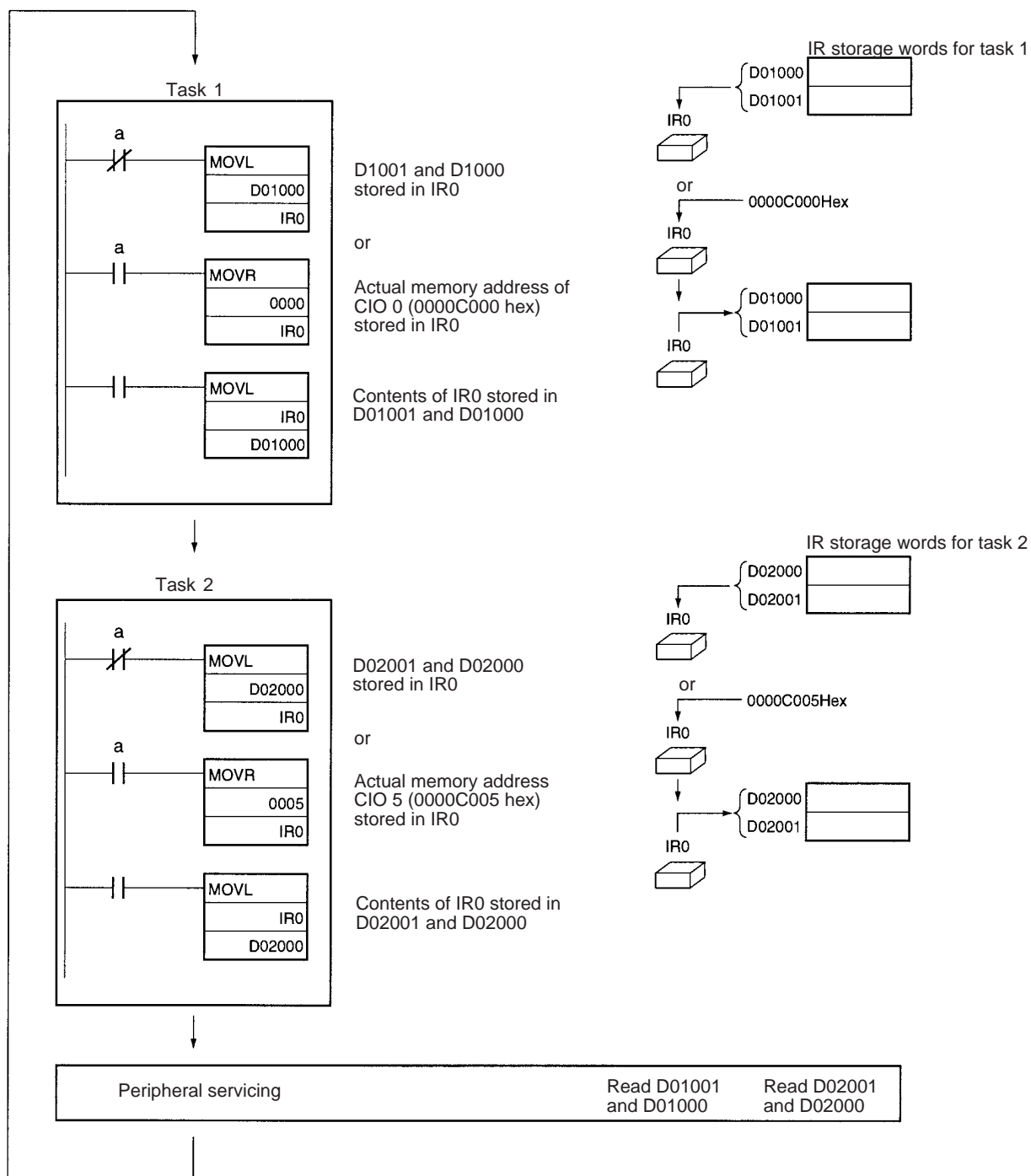


### Monitoring Index Registers

It is possible to monitor Index Registers as follows:

To use the Programming Devices to monitor the final Index Register values for each task, or to monitor the Index Register values using Host Link commands or FINS commands, write a program to store Index Register values from each task to another area (e.g., DM area) at the end of each task, and to read Index Register values from the storage words (e.g., DM area) at the beginning of each task. The values stored for each task in other areas (e.g., DM area) can then be edited using the CX-Programmer, Host Link commands, or FINS commands.

**Note** Be sure to use PLC memory addresses in Index Registers.



## 4-12 Data Registers

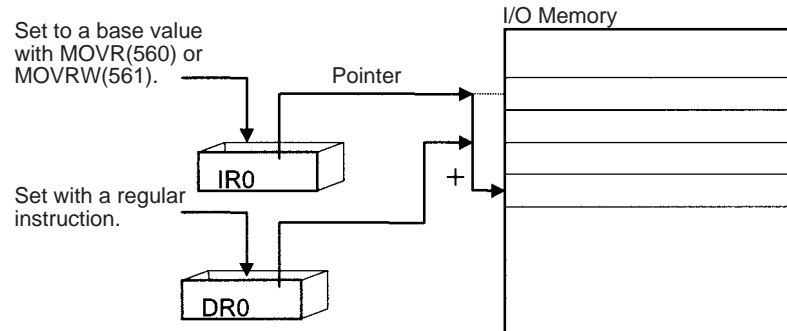
The sixteen Data Registers (DR0 to DR15) are used to offset the PLC memory addresses in Index Registers when addressing words indirectly.

The value in a Data Register can be added to the PLC memory address in an Index Register to specify the absolute memory address of a bit or word in I/O memory. Data Registers contain signed binary data, so the content of an Index Register can be offset to a lower or higher address.

Normal instructions can be used to store data in Data Registers.

### Forcing Bit Status

Bits in Data Registers cannot be force-set and force-reset.



### Examples

The following examples show how Data Registers are used to offset the PLC memory addresses in Index Registers.

- |                         |   |
|-------------------------|---|
| LD     DR0 ,IR0         | Adds the contents of DR0 to the contents of IR0 and loads the bit at that PLC memory address. |
| MOV(021) #0001 DR0 ,IR1 | Adds the contents of DR0 to the contents of IR1 and writes #0001 to that PLC memory address.  |

### Range of Values

The contents of data registers are treated as signed binary data and thus have a range of -32,768 to 32,767.

| Hexadecimal content | Decimal equivalent |
|---------------------|--------------------|
| 8000 to FFFF        | -32,768 to -1      |
| 0000 to 7FFF        | 0 to 32,767        |

### Data Register Initialization

The Data Registers will be cleared in the following cases:

1. When the operating mode is changed from PROGRAM mode to RUN/MONITOR mode or vice-versa and the IOM Hold Bit is OFF
2. When the power is cycled and the IOM Hold Bit is OFF or not protected in the PLC Setup

### IOM Hold Bit Operation

If the IOM Hold Bit (A500.12) is ON, the Data Registers won't be cleared when a FALS error occurs or the operating mode is changed from PROGRAM mode to RUN/MONITOR mode or vice-versa.

If the IOM Hold Bit (A500.12) is ON and the PLC Setup's "IOM Hold Bit Status at Startup" setting is set to protect the IOM Hold Bit, the Data Registers won't be cleared when the PLC's power supply is reset (ON → OFF → ON).

**Precautions**

Data Registers are normally local to each task. For example, DR0 used in task 1 is different from DR0 used in task 2. (A PLC Setup setting can be made from the CX-Programmer to share Data Registers between tasks.)

The content of Data Registers cannot be accessed (read or written) from the CX-Programmer.

Do not use Data Registers until a value has been set in the register. The register's operation will be unreliable if they are used without setting their values.

The values in Data Registers are unpredictable at the start of an interrupt task. When a Data Register will be used in an interrupt task, always set a value in the Data Register before using the register in that task.

## 4-13 Task Flags

Task Flags range from TK00 to TK31 and correspond to cyclic tasks 0 to 31. A Task Flag will be ON when the corresponding cyclic task is in executable (RUN) status and OFF when the cyclic task hasn't been executed (INI) or is in standby (WAIT) status.

**Note** These flags indicate the status of cyclic tasks only, they do not reflect the status of interrupt tasks.

**Task Flag Initialization**

The Task Flags will be cleared in the following cases, regardless of the status of the IOM Hold Bit.

1. When the operating mode is changed from PROGRAM mode to RUN/MONITOR mode or vice-versa
2. When the power is cycled.

**Forcing Bit Status**

The Task Flags **cannot** be force-set and force-reset.

## 4-14 Condition Flags

These flags include the Arithmetic Flags, such as the Error Flag and Equals Flag, which indicate the results of instruction execution.

The Condition Flags are specified with symbols, such as P\_CY and P\_ER, rather than addresses. The status of these flags reflects the results of instruction execution, but the flags are read-only; they cannot be written directly from instructions or the CX-Programmer.

**Note** The CX-Programmer treats condition flags as global symbols beginning with P\_.

All Condition Flags are cleared when the program switches tasks, so the status of the ER and AER flags are maintained only in the task in which the error occurred.

**Forcing Bit Status**

The Condition Flags **cannot** be force-set and force-reset.

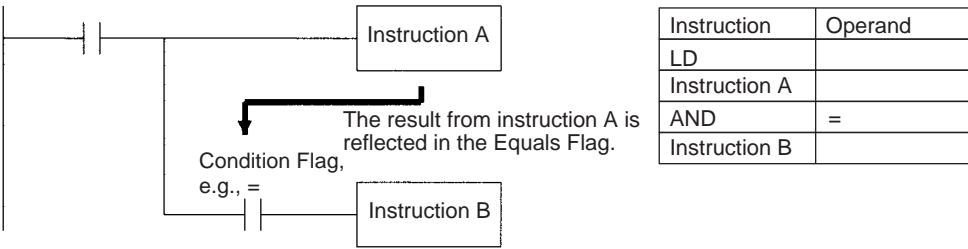
**Summary of the Condition Flags**

The following table summarizes the functions of the Condition Flags, although the functions of these flags will vary slightly from instruction to instruction. Refer to the description of the instruction for complete details on the operation of the Condition Flags for a particular instruction.

| Name                        | Symbol | Function  |
|-----------------------------|--------|---|
| Error Flag                  | P_ER   | Turned ON when the operand data in an instruction is incorrect (an instruction processing error) to indicate that an instruction ended because of an error.<br>When the PLC Setup is set to stop operation for an instruction error (Instruction Error Operation), program execution will be stopped and the Instruction Processing Error Flag (A29508) will be turned ON when the Error Flag is turned ON.                     |
| Access Error Flag           | P_AER  | Turned ON when an Illegal Access Error occurs. The Illegal Access Error indicates that an instruction attempted to access an area of memory that should not be accessed.<br>When the PLC Setup is set to stop operation for an instruction error (Instruction Error Operation), program execution will be stopped and the Instruction Processing Error Flag (A29510) will be turned ON when the Access Error Flag is turned ON. |
| Carry Flag                  | P_CY   | Turned ON when there is a carry in the result of an arithmetic operation or a "1" is shifted to the Carry Flag by a Data Shift instruction.<br>The Carry Flag is part of the result of some Data Shift and Symbol Math instructions.  |
| Greater Than Flag           | P_GT   | Turned ON when the first operand of a Comparison Instruction is greater than the second or a value exceeds a specified range.   |
| Equals Flag                 | P_EQ   | Turned ON when the two operands of a Comparison Instruction are equal the result of a calculation is 0.   |
| Less Than Flag              | P_LT   | Turned ON when the first operand of a Comparison Instruction is less than the second or a value is below a specified range.   |
| Negative Flag               | P_N    | Turned ON when the most significant bit (sign bit) of a result is ON.   |
| Overflow Flag               | P_OF   | Turned ON when the result of calculation overflows the capacity of the result word(s).  |
| Underflow Flag              | P_UF   | Turned ON when the result of calculation underflows the capacity of the result word(s).   |
| Greater Than or Equals Flag | P_GE   | Turned ON when the first operand of a Comparison Instruction is greater than or equal to the second.  |
| Not Equal Flag              | P_NE   | Turned ON when the two operands of a Comparison Instruction are not equal.  |
| Less Than or Equals Flag    | P_LE   | Turned ON when the first operand of a Comparison Instruction is less than or equal to the second.   |
| Always ON Flag              | P_On   | Always ON. (Always 1.)  |
| Always OFF Flag             | P_Off  | Always OFF. (Always 0.)   |

Using the Condition Flags

The Condition Flags are shared by all of the instructions, so their status may change often in a single cycle. Be sure to read the Condition Flags immediately after the execution of instruction, preferably in a branch from the same execution condition.

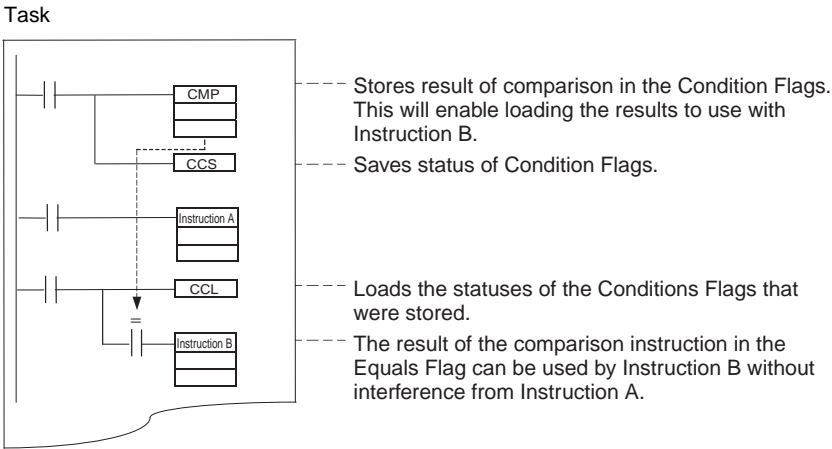


Since the Condition Flags are shared by all of the instructions, program operation can be changed from its expected course by interruption of a single task. Be sure to consider the effects of interrupts when writing the program. Refer to *SECTION 2 Programming of CS/CJ Series Programming Manual (W394)* for more details.

The Condition Flags are cleared when the program switches tasks, so the status of a Condition Flag cannot be passed to another task. For example the status of a flag in task 1 cannot be read in task 2.

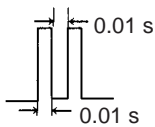
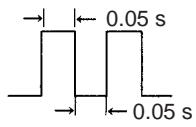
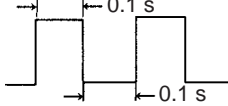
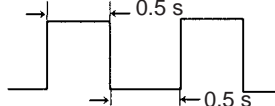
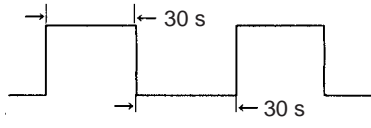
Saving and Loading Condition Flag Status

The CP1L-EL/EM CPU Units support instructions to save and load the Condition Flag status (CCS(282) and CCL(283)). These can be used to access the status of the Condition Flags at other locations in a task or in a different task. The following example shows how the Equals Flag is used at a different location in the same task.



## 4-15 Clock Pulses

The Clock Pulses are flags that are turned ON and OFF at regular intervals by the system.

| Name               | Symbol   | Operation   |                                 |
|--------------------|----------|---|---------------------------------|
| 0.02 s Clock Pulse | P_0_02_s |   | ON for 0.01 s<br>OFF for 0.01 s |
| 0.1 s Clock Pulse  | P_0_1s   |   | ON for 0.05 s<br>OFF for 0.05 s |
| 0.2 s Clock Pulse  | P_0_2s   |   | ON for 0.1 s<br>OFF for 0.1 s   |
| 1 s Clock Pulse    | P_1s     |   | ON for 0.5 s<br>OFF for 0.5 s   |
| 1 min Clock Pulse  | P_1min   |  | ON for 30 s<br>OFF for 30 s     |

The Clock Pulses are specified with symbols rather than addresses.

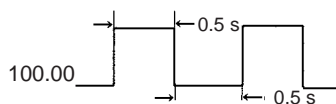
**Note** The CX-Programmer treats condition flags as global symbols beginning with P\_.

The Clock Pulses are read-only; they cannot be overwritten from instructions or the CX-Programmer.

The Clock Pulses are cleared at the start of operation.

### Using the Clock Pulses

The following example turns CIO 100.00 ON and OFF at 0.5 s intervals.



| Instruction | Operand |
|-------------|---------|
| LD          | 1 s     |
| OUT         | 100.00  |



# SECTION 5

## CX-Programmer Connection, Program Transfer, Trial Operation, and Debugging

This section describes the methods for CX-Programmer connection, the processes used to transfer the program to the CPU Unit and the functions that can be used to test and debug the program.

|       |  |     |
|-------|--|-----|
| 5-1   | Connecting the CX-Programmer . . . . . | 140 |
| 5-1-1 | Connecting to Ethernet Port . . . . .  | 140 |
| 5-1-2 | Connecting to a Serial Port . . . . .  | 149 |
| 5-2   | Program Transfer. . . . .              | 151 |
| 5-3   | Trial Operation and Debugging. . . . . | 151 |
| 5-3-1 | Forced Set/Reset . . . . .             | 151 |
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| 5-3-3 | Online Editing. . . . .                | 153 |
| 5-3-4 | Tracing Data . . . . .                 | 155 |

## 5-1 Connecting the CX-Programmer

The CX-Programmer (version 9.4 or higher), which runs on Windows, can be used with CP-series CP1L-EL/EM PLCs. Computers running Support Software (e.g., the CX-Programmer) can be connected to the Ethernet port or to a serial port.

**Note** A Programming Console cannot be used with CP1L-EL/EM PLCs.

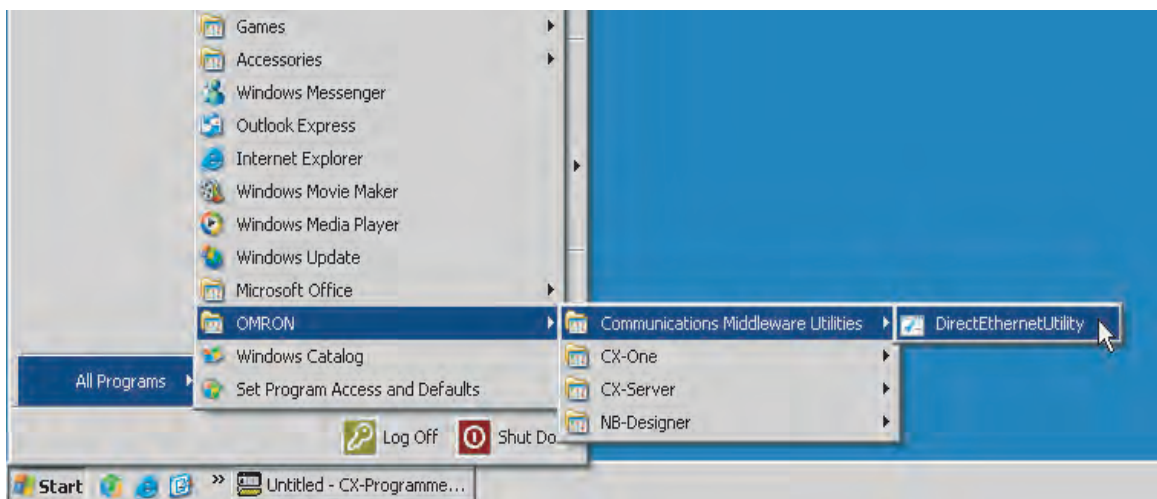
### 5-1-1 Connecting to Ethernet Port

CX-Programmer supports two methods for connecting online to the target PLC, which are auto online and normal online.

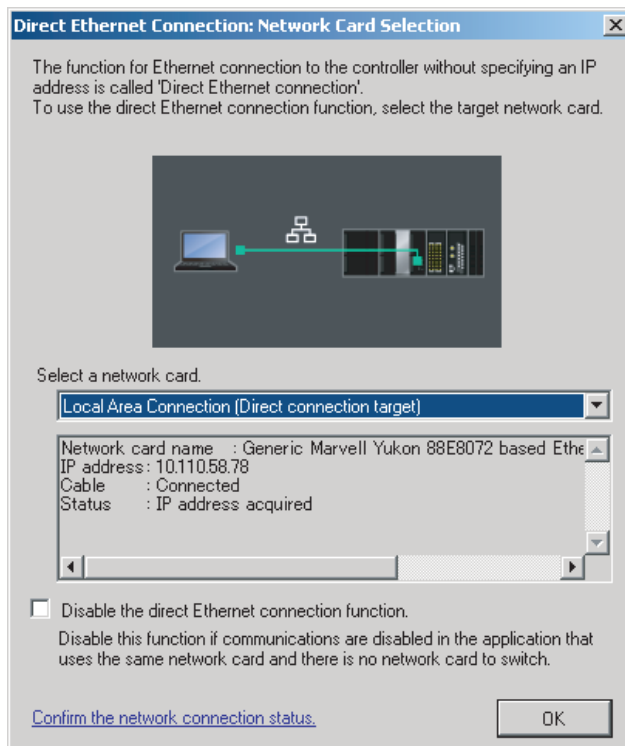
#### Auto Online

You can automatically and easily connect online to a PLC when PC and target PLC are in same local network by using auto online function.

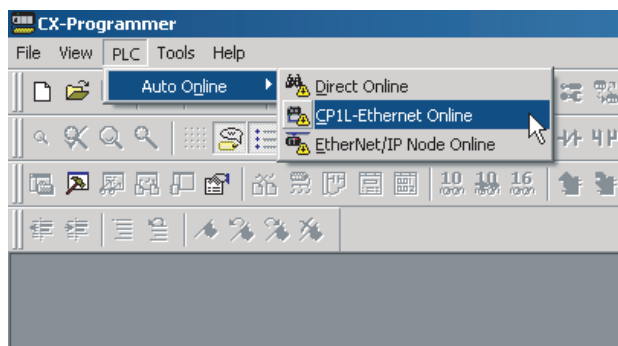
- 1,2,3...**
1. Connect the Ethernet port to the computer via a twisted-pair cable or hub according to the connection type (*Refer to 6-3 Network Installation*).
  2. Select **DirectEthernetUtility** from the Menu as follow.



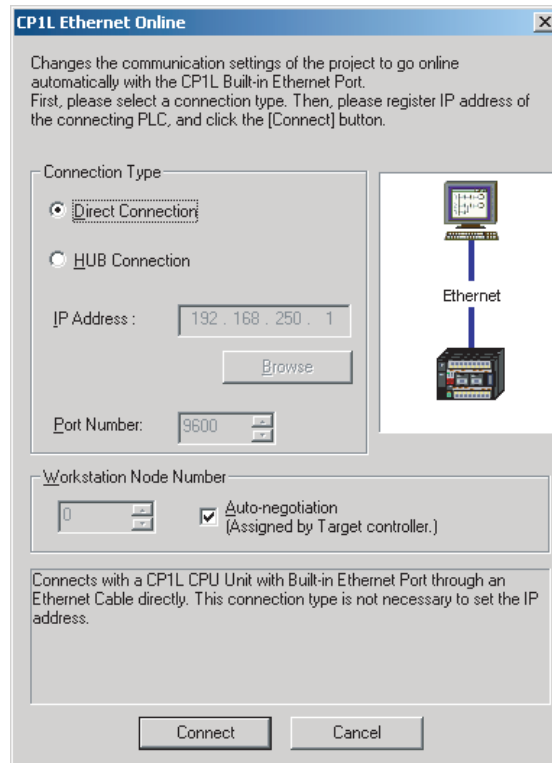
3. Select a target network card to connect with.



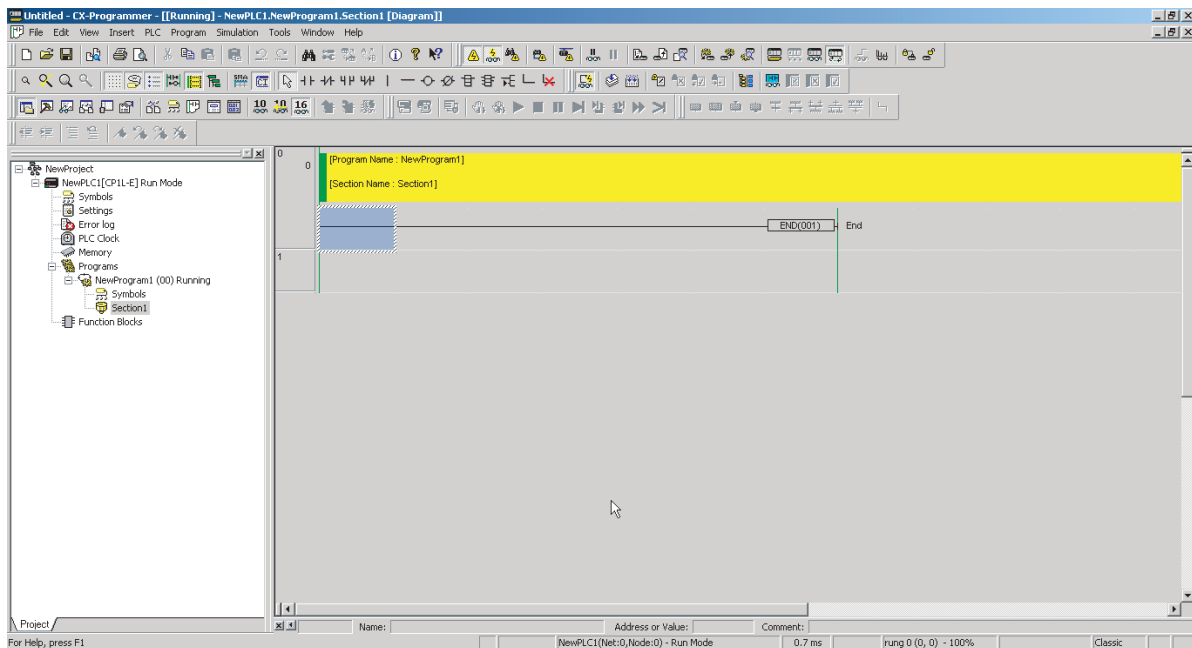
4. Open the CX-Programmer and click the **PLC** button as follow.



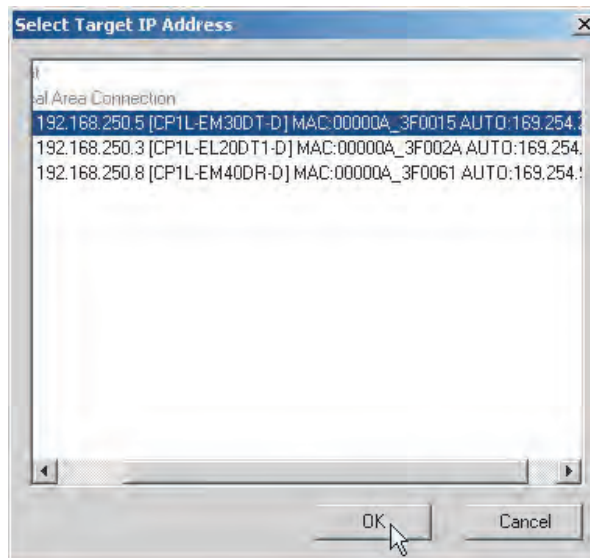
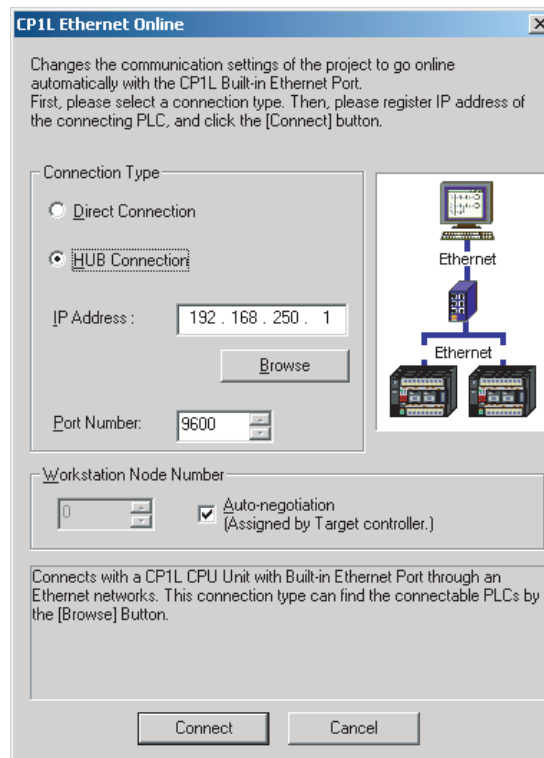
5. Select the **CP1L-Ethernet Online** item. The user can also click the  button in the Toolbars.

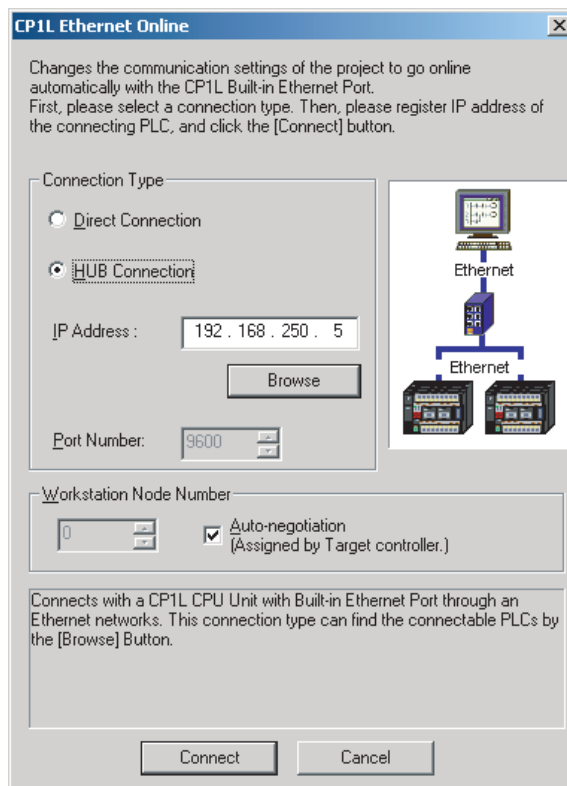


6. Select a connection type
  - a. Choose the **Direct Connection** item and click the **Connect** button. Then connection online is completed.

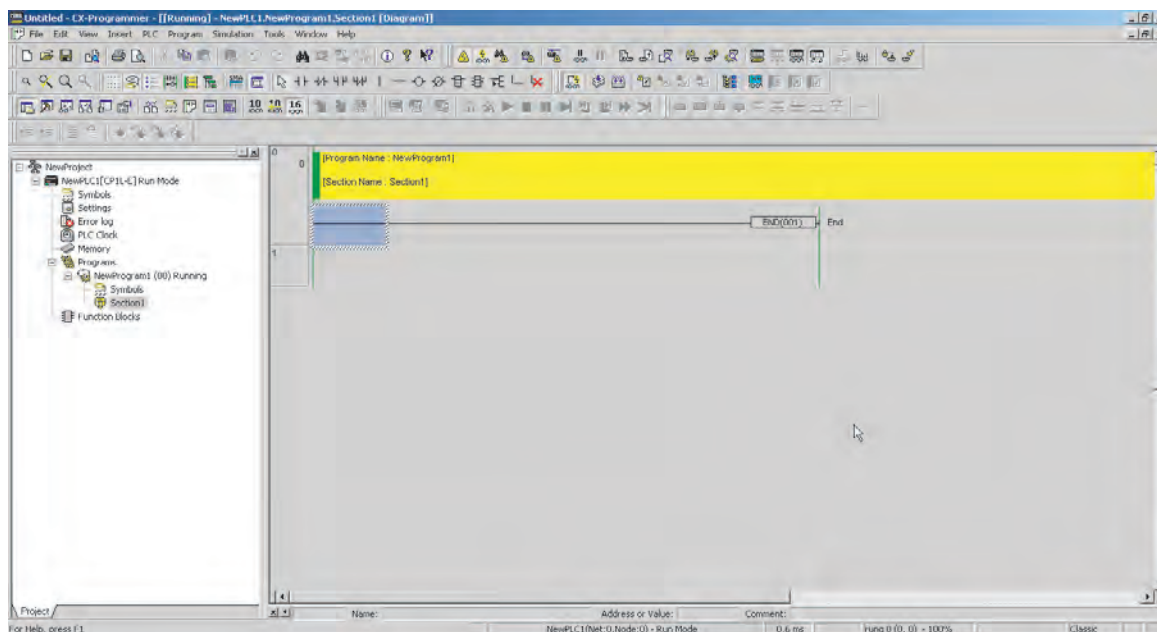


- b. Choose the **Hub Connection** item and click **Browse** button to select the PLC which user wants to connect.



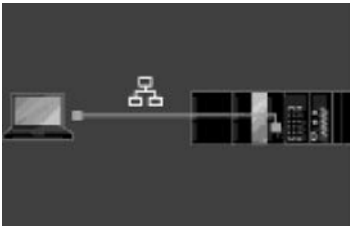
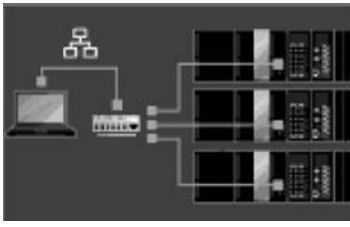


Click the **Connect** button to connect and then connection online is completed.



**Normal Online**

To connect with a PLC via Ethernet, there are two types of hardware connections that can be used (Refer to 6-3 *Network Installation*). These are described in the following table.

| Connection Type            | Ethernet - Direct connection   | Ethernet - HUB connection  |
|----------------------------|--|--|
| Connection diagram         |                                   |   |
| Description                | The Ethernet port on the computer is connected directly to the Ethernet port on the PLC with a twisted-pair cable. | The Ethernet port on the computer is connected to a hub and then the CX-Programmer is placed online with a PLC through the Ethernet network. |
| Network Type               | Ethernet (FINS/TCP)  | Ethernet or Ethernet (FINS/TCP)  |
| Destination PLC IP setting | No need  | Need   |
| PC IP setting              | No need  | Need   |

**Network Type**

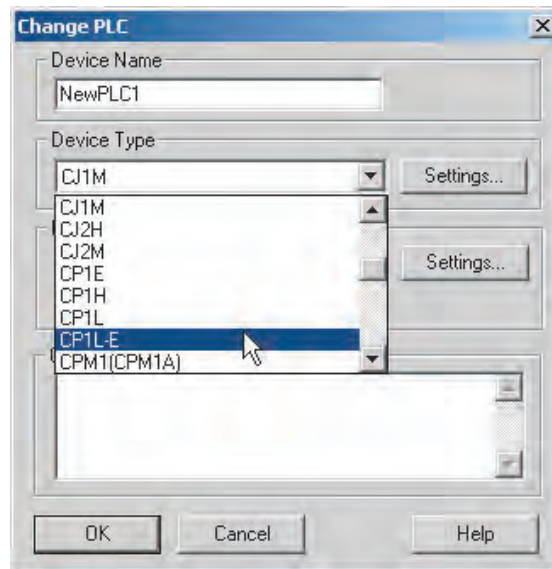
| Network Type | Ethernet   | Ethernet (FINS/TCP)   |
|--------------|--|---|
| Protocol     | FINS/UDP   | FINS/TCP  |
| Features     | A standard protocol for host computers with HUB connection only. | A standard protocol for host computers with either Direct connection or HUB connection. |

**Ethernet - Direct Connection**

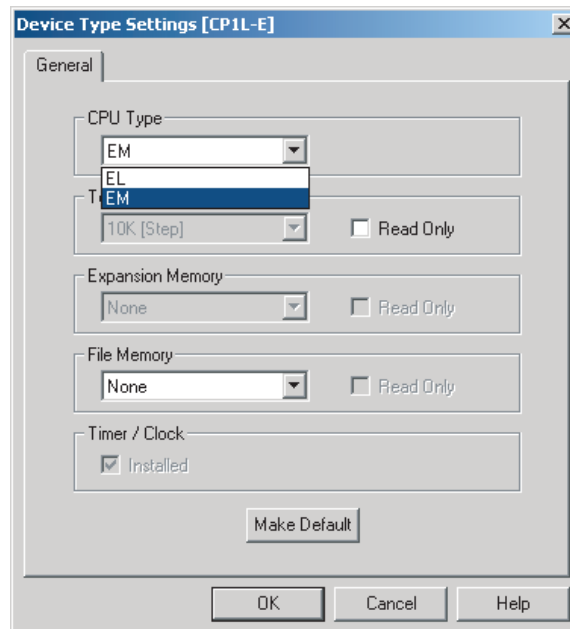
When the Ethernet port on the computer is connected directly to the Ethernet port on the PLC with a twisted-pair cable, this mode can be selected as the connection method.

In this mode, user need not change the IP setting in PC side.

- 1,2,3... 1. Select the PLC type as **CP1L-E** in **Device Type** in the CX-Programmer's **Change PLC** Dialog Box.

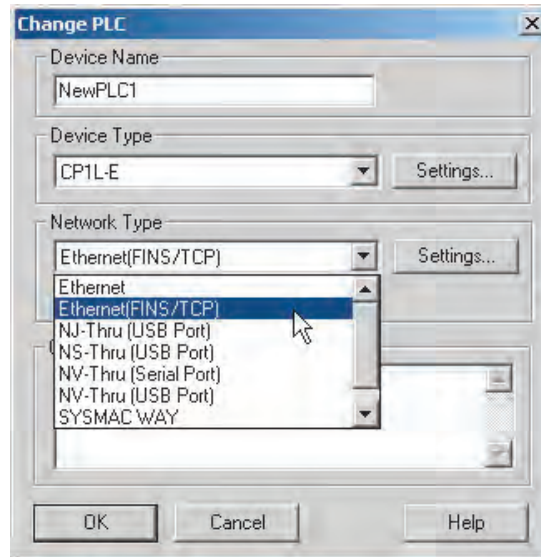


2. Click the **Settings** button on the right side of **Device Type**. Choose the CPU Type.

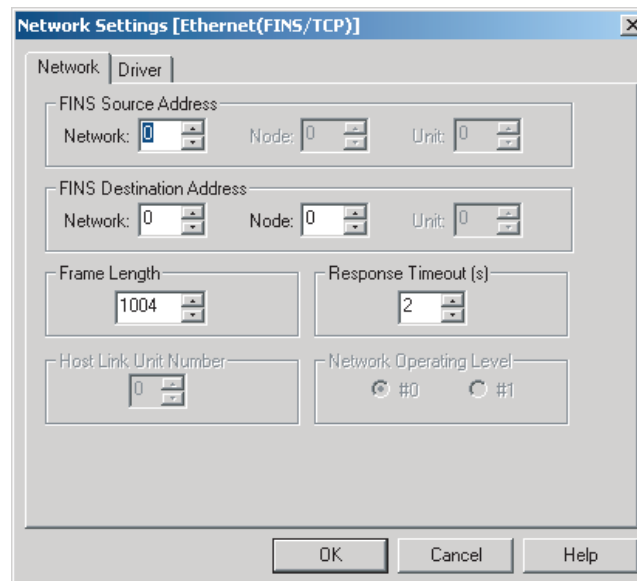


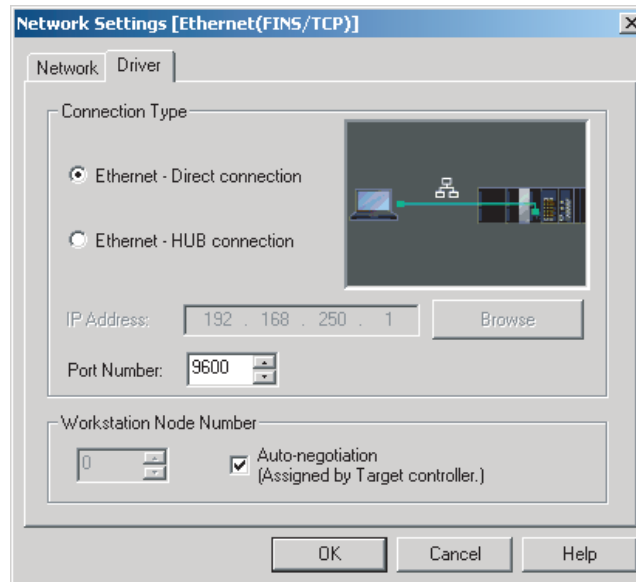


3. Set **Ethernet (FINS/TCP)** in **Network Type**.



4. Click the **Settings** button on the right side of **Network Type**. The settings in the Network Tab and in the Driver are as follow dialogue boxes.





5. Click [OK] and finish the settings of the direct connection.
6. Then connect to the CP1L-EL/EM by executing the CX-Programmer's on-line connection command.

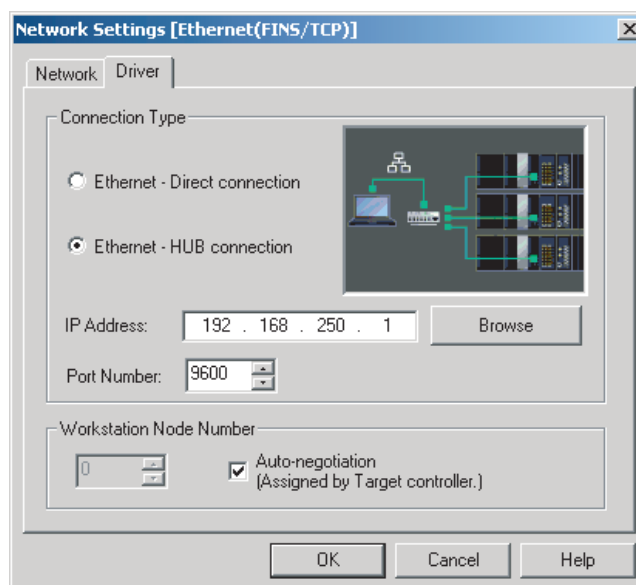
### **Ethernet - HUB connection**

When the Ethernet port on the computer is connected to a hub and then the CX-Programmer is placed online with a PLC through the Ethernet network, this mode can be selected as the connection method.

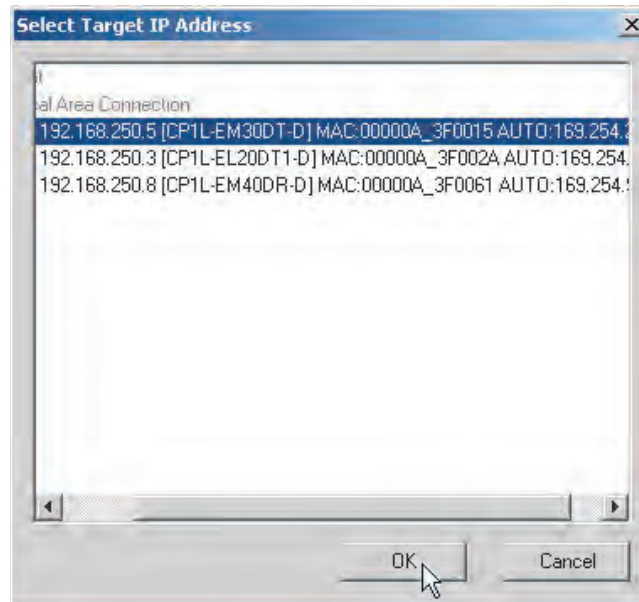
In this mode, user should change the IP setting in PC side in a same subnet as PLC.

**1,2,3...**

1. The settings of PLC type and CPU type are the same as Ethernet - Direct connection.
2. Set Network Type. Both Ethernet and Ethernet (FINS/TCP) are supported. In the following we will use Ethernet (FINS/TCP) as the sample. The settings of Network Tab in Network Settings are also the same as those in the Ethernet - Direct connection.
3. Set the connection type as Ethernet - HUB connection in Driver Tab.



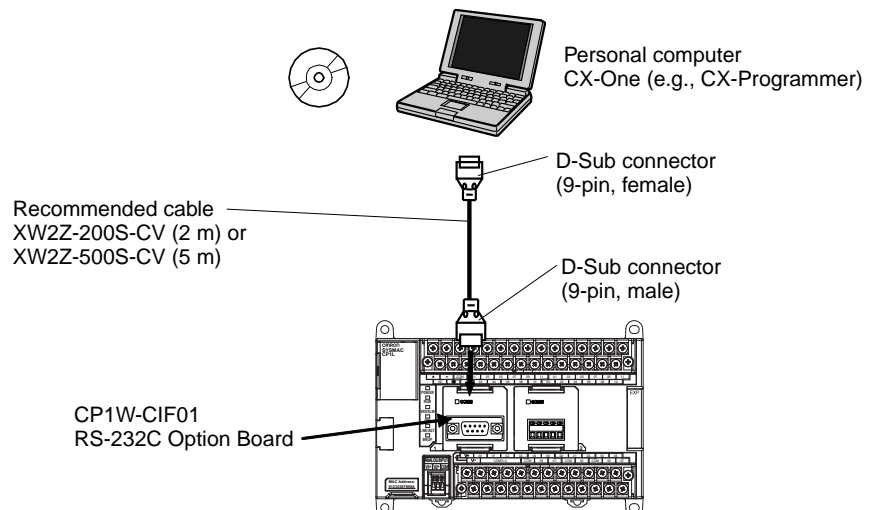
4. Set the target PLC's IP Address.  
If do not know the target PLC's IP address, user can click the **Browse** button on the right side of **IP Address** and it will show a dialogue box as follow. The CX-Programmer will automatically search all CP1L-EL/EM series PLCs under the same segment in the local area. All PLC found by CX-Programmer will be listed with the IP address, PLC's type and MAC ID in the **Select Target IP Address** dialogue box. Choose a target PLC to be connected and click the **OK** button.



5. Change the IP setting in PC side to an IP address in same subnet as the target PLC.
6. Click the **OK** button in the **Network Settings** dialogue box and finish the settings.
7. Then connect to the CP1L-EL/EM by executing the CX-Programmer's on-line connection command.

### 5-1-2 Connecting to a Serial Port

Mounting a CP1W-CIF01 RS-232C Option Board in a CP1L-EL/EM Option Board slot makes it possible to connect Support Software with serial communications, just as with previous models.



Connect the CX-Programmer to the RS-232C port of the CP1W-CIF01 Option Board by XW2Z-200S-CV/500S-CV RS-232C cable.

### Connection Method

Connect the Programming Device using the Connecting Cable that is appropriate for the serial communications mode of the computer and CPU Unit.

| Computer                |                   | Connecting Cable |        | CP1L-EL/EM CPU Unit  |                                      |
|-------------------------|-------------------|------------------|--------|--|--------------------------------------|
| Model                   | Connector         | Model            | Length | Connector  | Serial communications mode           |
| IBM PC/AT or compatible | D-Sub 9 pin, male | XW2Z-200S-CV     | 2 m    | D-Sub 9 pin, female<br>(With a CP1W-CIF01 RS-232C Option Board mounted in Option Board Slot 1 or 2.) | Peripheral bus or Host Link (SYSWAY) |
|                         |                   | XW2Z-500S-CV     | 5 m    |  |                                      |

### Serial Communications Mode

| Serial communications mode | Features   | CPU Unit setting method   |
|----------------------------|--|---|
| Peripheral bus (toolbus)   | <p>This is the faster mode, so it is generally used for CX-Programmer connections.</p> <ul style="list-style-type: none"> <li>• Only 1: 1 connections are possible.</li> <li>• When a CP1L-EL/EM CPU Unit is used, the baud rate is automatically detected by the Support Software.</li> </ul> | <p>Turn ON pins SW4 (Serial Port 1) and SW5 (Serial Port 2) on the DIP switch on the front panel of the CPU Unit. These settings enable connection by peripheral bus regardless of the serial port settings in the PLC Setup.</p>   |
| Host Link (SYSWAY)         | <p>A standard protocol for host computers with either 1: 1 or 1: N connections.</p> <ul style="list-style-type: none"> <li>• Slower than the peripheral bus mode.</li> <li>• Allows modem or optical adapter connections, or long-distance or 1: N connections using RS-422A/485.</li> </ul>   | <p>Turn OFF pins SW4 (Serial Port 1) and SW5 (Serial Port 2) on the DIP switch on the front panel of the CPU Unit.</p> <p>The mode will then be determined by the serial port settings in the PLC Setup. The default settings are for Host Link with a baud rate of 9,600 bits/s, 1 start bit, data length of 7 bits, even parity, and 2 stop bits.</p> |

**Note** When a Serial Communications Option Board is mounted in Option Board Slot 1, it is called "Serial Port 1". When mounted in Option Board Slot 2, it is called "Serial Port 2".

## 5-2 Program Transfer

The CX-Programmer is used to transfer the programs, PLC Setup, I/O memory data, and I/O comments to the CPU Unit with the CPU Unit in PROGRAM mode. The following procedure is used.

- 1,2,3... 1. Select **PLC - Transfer - To PLC**. The Download Options Dialog Box will be displayed.
2. Specify the items to transfer.
3. Click the **OK** Button.

**Note** The program data on a Memory Cassette can be automatic transferred when the power is turned ON.

## 5-3 Trial Operation and Debugging

### 5-3-1 Forced Set/Reset

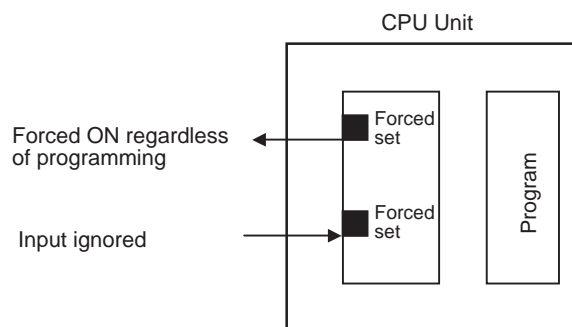
The CX-Programmer can force-set (ON) or reset (OFF) specified bits in the CIO Area, Auxiliary Area, and HR Area, as well as timer/counter Completion Flags. Forced status will take priority over status output from the program or I/O refreshing. This status cannot be overwritten by instructions, and will be stored regardless of the status of the program or external inputs until it is cleared from the CX-Programmer.

Force-set/reset operations are used to force input and output during a trial operation or to force certain conditions during debugging.

Force-set/reset operations can be executed in either MONITOR or PROGRAM modes, but not in RUN mode.

**Note** Turn ON the Forced Status Hold Bit (A500.13) and the IOM Hold Bit (A500.12) at the same time to retain the status of bits that have been force-set or reset when switching the operating mode.

Turn ON the Forced Status Hold Bit (A500.13) and the IOM Hold Bit (A500.12), and set the Forced Status Hold Bit at Startup parameter in the PLC Setup to retain the status of the Forced Status Hold Bit hold to retain the status of bits that have been force-set or reset when turning OFF the power.



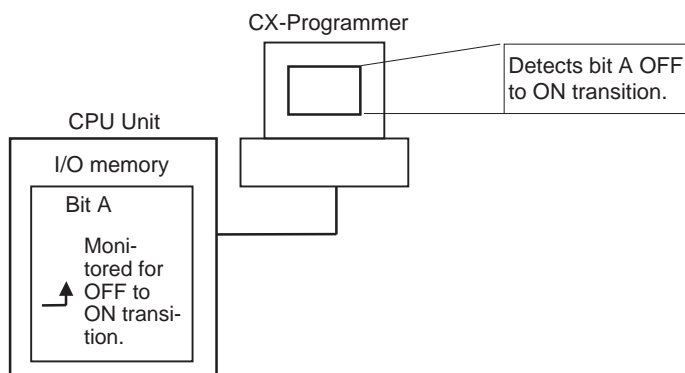
The following areas can be force-set and reset: CIO Area, Work Area, Timer Completion Flags, HR Area, Counter Completion Flags.

#### CX-Programmer Operation

- Selecting bits for forced setting/resetting
- Selecting forced set or forced reset status
- Clearing forced status (also clearing all forced status at the same time)

### 5-3-2 Differential Monitoring

When the CPU Unit detects that a bit set by the CX-Programmer has changed from OFF to ON or from ON to OFF, the results are indicated in the Differentiate Monitor Completed Flag (A508.09). The Flag will turn ON when conditions set for the differential monitor have been met. The CX-Programmer can monitor and display these results on screen.



#### CX-Programmer Operation

- 1,2,3... 1. Right-click the bit for differential monitoring.
2. Click **Differential Monitor** from the PLC Menu. The Differential Monitor Dialog Box will be displayed.
3. Click **Rising** or **Falling**.
4. Click the **Start** Button. The buzzer will sound when the specified change is detected and the count will be incremented.
5. Click the **Stop** Button. Differential monitoring will stop.

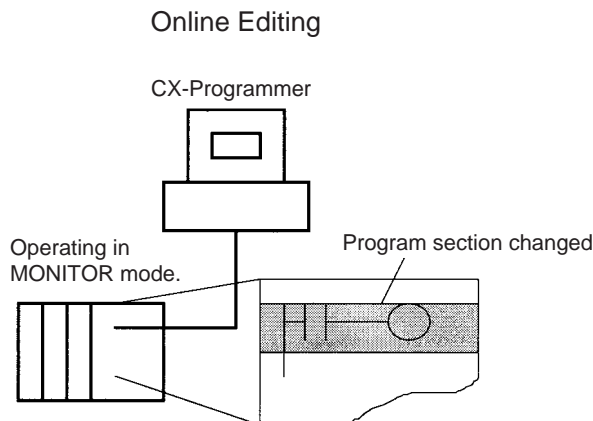
#### Related Auxiliary Bits/Words

| Name                                 | Address | Description   |
|--------------------------------------|---------|---|
| Differentiate Monitor Completed Flag | A508.09 | Turns ON when the differential monitoring condition has been met during differential monitoring.<br>Note: The flag will be cleared when differential monitoring is started. |

### 5-3-3 Online Editing

The Online Editing function is used to add to or change part of a program in a CPU Unit directly from the CX-Programmer when the CPU Unit is in MONITOR or PROGRAM mode. This function is designed for minor program changes without stopping the CPU Unit.

Online editing is possible simultaneously from more than one computer running the CX-Programmer as long as different tasks are edited.



The cycle time will be increased by from one to several cycle times if the program in the CPU Unit is edited online in MONITOR mode. The cycle time will also be increased to back up data in the flash memory after online editing. The BKUP indicator will be lit during this period and the progress of the backup will be displayed on the CX-Programmer. The increases per cycle are listed in the following table.

| CPU Unit             | Increase in cycle time |                        |
|----------------------|------------------------|------------------------|
|                      | Online editing         | Backup to flash memory |
| CP1L-EL/EM CPU Units | 16 ms max.             | 4% of cycle time       |

There is a limit to the number of edits that can be made consecutively. The actual number depends on the type of editing that is performed, but 40 edits should be used as a guideline. A message will be displayed on the CX-Programmer if the limit is exceeded, and further editing will not be possible until the CPU Unit has completed backing up the data.

The length of time that the cycle time is extended due to online editing is almost unaffected by the size of the task program being edited.

#### Precautions


The cycle time will be longer than normal when a program is overwritten using Online Editing in MONITOR mode, so make sure that the amount of time that it is extended will not exceed the cycle monitoring time set in the PLC Setup. If it does exceed the monitoring time, then a Cycle Time Over error will occur, and the CPU Unit will stop. Restart the CPU Unit by selecting PROGRAM mode first before changing to RUN or MONITOR mode.

**Note** If the task being edited online contains a block program, then previous execution information, such as Standby (WAIT) or Pause status, will be cleared by online editing, and the next execution will be from the beginning.

#### Online Editing from the CX-Programmer

- 1,2,3... 1. Display the program section that will be edited.
2. Select the instructions to be edited.
3. Select **Program - Online Edit - Begin.**

4. Edit the instructions.
5. Select **Program - Online Edit - Send Changes** The instructions will be checked and, if there are no errors, they will be transferred to the CPU Unit. The instructions in the CPU Unit will be overwritten and cycle time will be increased at this time.

 **Caution** Proceed with Online Editing only after verifying that the extended cycle time will not adversely affect operation. Input signals may not be read if the cycle time is too long.

#### **Temporarily Disabling Online Editing**

It is possible to disable online editing for specific cycles to ensure response characteristics for machine control in those cycles. Online editing from the CX-Programmer will be disabled for those cycles and any requests for online editing received during those cycles will be held until online editing is enabled.

Online editing is disabled by setting the Online Editing Disable Bit Validator (A527.00 to A527.07) to 5A and then turning ON the Online Editing Disable Bit (A527.09). When these settings have been made and a request for online editing is received, online editing will be put on standby and the Online Editing Wait Flag (A201.10) will be turned ON.

When the Online Editing Disable Bit (A527.09) is turned OFF, online editing will be performed, the Online Editing Processing Flag (A201.11) will turn ON, and the Online Editing Wait Flag (A201.10) will turn OFF. When online editing has been completed, the Online Editing Processing Flag (A201.11) will turn OFF.

Online editing can also be temporarily disabled by turning ON the Online Editing Disable Bit (A527.09) while online editing is being performed. Here too, the Online Editing Wait Flag (A201.10) will turn ON.

If a second request for online editing is received while the first request is on standby, the second request will not be recorded and an error will occur.

Online editing can also be disabled to prevent accidental online editing. As described above, disable online editing by setting the Online Editing Disable Bit Validator (A527.00 to A527.07) to 5A and turning ON the Online Editing Disable Bit (A527.09).

#### **Enabling Online Editing from the CX-Programmer**

When online editing cannot be enabled from the program, it can be enabled from the CX-Programmer. If operations continue with online editing in standby status, CX-Programmer may go offline. If this occurs, reconnect the computer to the CPU Unit and turn OFF the Online Edit Disable Bit (A527.09).

**Note** When using automatic transfer from a Memory Cassette at startup, be sure to transfer the data to the Memory Cassette if any changes are made using online editing. If power is turned OFF before the changes are transferred, the data from before online editing was performed will be read from the Memory Cassette.



**Related Auxiliary Bits/Words**

| Name                              | Address            | Description   |
|-----------------------------------|--------------------|---|
| Online Edit Disable Bit Validator | A527.00 to A527.07 | Enables using the Online Edit Disable Bit (A527.09).<br>Not 5A: Online Edit Disable Bit disabled.<br>5A: Online Edit Disable Bit enabled. |
| Online Edit Disable Bit           | A527.09            | To disable online editing, set the Online Edit Disable Bit Validator (A527.00 to A527.07) to 5A and turn ON this bit ON.                  |
| Online Editing Wait Flag          | A201.10            | ON while an online editing process is on standby because online editing is disabled.  |
| Online Editing Processing Flag    | A201.11            | ON while an online editing process is being executed.   |

**5-3-4 Tracing Data**

The Data Trace function samples specified I/O memory data using any one of the following timing methods. It stores the sampled data in Trace Memory, where they can be read and checked later from the CX-Programmer.

- Specified sampling time (10 to 2,550 ms in 10-ms units)
- One sample per cycle
- When the TRACE MEMORY SAMPLING instruction (TRSM(045)) is executed

Up to 31 bits and 6 words in I/O memory can be specified for sampling.

**Basic Procedure**

- 1,2,3...**
1. Sampling will start when the parameters have been set from the CX-Programmer and the command to start tracing has been executed.
  2. Sampled data (after step 1 above) will be traced when the trace trigger condition is met, and the data just after the delay (see note 1) will be stored in Trace Memory.
  3. Memory data will be sampled until the Trace Memory is full, and then the trace will be ended.

**Note** Delay value: Specifies how many sampling periods to offset the sampling in Trace Memory from when the trace condition is met. The setting ranges are shown in the following table.

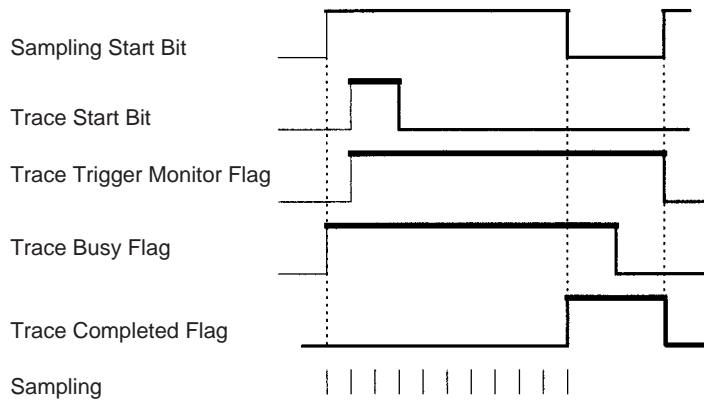
| No. of words sampled | Setting range |
|----------------------|---------------|
| 0                    | –1999 to 2000 |
| 1                    | –1332 to 1333 |
| 2                    | –999 to 1000  |
| 3                    | –799 to 800   |
| 4                    | –665 to 666   |
| 5                    | –570 to 571   |
| 6                    | –499 to 500   |

Positive delay: Store data delayed by the set delay.

Negative delay: Store previous data according go to the set delay.

**Example:** Sampling at 10 ms with a –30 ms delay time yields  $-30 \times 10 = 300$  ms, so data 300 ms before the trigger will be stored.

**Note** Use the CX-Programmer to turn ON the Sampling Start Bit (A508.15). Never turn ON this bit from the user program.



The following traces can be executed.

**Scheduled Data Trace**

A scheduled data trace will sample data at fixed intervals. Specified sampling interval is 10 to 2,550 ms in 10-ms units. Do not use the TRSM(045) instruction in the user program and be sure to set the sampling period higher than 0.

**One-cycle Data Trace**

A one-cycle data trace will sample I/O refresh data after the end of all cyclic tasks. Do not use the TRSM(045) instruction in the user program and be sure to set the sampling period higher than 0.

**Data Trace via TRSM(045)**

A sample will be taken once each time the TRACE MEMORY SAMPLING instruction (TRSM(045)) instruction is executed. When more than one TRSM(045) instruction is used in the program, a sample will be taken each time TRSM(045) is executed after the trace trigger condition has been met until trace memory is full.

**Data Trace Procedure**

Use the following procedure to execute tracing.

- 1,2,3...
  1. Use the CX-Programmer to set trace parameters (select **PLC - Data Trace** and then select **Operation - Configure**):  
Addresses of the sampled words/bits, sampling period, delay time, and trigger conditions.
  2. Use the CX-Programmer to start sampling or turn ON the Sampling Start Bit (A508.15).
  3. Put the trace trigger condition into effect.
  4. End tracing.
  5. Use CX-Programmer to read the trace data.
    - a) Select **Data Trace** from the PLC Menu.
    - b) Select **Select** from the Operation Menu.
    - c) Select **Execute** from the Operation Menu.
    - d) Select **Read** from the Operation Menu.

**Related Auxiliary Bits/Words**

| <b>Name</b>                | <b>Address</b> | <b>Description</b>   |
|----------------------------|----------------|--|
| Sampling Start Bit         | A508.15        | Use the CX-Programmer to turn ON this bit to start sampling. This bit must be turned ON from the CX-Programmer. Do not turn this bit ON and OFF from the user program.<br>Note: The bit will be turned OFF when the Data Trace has been completed.   |
| Trace Start Bit            | A508.14        | When this bit is turned ON, the trace trigger will be monitored and sampled data will be stored in Trace Memory when the trigger condition is met. The following traces are enabled with this bit.<br>1) Scheduled trace (trace at fixed intervals of 10 to 2,550 ms)<br>2) TRSM(045) instruction trace (trace when the TRSM(045) is executed)<br>3) One-cycle trace (trace at the end of execution of all cyclic tasks) |
| Trace Trigger Monitor Flag | A508.11        | This flag turns ON when the trace trigger condition has been met after the Trace Start Bit has turned ON. This flag will turn OFF when the sampling is started.  |
| Trace Busy Flag            | A508.13        | This flag turns ON when sampling is started and turns OFF when the trace has been completed.   |
| Trace Completed Flag       | A508.12        | This flag turns ON when Trace Memory becomes full after the trace trigger condition has been met during a trace operation and turns OFF when the next sampling operation is started.   |



## SECTION 6

### Ethernet

This section gives an outline of the built-in Ethernet function, explains its specification and how to make the settings required for operation.

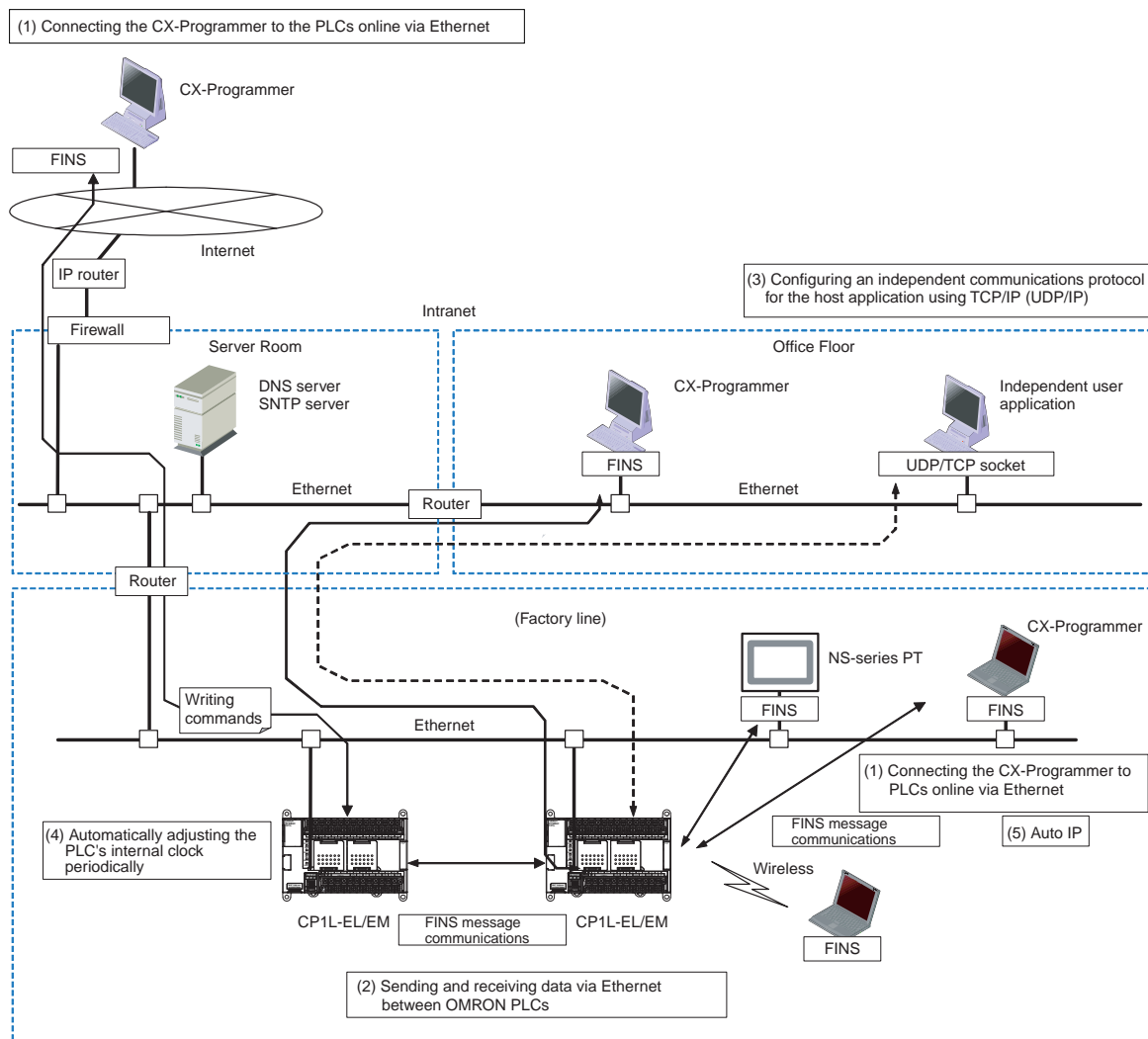
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## 6-1 System Configuration and Features

CP1L-EL/EM series PLC has a built-in Ethernet port. A variety of protocols make available a wide range of applications for use on an Ethernet network. The protocols can be selected include sending and receiving data by TCP/IP or UDP/IP (socket services), sending and receiving commands by OMRON's standard protocol FINS, and automatically adjusting the PLC's internal clock by SNTP.

Because a built-in Ethernet Controller with bus interface is used, the processing speed is faster than the Ethernet Option Board for CP1 series (CP1W-CIF41).

The following diagram shows an example of an overall system configuration using CP1L-EL/EM series PLCs.



### 6-1-1 Connecting the CX-Programmer to PLCs Online via Ethernet

#### Auto IP Operation

Auto IP protocol is supported by a CP1L-EL/EM series PLC.

With Auto-IP, CX-Programmer's online connection command can be executed without any IP setting in computer side when PLC is physically connected with the computer directly.

CX-Programmer can list all the CP1L-EL/EM series PLC connected in a same segment with the computer. And the information of PLC (such as IP address, MAC address) will be displayed.

**Connecting within the Same Segment**

Use the UDP/IP version of the FINS communications service (i.e., FINS/UDP). FINS/UDP is supported by many OMRON products and is compatible with earlier Ethernet Units (CS1W-ETN21, CJ1W-ETN21 and CP1W-CIF41). The CX-Programmer can be connected and used with FINS/UDP.

**Connecting through Multiple Segments**

Use the TCP/IP version of the FINS communications service (i.e., FINS/TCP). It provides automatic recovery at the TCP/IP layer from communications errors (such as packet loss) that occur during multilevel routing. For CX-Programmer, FINS/TCP can be used to directly connect to the PLC online.

**Connecting from a Personal Computer with a Dynamic Private IP Address**

Depending on whether or not the connection will be within the same segment, either use an IP address conversion method for dynamic IP addresses in the FINS/UDP service or use the FINS/TCP service.

It is possible to connect online to a PLC using the CX-Programmer from a computer serving as a temporarily connected node or a permanent DHCP client.

For CX-Programmer, FINS/TCP can be used to directly connect to the PLC online.

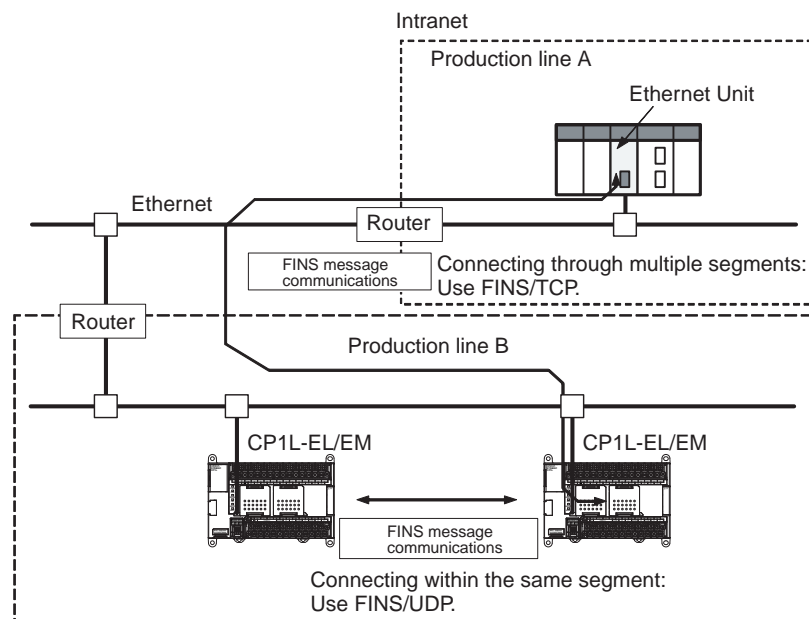
**6-1-2 Exchanging Data between OMRON PLCs using Ethernet****Connecting within the Same Segment**

Use the FINS/UDP, and construct applications using the SEND(090), RECV(098), and CMND(490) instructions in the ladder program. The protocol processing for FINS/UDP is simpler than for FINS/TCP, giving FINS/UDP certain advantages in terms of performance. Another feature of FINS/UDP is that it can be used for broadcasting.

On the other hand, with FINS/UDP it is necessary to provide measures, such as retries, for handling communications errors.

**Connecting through Multiple Segments**

Use the FINS/TCP, and construct applications using the SEND(090), RECV(098), and CMND(490) instructions in the ladder program. FINS/TCP is supported by many OMRON products (CS1W-ETN21, CJ1W-ETN21 and CP1W-CIF41). It provides automatic recovery at the TCP/IP layer from communications errors (such as packet loss) that occur during multilevel routing.



### 6-1-3 Creating an Original Communications Procedure Using TCP/IP (UDP/IP) for the Host Application or Communicating with PLCs from Another Manufacturer

#### Communications by UDP/IP and TCP/IP (Socket Services Function)

The standard Ethernet protocols, UDP/IP and TCP/IP, are supported, making it possible to communicate with a wide range of devices, workstations, computers, and Ethernet Units from other manufacturers.

Up to three ports can be used for various protocols, enabling the use of various applications.

#### Simplified Socket Services

The socket services function for TCP or UDP can be simplified by presetting parameters and using dedicated bits. In addition, the size of received data accumulated in the reception buffer is now stored, and a Data Received Flag has been added. These features eliminate the need for ladder programs to monitor the timing for completion of socket service processing, and thus reduce the amount of labor required for program development.

### 6-1-4 Automatically Adjusting the PLC's Internal Clock at Regular Intervals

#### Operation

Use the automatic clock adjustment function.

With the automatic clock adjustment function, the SNTP server's clock is taken as the standard for automatically adjusting the built-in clock of the PLC. The adjustment can be regularly executed at a specified time (once a day) and it can be executed each time by the ladder program.

To use the automatic clock adjustment function, there must be a separate SNTP server on the network. Aside from the IP address, the host name used for DNS service can be specified for the SNTP server.

#### Specification of Servers by Host Name

In addition to directly specifying the IP address for a SNTP server, it is also possible (by means of the PLC's DNS client function) to specify the server by host name. This enables automatic searches for IP addresses for purposes such as system checking, even when the IP addresses for servers have been changed.

**Note** A separate DNS server is required to specify servers by host name using DNS.



## 6-2 Specifications

### 6-2-1 General Specifications (Ethernet)

| Item                  |                     | Specifications   |  |
|-----------------------|---------------------|--|--|
| Type                  |                     | 100/10Base-TX (Auto-MDIX)  |  |
| Transfer              | Media access method | CSMA/CD  |  |
|                       | Modulation method   | Baseband   |  |
|                       | Transmission paths  | Star form  |  |
|                       | Baud rate           | 100 Mbit/s (100Base-TX)  | 10 Mbit/s (10Base-T)   |
|                       |                     | <ul style="list-style-type: none"> <li>• Half/full auto-negotiation for each port</li> <li>• Link speed auto-sensing for each port</li> </ul>  |  |
|                       | Transmission media  | <ul style="list-style-type: none"> <li>• Unshielded twisted-pair (UDP) cable<br/>Categories: 5, 5e</li> <li>• Shielded twisted-pair (STP) cable<br/>Categories: 100Ω at 5, 5e</li> </ul> | <ul style="list-style-type: none"> <li>• Unshielded twisted-pair (UDP) cable<br/>Categories: 3, 4, 5, 5e</li> <li>• Shielded twisted-pair (STP) cable<br/>Categories: 100Ω at 3, 4, 5, 5e</li> </ul> |
| Transmission distance |                     | 100 m (distance between hub and node)  |  |
| Protocols             |                     | TCP, UDP, ARP, ICMP (ping only), SNMP, DNS   |  |
| Applications          |                     | FINS, Socket, SNMP, DNS (Client)   |  |

### 6-2-2 Comparison with Previous Models (Ethernet Related)

| Model                             | CP1L-EL/EM  | CP1W-CIF41                                 | CS1W-ETN21<br>CJ1W-ETN21  |
|-----------------------------------|---|--|---|
| Local IP address                  | 192.168.250.FINS node address                                     | 192.168.250.1                              | 192.168.250.FINS node address                                     |
| FINS node address                 | Set in PLC setup  | Set in system settings                     | Set by rotary switch  |
| Physical layer                    | 100/10Base-TX (Auto-MDIX)   | 100/10Base-TX (Auto-MDIX)                  | 100/10Base-TX   |
| Number of nodes                   | 254   | 254  | 254   |
| Data length of FINS message       | 1004 bytes (Max)  | 1004 bytes (Max)                           | 2012 bytes (Max)  |
| FINS buffer size                  | 16K bytes   | 8K bytes                                   | 392K bytes  |
| Driver buffer number              | Input: 55×592 bytes<br>Output: 55×592 bytes                       | Input: 16×256 bytes<br>Output: 8×256 bytes | Input: 50×1.5K bytes<br>Output: 50×1.5K bytes                     |
| Process of driver buffer overflow | The last packet will be dropped.                                  | Restart Ethernet function                  | The last packet will be dropped.                                  |
| Connection number (FINS/TCP)      | 3 for user<br>1 for CX-Programmer auto connection                 | 2 (only server)                            | 16  |
| PLC maintenance via the Internet  | Not supported   | Not supported                              | Not supported   |
| Server specification              | Specification by IP address or by host name (DNS Client Function) | Not supported                              | Specification by IP address or by host name (DNS Client Function) |

| Model                                  |  | CP1L-EL/EM   | CP1W-CIF41   | CS1W-ETN21<br>CJ1W-ETN21   |
|--|--|--|--|--|
| FINS comm. service                     | Automatic IP address acquisition                               | A computer automatically acquiring IP addresses can send commands to the PLC and receive responses.        | A computer automatically acquiring IP addresses can send commands to the PLC and receive responses.        | A computer automatically acquiring IP addresses can send commands to the PLC and receive responses.  |
|  | FINS communication with computer without fixed node address    | Possible (with automatic allocation) (Client FINS automatic node address allocation function, TCP/IP only) | Possible (with automatic allocation) (Client FINS automatic node address allocation function, TCP/IP only) | Possible (with automatic allocation) (Client FINS automatic node address allocation function, TCP/IP only)   |
|  | Handling TCP/IP  | With FINS communications, both UDP/IP and TCP/IP (3 max.) possible.  | With FINS communications, both UDP/IP and TCP/IP (2 max.) possible. (Only can be set to server)            | With FINS communications, both UDP/IP and TCP/IP (16 max.) possible.   |
|  | Simultaneous connection of multiple applications in a computer | Possible (with both UDP/IP and TCP/IP)   | Possible (with both UDP/IP and TCP/IP)   | Possible (with both UDP/IP and TCP/IP)   |
| Mail function                          |  | Not supported  | Not supported  | E-mail attachments with I/O memory data are possible for the mail send function. (SMTP, file attachment) With the mail receive function, commands can be received from the PLC. (POP3, mail receive) |
| FTP server function                    |  | Not supported  | Not supported  | Supported  |
| Socket services function               |  | Supported  | Not supported  | Supported  |
| Automatic clock information adjustment |  | Supported  | Not supported  | Supported  |
| IP conflict (GARP)                     |  | Supported  | Not supported  | Supported  |
| TCP keep-alive function                |  | Supported  | Not supported  | Supported  |
| Multicast function                     |  | Not supported  | Not supported  | Not supported  |
| Web function                           |  | Not supported  | Supported  | Supported  |

### Improved FINS Message Communications from CP1W-CIF41

The following functions have been maintained according to the existing Ethernet Unit models for CP1W-CIF41.

- The maximum number of nodes is 254.
- Communications are enabled even if the host computer's IP address is dynamic.
- An automatic client FINS node address allocation function makes it possible to connect online to the PLC even if no FINS node address has been set for the host computer.
- FINS message communications are enabled in both UDP/IP and TCP/IP, and it is enabled in TCP/IP with up to 3 simultaneous connections.  
→Previously CP1W-CIF41 is enabled in TCP/IP with up to 2 simultaneous connections and all can only be set to server.
- Multiple FINS applications, such as the CX-Programmer, on the same computer can be connected online to the PLC via Ethernet.

## 6-3 Network Installation

### Basic Installation Precautions

- Take the greatest care when installing the Ethernet System, being sure to follow ISO 802-3 specifications. You must obtain a copy of these specifications and be sure you understand them before attempting to install an Ethernet System. Unless you are already experienced in installing communications systems, we strongly recommend that you employ a professional to install your system.
- Do not install Ethernet equipment near sources of noise. If noise-prone environments are unavoidable, be sure to take adequate measures against noise interference, such as installing network components in grounded metal cases, using optical links in the system, etc.

### Recommended products

The following products are recommended for use with the CP1L-EL/EM series PLC.

| Part                         | Maker           | Model number           | Specifications   | Inquires  |
|------------------------------|-----------------|------------------------|--|---|
| Hub                          | 100BASE-TX      |                        |  |   |
|                              | OMRON           | W4S1-03B               | 10/100 Mbit/s 3-port hub   |   |
|                              | OMRON           | W4S1-05B (C)           | 10/100 Mbit/s 5-port hub   |   |
|                              | PHOENIX CONTACT | SWITCH 5TX             | 10/100 Mbit/s 5-port hub   |   |
|                              | 10BASE-T        |                        |  |   |
|                              | Allied Telesis  | MR820TLX               | 9-port hub with 10Base-5 backbone port   | Allied Telesis<br>(0120) 86-0442<br>(in Japan only) |
| Twisted-pair cable           | 100BASE-TX      |                        |  |   |
|                              | Fujikura        | F-LINK-E<br>0.5mm x 4P | STP (shielded twisted-pair) cable: Category 5, 5e<br><b>Note:</b> Impedance is limited to 100 Ω.       | ---   |
|                              | Fujikura        | CTP-LAN5<br>0.5mm x 4P | UTP (unshielded twisted-pair) cable: Category 5, 5e  |   |
|                              | 10BASE-T        |                        |  |   |
|                              | Fujikura        | F-LINK-E<br>0.5mm x 4P | STP (shielded twisted-pair) cable: Category 3, 4, 5, 5e<br><b>Note:</b> Impedance is limited to 100 Ω. |   |
|                              | Fujikura        | CTP-LAN5<br>0.5mm x 4P | UTP (unshielded twisted-pair) cable: Category 3, 4, 5, 5e  |   |
| Connectors<br>(Modular plug) | STP Plug        |                        |  |   |
|                              | Panduit Corp    | MPS588                 | ---  |   |
|                              | UTP Plug        |                        |  |   |
|                              | Panduit Corp    | MP588-C                | ---  |   |

## Precautions on Laying Twisted-pair Cable

### Basic Precautions

- Press the cable connector in firmly until it locks into place at both the hub and the PLC.
- After laying the twisted-pair cable, check the connection with a 10Base-T cable tester.

### Environment Precautions

- The UTP cable is not shielded, and the hub is designed for use in OA environments. In environments subject to noise, construct a system with shielded twisted-pair (STP) cable and hubs suitable for an FA environment.
- Do not lay the twisted-pair cable together with high-voltage lines.
- Do not lay the twisted-pair cable near devices that generate noise.
- Do not lay the twisted-pair cable in locations subject to high temperature or high humidity.
- Do not lay the twisted-pair cable in locations subject to excessive dirt and dust or to oil mist or other contaminants.

### Hub Installation Environment Precautions

- Do not install the hub near devices that generate noise.
- Do not install the hub in locations subject to high temperature or high humidity.
- Do not install the hub in locations subject to excessive dirt and dust or to oil mist or other contaminants.

### Hub Connection Methods

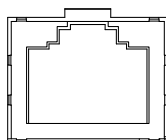
If more hub ports are required, they can be added by connecting more than one hub. There are two possible connection methods for hubs: Cascade and stacked.

## Ethernet Connectors

The following standards and specifications apply to the connectors for the Ethernet twisted-pair cable.

- Electrical specifications: Conforming to IEEE802.3 standards
- Connector structure: RJ45 8-pin Modular Connector

(conforming to ISO8877)



| Connector Pin | Signal Name         | Abbr. | Signal Direction |
|---------------|---------------------|-------|------------------|
| 1             | Transmission data + | TD+   | Output           |
| 2             | Transmission data - | TD-   | Output           |
| 3             | Reception data +    | RD+   | Input            |
| 4             | Not used            | ---   | ---              |
| 5             | Not used            | ---   | ---              |
| 6             | Reception data -    | RD-   | Input            |
| 7             | Not used            | ---   | ---              |
| 8             | Not used            | ---   | ---              |
| Hood          | Frame ground        | FG    | ---              |

## Connecting the Cable

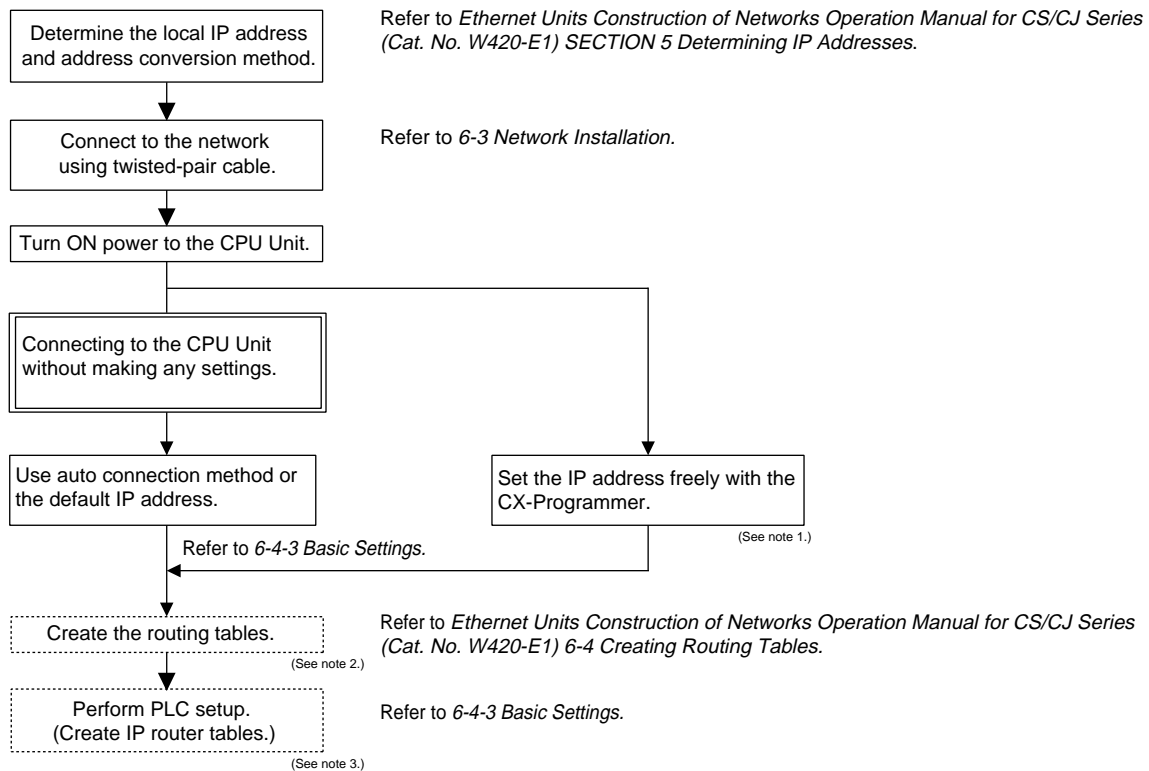
**⚠ Caution** Turn OFF the PLC's power supply before connection or disconnecting twisted-pair cable.

**⚠ Caution** Allow enough space for the bending radius of the twisted-pair cable.

- 1,2,3...
1. Lay the twisted-pair cable.
  2. Connect the cable to the hub. Be sure to press in the cable until it locks into place.  
Request cable installation from a qualified professional.
  3. Connect the cable to the connector on the PLC. Be sure to press in the cable until it locks into place.

## 6-4 Basic Setting for Ethernet

### 6-4-1 Overview of Startup Procedure



#### Note

- (1) The local IP address and other parameters can be set from the CX-Programmer.
- (2) It is not necessary step, and the CX-Integrator version 2.53 or higher (CX-ONE version 4.25 or higher) is required.  
When the FINS communications service is used, routing tables must be created in advance. Routing tables are required in the following circumstances.
  - When communicating with a PLC or computer on another network (e.g. remote programming or monitoring using FINS message or a CX-programmer)
  - When routing tables are used for one or more other nodes on the same network
- (3) It is not necessary step.

## 6-4-2 PLC Setup Procedure

Use the CX-Programmer (Ver. 9.40 or higher) for the CP1L-EL/EM Setup, and follow the procedure described below.

**1,2,3...**

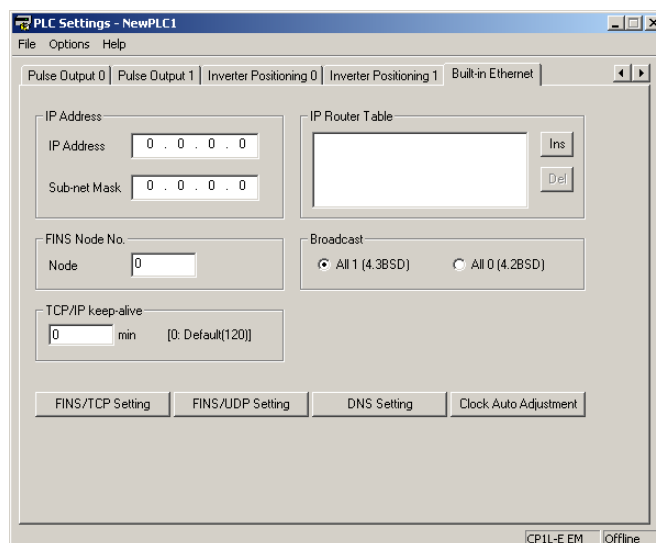
1. Connect the CX-Programmer online.

The CX-Programmer can be connected to the PLC in either of the following ways:

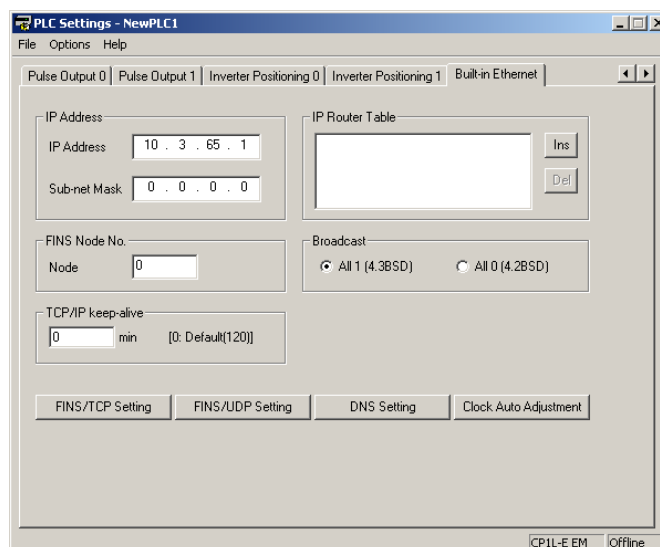
- a. Connect the personal computer to the PLC by Ethernet.  
With Auto-IP function, CX-Programmer's online connection command can be executed without any IP setting in computer side when the PLC is physically connected with the computer directly.
- b. Connect the personal computer to the PLC by serial cable, through PLC's serial port with CP1W-CIF01/CIF11/CIF12.

For details on connecting the CX-Programmer to the PLC by serial cable, refer to *5-1 Connecting the CX-Programmer*.

2. Move the cursor to the **Settings** and double click. Select the Built-in Ethernet Tab to display the window for making the Ethernet Port Setup. The default settings are shown below.

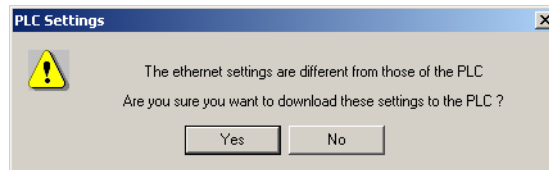
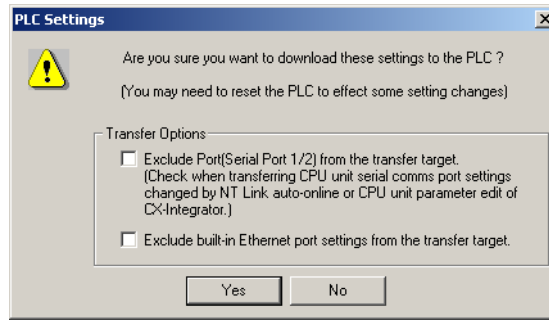


3. Make the required settings (i.e., the IP address in this case).



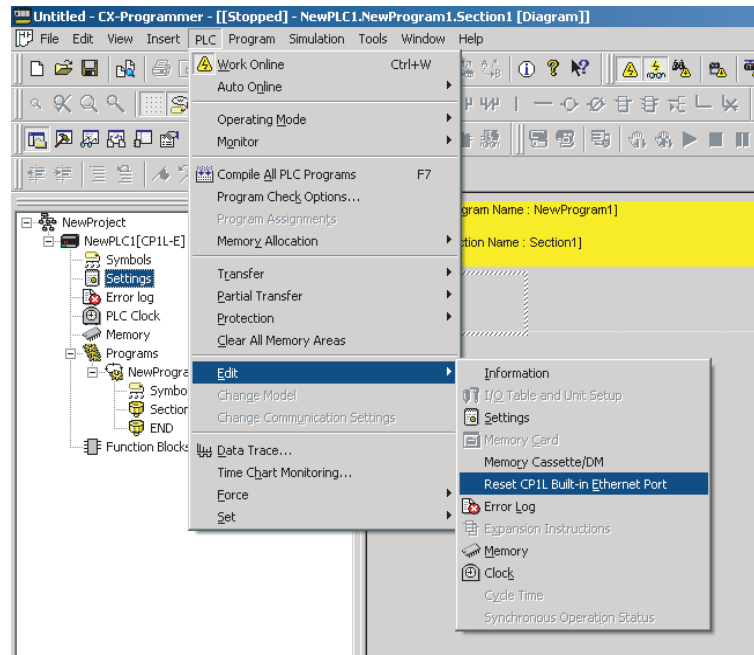
4. Transfer the settings to the PLC.

Click on **Yes** in the following dialog box.



5. In order for the Ethernet Setup to go into effect, the Ethernet Port must be restarted.

Please use the following way to reset CP1L built-in Ethernet Port.



After the LNK/ACT indicator has turned OFF and then turned ON again (Ethernet cable should be connected), the Ethernet port will recognize the new settings.

### 6-4-3 Basic Settings

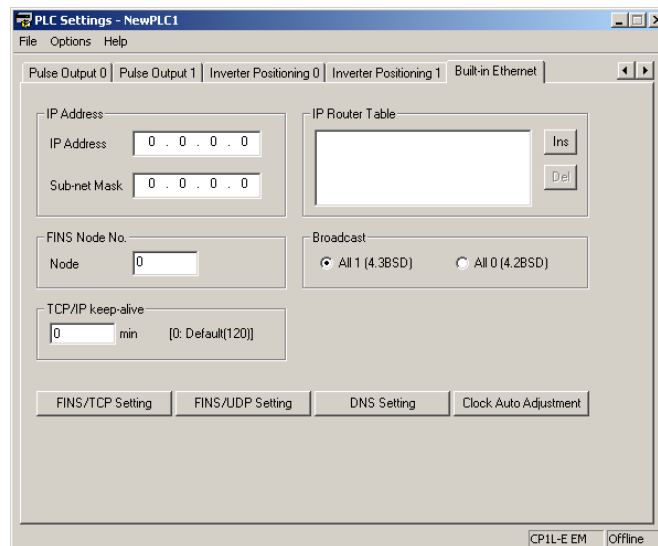
The following items comprise the basic settings in the PLC's Ethernet port setup.

#### Basic Setting

| CX-Programmer tab | Settings           |
|-------------------|--------------------|
| Built-in Ethernet | IP address         |
|                   | Subnet mask        |
|                   | Broadcast settings |
|                   | TCP/IP keep-alive  |
|                   | IP router table    |

#### CX-Programmer Setup

Move the cursor to the **Settings** and double click. Select the Built-in Ethernet Tab in PLC setup dialog.



| Item              | Contents   | Default  |
|-------------------|--|--|
| IP Address        | Set the local IP address.  | 0.0.0.0<br>(192.168.250. FINS node address )         |
| Sub-net Mask      | Set the subnet mask.<br>This is required if a method other than the IP address table method is used for address conversion.  | 0.0.0.0<br>(default net mask for IP address setting) |
| Broadcast         | Set the method for specifying IP addresses for broadcasting in FINS/UDP.<br><ul style="list-style-type: none"> <li>All 1 (4.3BSD): Broadcast with host number set to all ones.</li> <li>All 0 (4.2BSD): Broadcast with host number set to all zeros.</li> </ul> Normally the default setting should be used.   | All 1 (4.3BSD)                                       |
| TCP/IP keep-alive | Set the liveness-checking interval. When socket services using either FINS/TCP or TCP/IP are used, the connection will be terminated if there is no response from the remote node (either a server or client) within the time set here. (Enabled for socket services using FINS/TCP or TCP/IP only.)<br>Setting range: 0 to 65,535 minutes<br>This setting applies to the keep-alive setting for each connection set with the FINS/TCP Setting button. | 0<br>(120 minutes)                                   |
| IP Router Table   | Set when the PLC is to communicate through the IP router with nodes on another IP network segment.   | None   |



- Note**
- (1) Make settings using the PLC settings function in the CX-Programmer (to be included in version 9.4 and higher).
  - (2) For details, refer to 2-9 *Basic Settings* in the *Ethernet Units Construction of Networks Operation Manual* (Cat. No. W420-E1).

### 6-4-4 Communications Test

If the basic settings (in particular the IP address and subnet mask) have been made correctly, then it should be possible to communicate with nodes on the Ethernet.

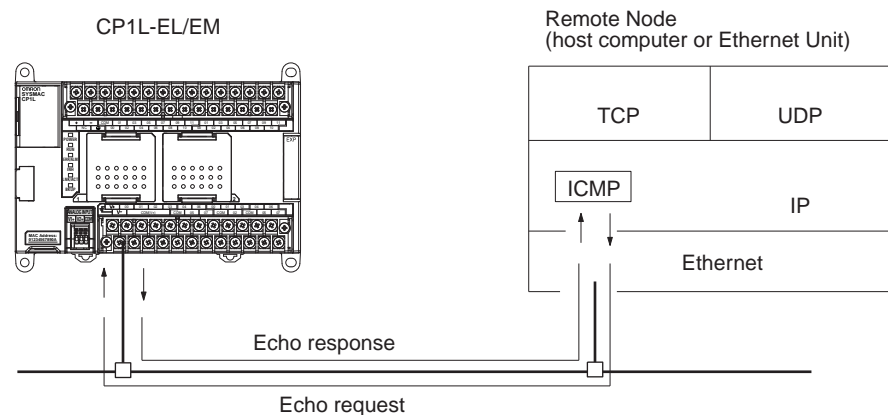
The following describes how to use the PING command to perform communications testing between CP1L-EL/EM series PLCs.

#### PING Command

The PING command sends an echo request packet to a remote node and receives an echo response packet to confirm that the remote node is communicating correctly. The PING command uses the ICMP echo request and responses. The echo response packet is automatically returned by the ICMP.

The PING command is normally used to check the connections of remote nodes when configuring a network. The PLC supports the ICMP echo reply functions.

If the PLC returns a normal response to the PING command, then the remote nodes are physically connected correctly.



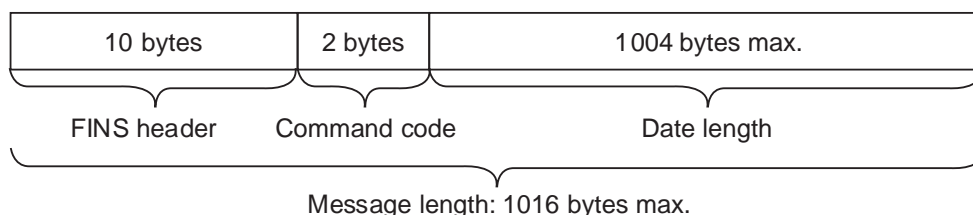
The PLC automatically returns the echo response packet in response to an echo request packet sent by another node (host computer or other Ethernet Unit).

## 6-5 FINS Communications

### 6-5-1 FINS Communications Service Specifications

| Item                      | Specification  |  |
|---------------------------|--|--|
| Number of nodes           | 254  |  |
| Message Length            | 1016 bytes max.  |  |
| Date Length (See note 1.) | 1004 bytes max.  |  |
| Number of buffer          | 16   |  |
| Protocol name             | FINS/UDP method  | FINS/TCP method  |
| Protocol used             | UDP/IP   | TCP/IP   |
|                           | The selection of UDP/IP or TCP/IP is made by means of the FINS/UDP or FINS/TCP button in Built-in Ethernet Tab in the CX-Programmer's PLC Setup.   |  |
| Number of connections     | ---  | 3 for user, 1 for CX-Programmer auto connection  |
| Port number (See note 2.) | 9600 (default)<br>Can be changed.  | 9600 (default)<br>Can be changed.  |
| Protection                | No   | Yes (Specification of client IP addresses when unit is used as a server)   |
| Other                     | Items set for each UDP port <ul style="list-style-type: none"> <li>• Broadcast</li> <li>• Address conversion method</li> </ul>   | Items set for each connection <ul style="list-style-type: none"> <li>• Server/client specification</li> <li>• Remote IP address specification<br/>Server: Specify IP addresses of clients permitted to connect.<br/>Client: Specify remote Ethernet Unit (server) IP address.</li> <li>• Automatic FINS node address allocation:<br/>Specify automatic allocation of client FINS node addresses.</li> <li>• Keep-alive:<br/>Specify whether remote node keep-alive is to be used.</li> </ul> |
| Internal table            | <p>This is a table of correspondences for remote FINS node addresses, remote IP addresses, TCP/UDP, and remote port numbers. It is created automatically when power is turned ON to the PLC or when the unit is restarted, and it is automatically changed when a connection is established by means of the FINS/TCP method or when a FINS command received.</p> <p>The following functions are enabled by using this table.</p> <ul style="list-style-type: none"> <li>• IP address conversion using the FINS/UDP method</li> <li>• Automatic FINS node address conversion after a connection is established using the FINS/TCP method</li> <li>• Automatic client FINS node address allocation using the FINS/TCP method</li> <li>• Simultaneous connection of multiple FINS applications</li> </ul> |  |

**Note** (1) Refer to the following diagram for the relation between message length and date length.

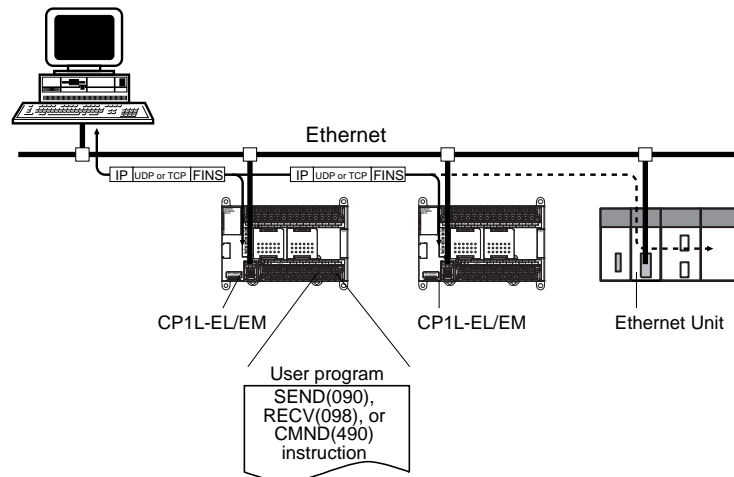


(2) The FINS/UDP and FINS/TCP port numbers for CX-Programmer Auto Connection are always set to 9600, although the FINS/UDP and FINS/TCP port numbers for user are set to other values.

## 6-5-2 FINS Communications Service

### Basic Functions

FINS commands can be sent to or received from other PLCs or computers on the same Ethernet network by executing SEND(090), RECV(098), or CMND(490) instructions in the ladder diagram program. This enables various control operations such as the reading and writing of I/O memory between PLCs, mode changes.



Executing, from the host computer, FINS commands with UDP/IP or TCP/IP headers enables various control operations, such as the reading and writing of I/O memory between PLCs, mode changes.

For example, it is possible to connect online via Ethernet from FINS communications applications such as the CX-Programmer, and to perform remote programming and monitoring.

## 6-5-3 Procedure for Using FINS/UDP, FINS/TCP

### Procedure for Using FINS/UDP

1. Make the basic settings.  
Refer to 6-4-1 Overview of Startup Procedure.



2. Make the settings for FINS/UDP in the PLC Setup with CX-Programmer.



3. Make the routing table settings and transfer them to each PLC. (See note.)  
Set the routing tables with CX-Integrator, and transfer it to each PLC.



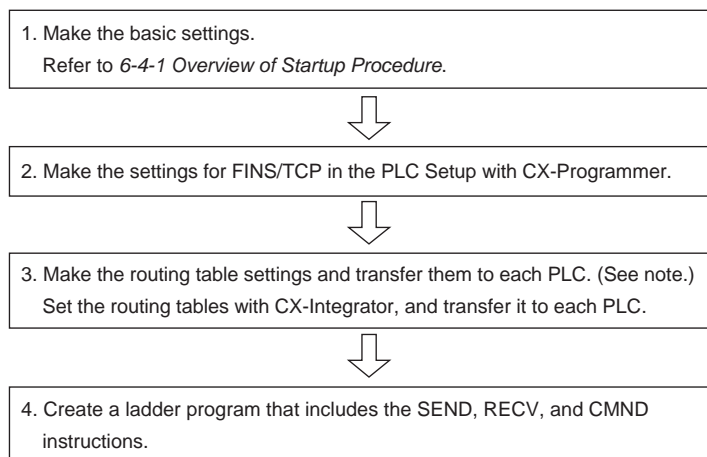
4. Create a ladder program that includes the SEND, RECV, and CMND instructions.

**Note** Routing tables are required in the following situations:

- When communicating with a PLC or computer on another network (e.g., remote programming or monitoring using FINS messages or a CX-Programmer).

- When routing tables are used for one or more other nodes on the same network.  
It is not necessary to set routing tables if the nodes are connected as one network.

### Procedure for Using FINS/TCP



**Note** Routing tables are required in the following situations:

- When communicating with a PLC or computer on another network (e.g., remote programming or monitoring using FINS messages or a CX-Programmer).
- When routing tables are used for one or more other nodes on the same network.  
It is not necessary to set routing tables if the nodes are connected as one network.

### 6-5-4 PLC Setup for FINS/UDP and FINS/TCP Applications

Aside from the basic settings, the required settings vary depending on the particular communications applications that are used. All these settings are in the Built-in Ethernet Tab. Click on the relative button can open the setup dialog.

#### FINS/UDP

| Button name      | Settings                                  |
|------------------|---|
| FINS/UDP Setting | Conversion                                |
|                  | FINS/UDP Port No.                         |
|                  | IP Address Table                          |
|                  | Destination IP Address Change Dynamically |

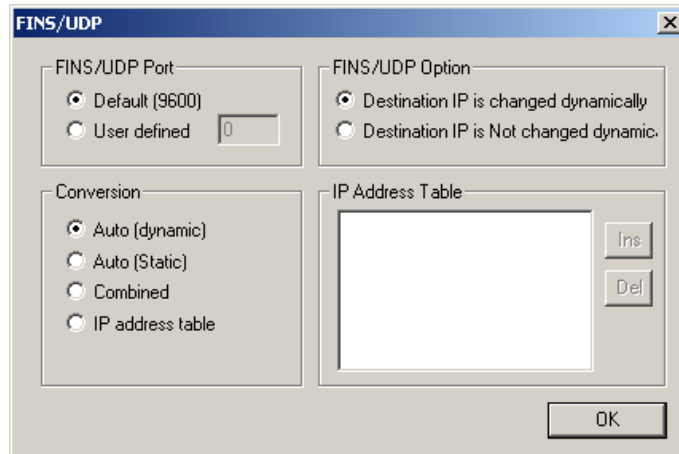
#### FINS/TCP

| Button name      | Settings                  |
|------------------|---------------------------|
| FINS/TCP Setting | FINS/TCP Port No.         |
|                  | FINS/TCP Connection Setup |

## CX-Programmer Setup

### FINS/UDP

Move the cursor to the **Settings** and double click. Select the Built-in Ethernet Tab. Click the **FINS/UDP Setting** button to display the FINS/UDP setup dialog.

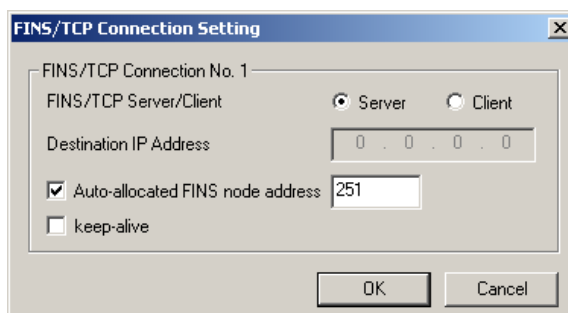
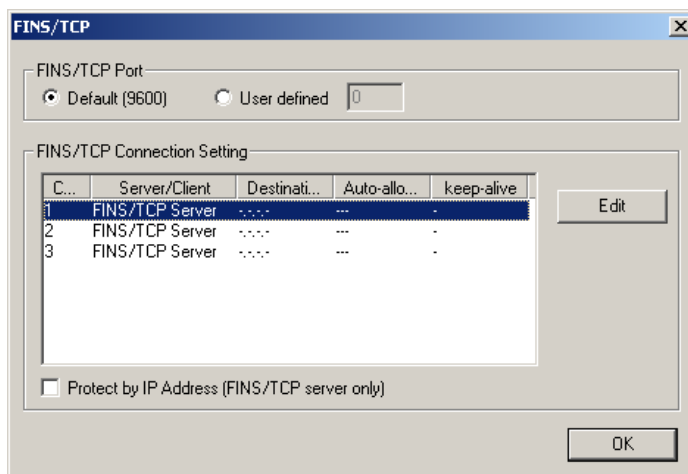


| Item   | Contents  | Default                         |
|--|---|---------------------------------|
| FINS/UDP Port                                  | Specify the local UDP port number to be used for the FINS communications service. The UDP port number is the number used for UDP identification of the application layer (i.e., the FINS communications service in this case). <ul style="list-style-type: none"> <li>• Default (9,600)</li> <li>• User defined (Setting range: 1 to 65,535)</li> </ul> <b>Note:</b> Make the settings so that UDP port number does not overlap with port number 123 for SNTP and port number 53 for DNS. | 0<br>(9,600)                    |
| Conversion                                     | Select any of the following as the method for finding and converting IP addresses from FINS node addresses. (Enabled for FINS/UDP only.) <ul style="list-style-type: none"> <li>• Automatic generation (dynamic): Auto (dynamic)</li> <li>• Automatic generation (static): Auto (Static)</li> <li>• IP address table method: Table used</li> <li>• Combined method: Mixed</li> </ul>  | Auto (dynamic)                  |
| Destination IP Address<br>(Change Dynamically) | Select to dynamically change the remote (destination) IP address for FINS/UDP. To prohibit dynamic changes, deselect this box.  | Checked<br>(Change Dynamically) |
| IP Address Table                               | Set the IP address table that defines the relationship between FINS node addresses and IP addresses.<br><br>With FINS/UDP, this is enabled only when the IP address table method or combined method is set as the IP address conversion method.   | None                            |

**Note** Make settings using the PLC settings function in the CX-Programmer (to be included in version 9.4 and higher).

## FINS/TCP

Move the cursor to the **Settings** and double click. Select the Built-in Ethernet Tab. Click the **FINS/TCP Setting** button to display the FINS/TCP setup dialog.



| Item                  | Contents   | Default       |
|-----------------------|--|---------------|
| FINS/TCP Port         | Specify the local TCP port number to be used for the FINS communications service. The TCP port number is the number used for TCP identification of the application layer (i.e., the FINS communications service in this case). <ul style="list-style-type: none"> <li>• Default (9,600)</li> <li>• User defined (Setting range: 1 to 65,535)</li> </ul>                | 0<br>(9,600)  |
| No.                   | Shows the connection number. This is a network API used when TCP is used for the FINS communications service. It corresponds to a socket in the socket services. Up to 3 can be used at a time, and they are identified by connection numbers 1 to 3. The PLC can thus simultaneously execute the FINS communications service by TCP with up to 3 remote nodes.        |               |
| Protect by IP address | When this option is selected, if the PLC is set for use as a server, and if a connection number other than 0.0.0.0 is set for a destination IP address, any connection request from other than the number set for that IP address will be denied.<br><br>Select this option to prevent faulty operation (by FINS commands) from specific nodes from affecting the PLC. | Not protected |

The following settings can be made for each connection number.

| Item                     | Contents  | Default                                     |
|--------------------------|---|---|
| FINS/TCP Server/Client   | <p>For each connection number, this setting specifies the PLC for use as either a server or a client.</p> <ul style="list-style-type: none"> <li>• When the PLC is used as a server:<br/>The PLC opens a connection with that connection number and waits for service requests (FINS commands) from clients. Connection numbers are used in ascending order and allocated to clients in the order connections are made.</li> <li>• When the PLC is used as a client:<br/>The PLC establishes a connection with the server set as the destination IP address. Once the connection has been established, FINS/TCP is used for FINS communications.</li> </ul> | Server                                      |
| Destination IP Address   | <ul style="list-style-type: none"> <li>• When the PLC is used as a server:<br/>If the option is selected to use IP addresses to protect, set the IP addresses as required at clients from which connection is permitted. If not set for those connections, the default setting of 0.0.0.0 can be used.</li> <li>• When the PLC is used as a client:<br/>Set the IP address for the remote PLC (i.e., the server) that is to be connected by FINS/TCP. It is required that an IP address be set for the remote PLC.</li> </ul>   | 0.0.0.0                                     |
| Auto allocated FINS node | If the client (normally a personal computer) application supports FINS/TCP, and if FINS node addresses are not fixed, the client will take 0 as its node address. Then, when a FINS command arrives, the number set here (from 251 to 253) will automatically be allocated as the client's FINS node address.   | From 251 to 253, for connection Nos. 1 to 3 |
| keep-alive               | <p>For each connection number, set whether or not the remote node connection check function is to be used for the FINS/TCP server and client.</p> <p>If the keep-alive box is checked here, then, when the remote node goes without responding for longer than the monitor time set in the Setup, the connection will be terminated. If a remote node turns OFF without warning, the connection will remain open indefinitely, so this option should be used whenever possible.</p>   | Use   |

For details, refer to *SECTION 6 FINS Communications Service* in the *Ethernet Units Operation Manual Construction of Networks (Cat. No. W420-E1)*.

## 6-5-5 Memory Allocations

### Auxiliary Area Allocation

The following table and descriptions cover the words and bits in the Auxiliary Area of PLC memory that are related to the FINS/UDP and FINS/TCP.

#### Ethernet Status

| Address | Bit(s) | Name                          | Status | Manipulated by | Unit operation   | Access    |
|---------|--------|-------------------------------|--------|----------------|--|-----------|
| A45     | 14     | Link Status Flag              | ON     | Unit           | ON while a link is established between hub or remote device.   | Read only |
|         |        |                               | OFF    | Unit           | OFF when the link between hub or remote device is terminated.  |           |
| A46     | 2      | IP Address Setting Error Flag | ON     | Unit           | ON if any of the following conditions apply to the IP address.<br>• All bits in the host ID are 0 or 1.<br>• All bits in the network ID are 0 or 1.<br>• All bits in the subnet ID are 1.<br>• The IP address begins with 127 (0x7F) | Read only |
|         |        |                               | OFF    | Unit           | OFF when the IP address is normal.   |           |
|         | 3      | IP Address Table Error Flag   | ON     | Unit           | On if the IP address table information is incorrect.   |           |
|         |        |                               | OFF    | Unit           | OFF when the IP address table is normal.   |           |
|         | 4      | IP Router Table Error Flag    | ON     | Unit           | ON if the IP router table information is incorrect.  |           |
|         |        |                               | OFF    | Unit           | OFF when the IP address table is normal.   |           |
|         | 5      | DNS Server Error Flag         | ON     | Unit           | ON when the following errors occur during DNS server operation:<br>• An illegal server IP address is set.<br>• A timeout occurs during communications with the server.   |           |
|         |        |                               | OFF    | Unit           | OFF when DNS server operation is normal.   |           |
|         | 6      | Routing Table Error Flag      | ON     | Unit           | ON if the routing table information is incorrect.  |           |
|         |        |                               | OFF    | Unit           | OFF when the routing table is normal.  |           |
|         | 11     | SNTP Server Error             | ON     | Unit           | ON when the following errors occur during SNTP server operation:<br>• An illegal server IP address or host name is set.<br>• A timeout occurs during communications with the server.   |           |
|         |        |                               | OFF    | Unit           | OFF when SNTP server operation is normal.  |           |
|         | 14     | Address Disagreement Flag     | ON     | Unit           | ON if the remote IP address is set to automatic generation but the local IP address host number and FINS node address do not agree   |           |
|         |        |                               | OFF    | Unit           | OFF under all other circumstances  |           |



| Address | Bit(s) | Name                       | Status | Manipulated by | Unit operation  | Access    |
|---------|--------|----------------------------|--------|----------------|---|-----------|
| A47     | 0      | FINS/TCP Connection Flag 1 | ON     | Unit           | Turned ON by the Unit when a connection is established.   | Read only |
|         |        |                            | OFF    | Unit           | Turned OFF by the Unit when the connection is terminated. |           |
|         | 1      | FINS/TCP Connection Flag 2 | ON     | Unit           | Turned ON by the Unit when a connection is established.   |           |
|         |        |                            | OFF    | Unit           | Turned OFF by the Unit when the connection is terminated. |           |
|         | 2      | FINS/TCP Connection Flag 3 | ON     | Unit           | Turned ON by the Unit when a connection is established.   |           |
|         |        |                            | OFF    | Unit           | Turned OFF by the Unit when the connection is terminated. |           |

**FINS Communication Error Information**

| Address    | Bit(s) | Name                                     | Status | Manipulated by | Unit operation   | Access     |
|------------|--------|--|--------|----------------|--|------------|
| A40 to A44 | ---    | Ethernet Communication Error Information | ---    | Unit           | <p>When an error has occurred, the error code, error contents, and error's time and date are stored in these AR channels. The most recent error can be stored.</p> <p>The function of these 5 words is as follows:</p> <p>1) Error code (bits 0 to 15)</p> <p>2) Error contents (bits 0 to 15)</p> <p>3) Minutes (bits 8 to 15), Seconds (bits 0 to 7)</p> <p>4) Day of month (bits 8 to 15), Hours (bits 0 to 7)</p> <p>5) Year (bits 8 to 15), Month (bits 0 to 7)</p> <p>The detail of error code and contents, please refer to <i>12-2-6 Other Errors</i>.</p> <p>Seconds: 00 to 59, BCD</p> <p>Minutes: 00 to 59, BCD</p> <p>Hours: 00 to 23, BCD</p> <p>Day of month: 01 to 31, BCD</p> <p>Month: 01 to 12, BCD</p> <p>Year: 00 to 99, BCD</p> | Read only  |
| A46        | 15     | Ethernet Communication Error Flag        | ON     | Unit           | ON if an Ethernet communication error has occurred. The detail information is stored in A40 to A44.  | Read only  |
|            |        |  | OFF    | Unit           | OFF when Ethernet communication error has been cleared by Ethernet communication error clear flag (A500.11).   |            |
| A500       | 11     | Ethernet Communication Error Clear Flag  | ON     | User           | ON if want to clear Ethernet communication error.  | Read/write |
|            |        |  | OFF    | Unit           | OFF after Ethernet communication error has been cleared.   |            |

## 6-5-6 New FINS Commands

### New FINS Commands Code List

The command codes listed in the following table are new added commands to CP1L-EL/EM series PLC.

For the details of other FINS commands, refer to the *SYSMAC CS/CJ/CP/NSJ-series Communications Commands Reference Manual (Cat. No. W342-E1)*.

| Command code |     | Name   | Unit address<br>(See note.) |
|--------------|-----|--|-----------------------------|
| MRC          | SRC |  |                             |
| 04           | 03  | RESET  | 0xFA                        |
| 05           | 01  | ETHERNET PORT DATA READ                        |                             |
| 27           | 30  | FINS/TCP CONNECTION REMOTE NODE CHANGE REQUEST | 0x00                        |
|              | 31  | FINS/TCP CONNECTION STATUS READ                |                             |
|              | 50  | IP ADDRESS TABLE WRITE                         |                             |
|              | 51  | IP ROUTER TABLE WRITE                          |                             |
|              | 60  | IP ADDRESS TABLE READ                          |                             |
|              | 61  | IP ROUTER TABLE READ                           |                             |

**Note** There are two unit address (DA2 in FINS header) used in CP1L-EL/EM series PLC units.

|      |   |
|------|---|
| 0xFA | It is used for the two new added FINS commands relative with built-in Ethernet Port. (Ethernet controller reset command and Ethernet Port information read command) |
| 0x00 | It is used for the FINS commands other than the two commands above.   |

**Note** Ethernet controller reset command and Ethernet Port information read command can only be executed by other PLCs or computers on the Ethernet network. It cannot be executed by CMND(490) instruction in the user program.

### Response Code List

Response codes are 2-byte codes which indicate the results of command execution. They are returned in the response following the command code.

The first byte of a response code is the MRES (main response code), which categorizes the results of command execution. The second byte is the SRES (sub-response code) which specifies the results.

|                 |                  |
|-----------------|------------------|
| Command<br>code | Response<br>code |
|-----------------|------------------|

□ □ □ □

MRC SRC MRES SRES

MRC: Main request code  
 SRC: Sub-request code  
 MRES: Main response code  
 SRES: Sub-response code

The MRES codes are shown in the following table along with the results they indicate.

| MRES | Execution results             |
|------|-------------------------------|
| 00   | Normal completion             |
| 01   | Local node error              |
| 02   | Remote node error             |
| 03   | Unit error (controller error) |
| 04   | Service not supported         |
| 05   | Routing error                 |
| 10   | Command format error          |
| 11   | Parameter error               |
| 22   | Status error                  |
| 23   | Operating environment error   |
| 25   | Unit error                    |

Refer to the *SYSMAC CS/CJ/CP/NSJ-series Communications Commands Reference Manual (Cat. No. W342-E1)* or the operation manuals for the relevant unit for further information on response codes.

## Command/Response Reference

This section describes the FINS commands that can be sent to PLC's Ethernet module and the responses to each command.

The command, response, and (where applicable) the results storage blocks are given with the commands in graphic form as shown in the following diagram. If the data is fixed, it is included in the blocks. If the data is variable, it is described following the blocks. Each box represents 1 byte; every two boxes represents 1 word. The following diagram shows 2 bytes, or 1 word.



Two bytes

The results storage format is the format used to store transfer results.

Response codes applicable to the command are described at the end of the command description. If any UNIX error codes are generated, these are also described. Refer to your UNIX error symbol definition file `/usr/include/sys/errno.h` for details. UNIX errors are returned in the results storage area.

**Note** Except for special cases, all send/receive data is in hexadecimal format.

## New FINS Commands Addressed to Built-in Ethernet Port (0xFA)

### Command Code List

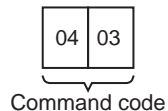
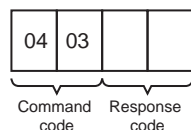
The command codes listed in the following table can be sent to the built-in Ethernet port.

The destination unit address (DA2) in FINS frame should be set as 0xFA.

| Command code |     | Name                    |
|--------------|-----|-------------------------|
| MRC          | SRC |                         |
| 04           | 03  | RESET                   |
| 05           | 01  | ETHERNET PORT DATA READ |

**RESET: 0403**

Reset the Ethernet Unit.

**Command Block****Response Block****Precautions**

No response will be returned if the command ends normally. A response will be returned only if an error occurs.

In some cases, send requests (SEND/RECV instructions) made from the PLC to the built-in Ethernet port just before execution of the RESET command may not be executed.

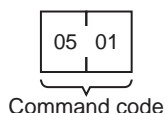
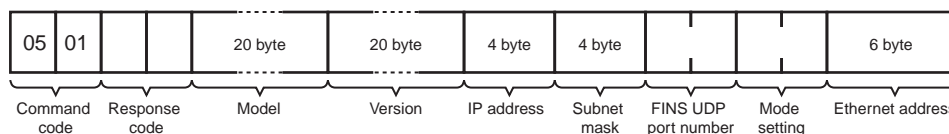
Except for the FINS communications service sockets, all open sockets (for sockets services) are closed immediately before resetting.

**Response Codes**

| Response code | Description       |
|---------------|-------------------|
| 1001          | Command too large |

**ETHERNET PORT CONTROLLER DATA READ: 0501**

Reads the following data from the Ethernet port, PLC model, PLC version, IP address, subnet mask, FINS UDP port number, mode settings, Ethernet address.

**Command Block****Response Block****Parameters****Model, Version (Response)**

The PLC model and version are returned as ASCII characters occupying 20 bytes each (i.e., 20 characters each). If all bytes are not used, the remaining bytes will be all spaces (ASCII 20 Hex).

Example Model: CP1L-ETN21  
Version: V1.00

**IP Address, Subnet Mask (Response)**

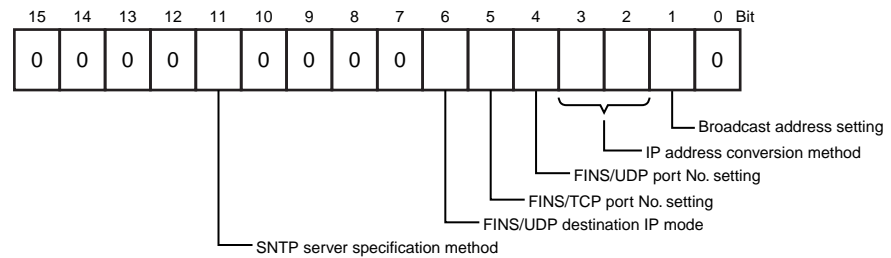
The built-in Ethernet port's IP address and subnet mask are returned as 4 bytes each.

**FINS UDP Port Number (Response)**

The built-in Ethernet port's UDP port number for FINS is returned as 2 bytes.

**Mode Setting (Response)**

The mode setting in the system setup is returned.

**Broadcast Address Setting**

0: Broadcast with host number set to all ones (4.3BSD specifications)

1: Broadcast with host number set to all zeroes (4.2BSD specifications)

**IP Address Conversion Method Setting**

00, 01: Automatic generation method

10: IP address table reference method

11: Combined method (IP address table reference + automatic generation)

**FINS/UDP Port Number Setting**

0: Default (9600)

1: Unit Setup value

**FINS/TCP Port Number Setting**

0: Default (9600)

1: Unit Setup value

**FINS/UDP Destination IP Mode**

0: Dynamical mode

1: Static mode

**SNTP Server Specification Method**

0: IP address

1: Host name

**Ethernet Address (Response)**

The Ethernet address of the Ethernet port is returned. The Ethernet address is the address marked on the label on the top of the PLC.

**Response Codes**

| Response code | Description       |
|---------------|-------------------|
| 0000          | Normal            |
| 1001          | Command too large |

**New FINS Commands Addressed to CPU Port (0x00)****Command Code List**

This section describes the new FINS commands that can be sent to the CPU port and the responses that are returned.

The command codes listed in the following table can be sent to the CPU port.

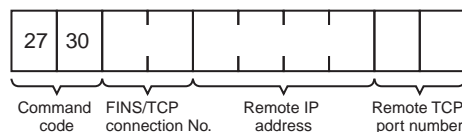
The destination unit address (DA2) in FINS frame should be set as 0x00.

| Command code |     | Name   |
|--------------|-----|--|
| MRC          | SRC |  |
| 27           | 30  | FINS/TCP CONNECTION REMOTE NODE CHANGE REQUEST |
|              | 31  | FINS/TCP CONNECTION STATUS READ                |
|              | 50  | IP ADDRESS TABLE WRITE                         |
|              | 51  | IP ROUTER TABLE WRITE                          |
|              | 60  | IP ADDRESS TABLE READ                          |
|              | 61  | IP ROUTER TABLE READ                           |

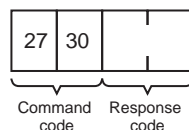
### **FINS/TCP CONNECTION REMOTE NODE CHANGE REQUEST: 2730**

Requests a remote node change for the FINS/TCP connection.

#### **Command Block**



#### **Response Block**



#### **Parameters**

##### **FINS/TCP Connection No. (Command)**

Specifies, in two bytes, the FINS/TCP connection number (1 to 3) for which the change is to be made.

##### **Remote IP Address (Command)**

Specifies the remote node's IP address (must be non-zero) in hexadecimal.

##### **Remote Port Number (Command)**

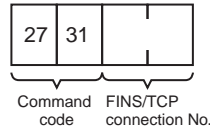
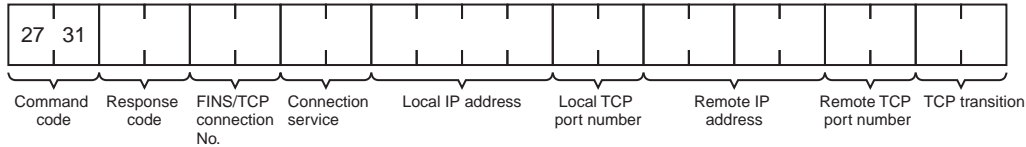
Specifies the remote TCP port number (must be non-zero) with this command.

#### **Response Codes**

| Response code | Description   |
|---------------|---|
| 0000          | Normal  |
| 0105          | Node address setting error<br>Local IP address setting error  |
| 0302          | CPU Unit error; execution not possible.   |
| 1001          | Command too large   |
| 1002          | Command too small   |
| 1100          | Connection number not set from 1 to 3<br>Remote IP address set to 0<br>Remote TCP port number set to 0                  |
| 2230          | Connection already established with specified remote node   |
| 2231          | Specified connection number not set as FINS/TCP client in Unit Setup  |
| 2232          | Remote node change processing for specified connection number aborted because change request received during processing |

**FINS/TCP CONNECTION STATUS READ: 2731**

Reads the FINS/TCP connection status.

**Command Block****Response Block****Parameters****FIFINS/TCP Connection No. (Command, Response)**

Command: Specifies, in two bytes, the FINS/TCP connection number (1 to 3) for which the status is to be read.

Response: Specifies the FINS/TCP connection number (1 to 3) for which the status was read.

**Connection Service (Response)**

Specifies the service that is being used for the FINS/TCP connection as a number.

0003: FINS/TCP server

0004: FINS/TCP client

**Local IP Address (Response)**

Specifies the IP address for the local node in hexadecimal.

**Local TCP Port Number (Response)**

Specifies the TCP port number for the local node.

**Remote IP Address (Response)**

Specifies the IP address for the remote node in hexadecimal.

**Remote TCP Port Number (Response)**

Specifies the TCP port number for the remote node.

**TCP Transitions (Response)**

Specifies the TCP connection status using the following numbers.

For details on TCP status changes, refer to *Appendix H TCP Status Transitions*.

| Number   | Status       | Meaning                                    |
|----------|--------------|--|
| 00000000 | CLOSED       | Connection closed.                         |
| 00000001 | LISTEN       | Waiting for connection.                    |
| 00000002 | SYN SENT     | SYN sent in active status.                 |
| 00000003 | SYN RECEIVED | SYN received and sent.                     |
| 00000004 | ESTABLISHED  | Already established.                       |
| 00000005 | CLOSE WAIT   | FIN received and waiting for completion.   |
| 00000006 | FIN WAIT 1   | Completed and FIN sent.                    |
| 00000007 | CLOSING      | Completed and exchanged FIN. Awaiting ACK. |
| 00000008 | LAST ACK     | FIN sent and completed. Awaiting ACK.      |

| Number   | Status     | Meaning  |
|----------|------------|--|
| 00000009 | FIN WAIT 2 | Completed and ACK received. Awaiting FIN.                    |
| 0000000A | TIME WAIT  | After closing, pauses twice the maximum segment life (2MSL). |

### Response Codes

| Response code | Description  |
|---------------|--|
| 0000          | Normal   |
| 0105          | Node address setting error<br>Local IP address setting error |
| 0302          | CPU Unit error; execution not possible.                      |
| 1001          | Command too large  |
| 1002          | Command too small  |
| 1100          | Connection number not set from 1 to 4                        |

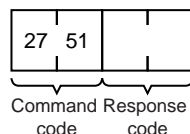
### IP ADDRESS TABLE WRITE: 2750

Writes the IP address table.

#### Command Block



#### Response Block



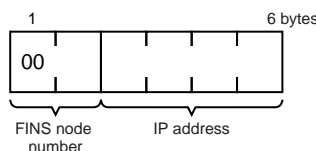
#### Parameters

##### Number of Records (Command)

The number of records to write is specified in hexadecimal between 0000 and 0020 (0 to 32 decimal) in the command. If this value is set to 0, the IP address table will be cleared so that no records are registered.

##### IP Address Table Records (Command)

Specify the IP address table records. The number of records specified must be provided. The total number of bytes in the IP address table records is calculated as the number of records  $\times$  6 bytes/record. The configuration of the 6 bytes of data in each record is as shown in the following diagram.



##### FINS Node Address

Node address for communications via the FINS command (hexadecimal).

##### IP Address

IP address used by TCP/IP protocol (hexadecimal).

#### Precautions

The new I/O address table records will not be effective until the PC is restarted or the Ethernet Unit is reset.

An error response will be returned if the IP address conversion method in the system mode settings is set for automatic generation.



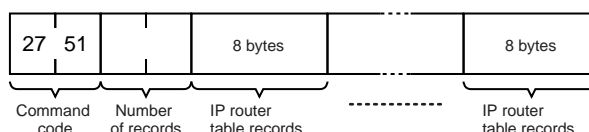
## Response Codes

| Response code | Description  |
|---------------|--|
| 0000          | Normal (echo reply received from the remote node)  |
| 1001          | Command too large  |
| 1002          | Command too small  |
| 1003          | The number of records specified does not match the sent data length.   |
| 110C          | The number of records is not between 0 and 32.<br>The FINS node address is not between 1 and 126<br>The IP address is 0. |
| 2307          | IP address conversion method is set for automatic generation.  |

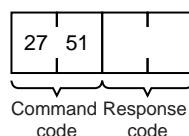
**IP ROUTER TABLE WRITE: 2751**

Writes the IP router table.

## Command Block



## Response Block



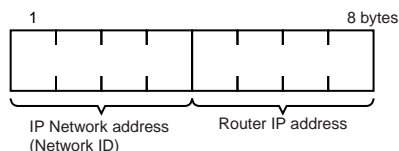
## Parameters

**Number of Records (Command)**

The number of records to write is specified in hexadecimal between 0000 and 0008 in the command. If this value is set to 0, the IP router table will be cleared so that no records are registered.

**IP Router Table Records (Command)**

Specify the IP router table records. The number of records specified must be provided. The total number of bytes in the IP router table records is calculated as the number of records  $\times$  8 bytes/record. The configuration of the 8 bytes of data in each record is as shown in the following diagram.

**IP Network Address**

The network ID from the IP address in hexadecimal. The network ID part corresponding to the address class (determined by the leftmost 3 bits) set here, is enabled.

**Router IP Address**

The IP address (in hexadecimal) of a router connected to a network specified with IP addresses.

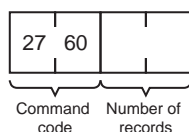
## Response Codes

| Response code | Description  |
|---------------|--|
| 0000          | Normal   |
| 1001          | Command too large  |
| 1002          | Command too small  |
| 1003          | The number of records specified does not match the sent data length.         |
| 110C          | The number of records is not between 0 and 8.<br>The router IP address is 0. |

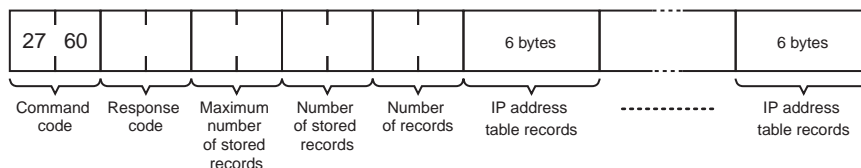
## IP ADDRESS TABLE READ: 2760

Reads the IP address table.

## Command Block



## Response Block



## Parameters

## Number of Records (Command, Response)

The number of records to read is specified between 0000 and 0020 (0 to 32 decimal) in the command. If this value is set to 0, the number of stored records is returned but the IP address table records are not returned. The response returns the actual number of records read.

**Maximum Number of Stored Records (Response)**

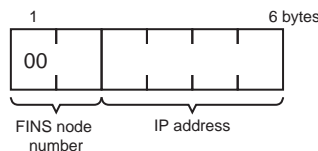
The maximum number of records that can be stored in the IP address table is returned. The maximum number of stored records is fixed at 0020 (32 records).

### Number of Stored Records (Response)

The number of IP address table records stored at the time the command is executed is returned as a hexadecimal number.

### IP Address Table Records (Response)

The number of IP address table records specified in the number of records parameter is returned. The total number of bytes in the IP address table records is calculated as the number of records  $\times$  6 bytes/record. The configuration of the 6 bytes of data in each record is as shown in the following diagram.



## FINS Node Address

Node address for communications via the FINS command (in hexadecimal).

## IP Address

IP number used by TCP/IP protocol (in hexadecimal).

**Precautions**

If the IP address table contains fewer records than the number specified in the *number of records* parameter, all the records contained in the IP address table when the command is executed will be returned and the command execution will end normally.

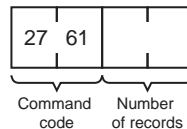
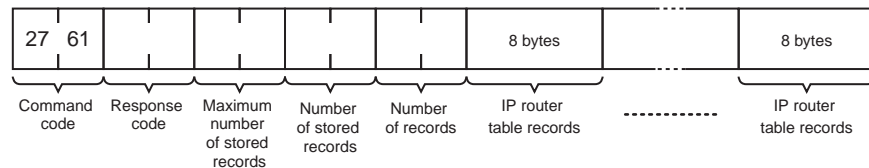
An error response will be returned if the IP address conversion method in the system mode settings is set to the automatic generation method.

**Response Codes**

| Response code | Description   |
|---------------|---|
| 0000          | Normal  |
| 1001          | Command too large   |
| 1002          | Command too small   |
| 2307          | IP address conversion method is set to the automatic generation method. |

**IP ROUTER TABLE READ: 2761**

Reads the IP router table.

**Command Block****Response Block****Parameters****Number of Records (Command, Response)**

The number of records to read is specified between 0000 and 0008 (0 to 8 decimal) in the command. If this value is set to 0, the number of stored records will be returned but the IP router table records will not be returned. The response returns the actual number of records read.

**Maximum Number of Stored Records (Response)**

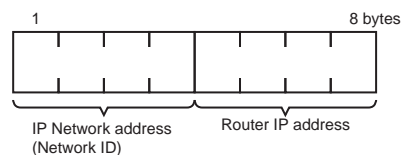
The maximum number of records that can be stored in the IP router table is returned. The maximum number of stored records is fixed at 0008 (8 records).

**Number of Stored Records (Response)**

The number of IP router table records stored at the time the command is executed is returned in hexadecimal.

**IP Router table Records (Response)**

The number of IP router table records specified in the *number of records* parameter is returned. The total number of bytes in the IP router table records is calculated as the number of records × 8 bytes/record. The configuration of the 8 bytes of data in each record is shown below.



**IP Network Address**

The network ID from the IP address in hexadecimal. The network ID part corresponding to the address class (determined by the leftmost 3 bits) set here, is enabled.

**Router IP Address**

The IP address (in hexadecimal) of a router connected to a network specified with IP addresses.

**Precautions**

If the IP router table contains fewer records than the number specified in the *number of records* parameter, all the records contained in the IP router table when the command is executed will be returned and the command execution will end normally.

**Response Codes**

| Response code | Description       |
|---------------|-------------------|
| 0000          | Normal            |
| 1001          | Command too large |
| 1002          | Command too small |

**6-5-7 CMND/SEND/RECV Instructions**

CMND/SEND/RECV is the instruction to send FINS commands to other units. In CP1L-EL/EM system, there is a new port that can be specified as destination unit. It is built-in Ethernet port of CP1L-EL/EM.

Use the low byte (bit 00 to bit 07) of the third control word of CMND instruction, or the low byte (bit 00 to bit 07) of the second control word of SEND/RECV instruction, to specify built-in Ethernet port of CP1L-EL/EM as the destination unit.

The unit address of built-in Ethernet port is 0xFA.

If user want to send FINS frame by Ethernet, please set command control word Channel C+2 bit 08 to bit 11 to "0". (Serial port is not used.)

**Sample Program**

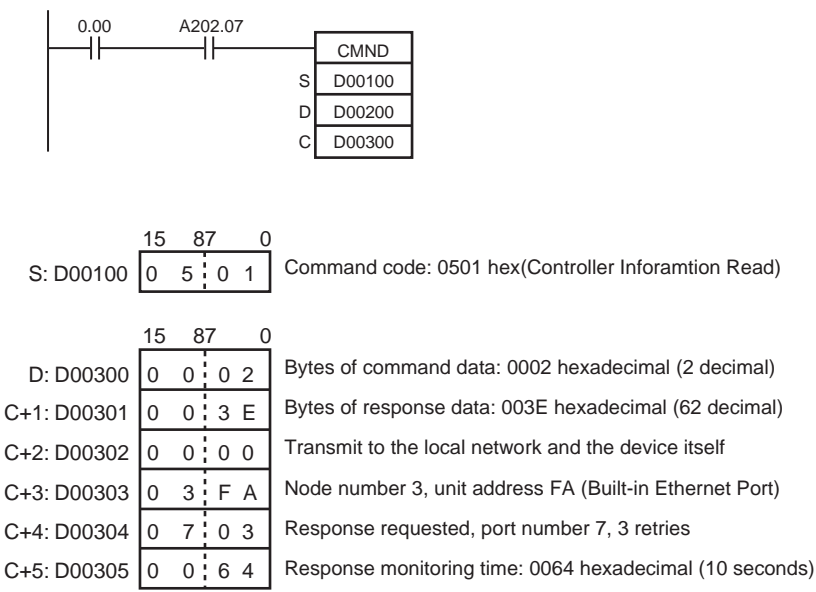
Issuing a FINS command to built-in Ethernet port of another CP1L-EM/EL on the network.

The following program shows an example of sending a FINS command to built-in Ethernet port of another CP1L-EL/EM on the network.

When CIO 0.00 and A202.07 (the Communications Port Enabled Flag for port 07) are ON, CMND(490) transmits FINS command 0501 (CONTROLLER INFORMATION READ) to built-in Ethernet port of CP1L-EL/EM on node number 3. The response is stored in D200 to D230.

The CONTROLLER INFORMATION READ command reads built-in Ethernet port information. The response contains the 2-byte command code (0501), the 2-byte completion code, and then the 29 words of information, for a total of 31 words or 62 bytes.

The data will be retransmitted up to 3 times if a response is not received within ten seconds.



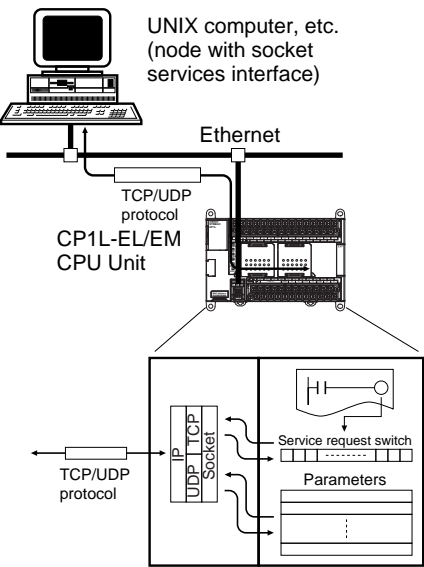
6-6 Socket Services

The socket services allow devices on the Ethernet to send and receive various data using either the UDP or TCP protocol.

6-6-1 Overview of Socket Service

Manipulating Dedicated Control Bits

The way to use socket services is to set the required parameters in the parameter area allocated in the DM Area, and then to request particular UDP or TCP socket services by turning ON dedicated control bits in the AR Area. When the PLC has completed the requested process, the same bit is turned OFF to provide notification. Data that is sent or received is automatically handled according to the I/O memory locations specified in the parameter area. A total of three ports (UDP and TCP combined) can be used for socket services.



## 6-6-2 Procedure for Using Socket Service Functions

### Procedure for Using Socket Service Functions

1. Make the basic settings.  
Refer to 6-4-3 *Basic Settings*.



2. Use the CX-Programmer or Programming Console to make the socket service settings in the socket service parameter areas 1 to 3 (m+8 to m+37) allocated in the DM Area.

**Note** The first word m in the allocated DM Area = D32400



3. Select **Transfer to PLC** from the Options Menu, and then click the **Yes** button. The Setup data in the allocated DM Area will be transferred to the CPU Unit.

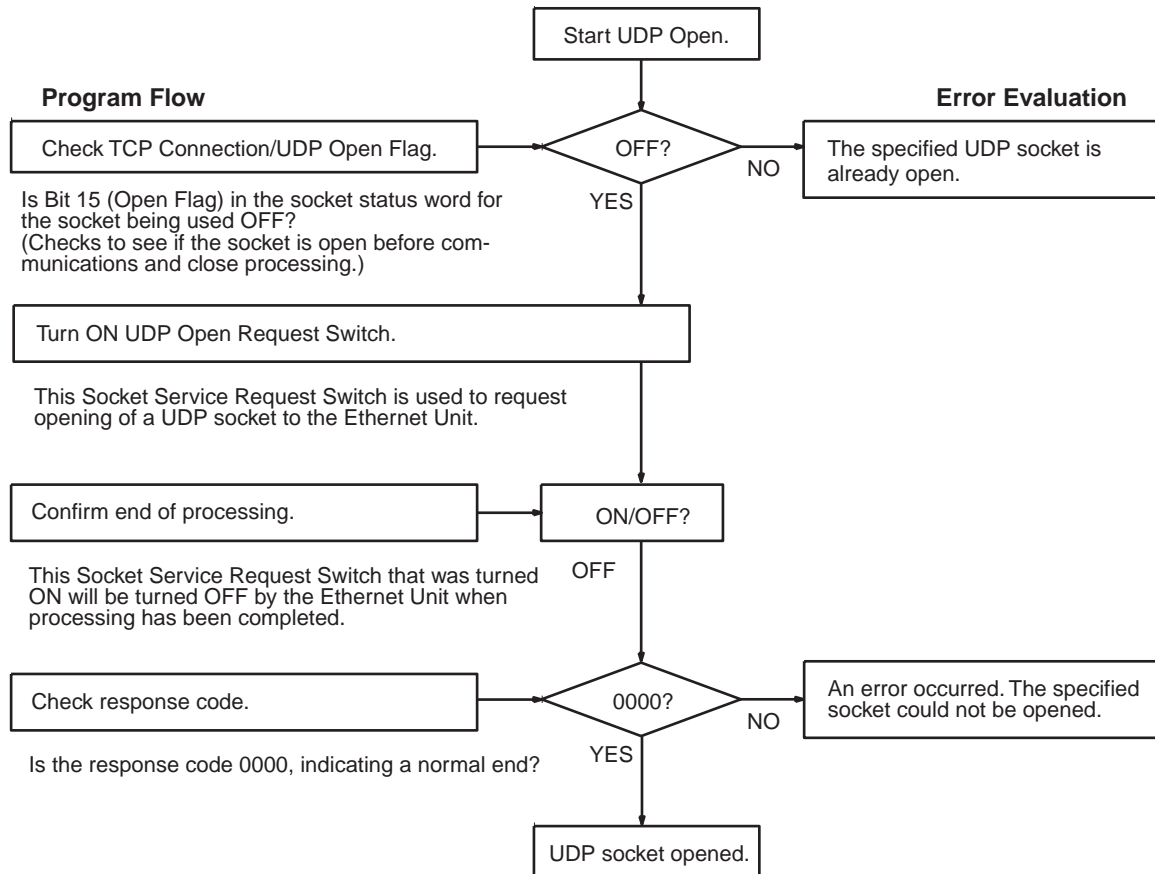
#### Precautions

A Socket Service Parameter Area cannot be used for other sockets once open processing has been successfully completed for it. Check the socket status before attempting to open a socket. TCP socket status is provided in words m+4 to m+6 in the DM Area for sockets 1 to 3.

**Note** When a send or receive request is made, the data will be automatically sent or received according to the send/receive data address in the Socket Service Parameter Area. When processing has been completed, a response code will be automatically stored in the Socket Service Parameters.

### 6-6-3 Socket Services and Socket Status

When using socket services, it is important to consider the timing of the status changes in the Socket Status Area. The diagram below shows a flowchart for opening UDP. The flow is similar for other socket services. Replace the names of the appropriate flags in the flowchart to adapt it to other socket services.



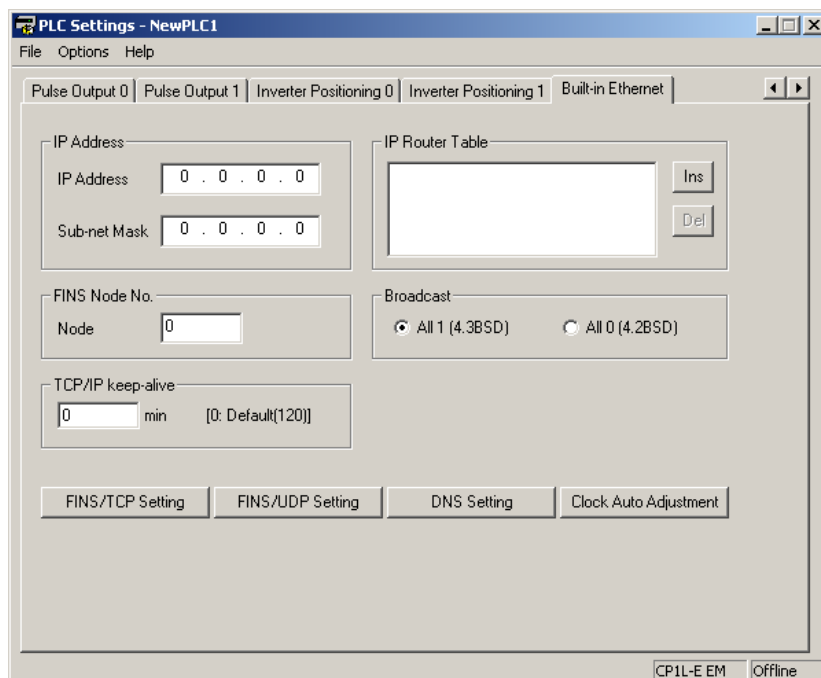
**Note** For details about timing charts, refer to *SECTION 6 Socket Services* in the *Ethernet Units Construction of Applications Operation Manual (Cat. No. W421-E1)*.

Socket services cannot support CMND command.

## 6-6-4 PLC Setup for Socket Services

### Socket Services

| CX-Programmer tab | Setting    |
|-------------------|------------|
| Built-in Ethernet | Keep-alive |



| Item              | Contents  | Default            |
|-------------------|---|--------------------|
| TCP/IP keep-alive | <p>Set the liveness-checking interval. When socket services using either FINS/TCP or TCP/IP are used, the connection will be terminated if there is no response from the remote node (either a server or client) within the time set here. (Enabled for socket services using FINS/TCP or TCP/IP only.)</p> <p>Setting range: 0 to 65,535 minutes</p> <p>This setting applies to the keep-alive setting for each connection set with the FINS/TCP Setting button.</p> | 0<br>(120 minutes) |

**Note** Make settings using the PLC settings function in the CX-Programmer (to be included in version 9.4 and higher).



### 6-6-5 Auxiliary Area Allocation

The following table and descriptions cover the words and bits in the Auxiliary Area of PLC memory that are related to the socket services.

#### Ethernet Status

| Address | Bit(s)   | Name                          | Status | Manipulated by | Unit operation   | Access    |
|---------|----------|-------------------------------|--------|----------------|--|-----------|
| A45     | 0 to 13  | Reserved                      | ---    | ---            | ---  | Read only |
|         | 14       | Link Status Flag              | ON     | Unit           | ON while a link is established between hub.  |           |
|         |          |                               | OFF    | Unit           | OFF when the link between hub is terminated.   |           |
|         | 15       | Reserved                      | ---    | ---            | ---  |           |
| A46     | 0 to 1   | Reserved                      | ---    | ---            | ---  | Read only |
|         | 2        | IP Address Setting Error Flag | ON     | Unit           | ON if any of the following conditions apply to the IP address.<br>• All bits in the host ID are 0 or 1.<br>• All bits in the network ID are 0 or 1.<br>• All bits in the subnet ID are 1.<br>• The IP address begins with 127 (0x7F) |           |
|         |          |                               | OFF    | Unit           | OFF when the IP address is normal.   |           |
|         | 3        | IP Address Table Error Flag   | ON     | Unit           | ON if the IP address table information is incorrect.   |           |
|         |          |                               | OFF    | Unit           | OFF when the IP address table is normal.   |           |
|         | 4        | IP Router Table Error Flag    | ON     | Unit           | ON if the IP router table information is incorrect.  |           |
|         |          |                               | OFF    | Unit           | OFF when the IP address table is normal.   |           |
|         | 5        | DNS Server Error Flag         | ON     | Unit           | ON when the following errors occur during DNS server operation:<br>• An illegal server IP address is set.<br>• A timeout occurs during communications with the server.   |           |
|         |          |                               | OFF    | Unit           | OFF when DNS server operation is normal.   |           |
|         | 6        | Routing Table Error Flag      | ON     | Unit           | ON if the routing table information is incorrect.  |           |
|         |          |                               | OFF    | Unit           | OFF when the routing table is normal.  |           |
|         | 7 to 10  | Reserved                      | ---    | ---            | ---  |           |
|         | 11       | SNTP Server Error             | ON     | Unit           | ON when the following errors occur during SNTP server operation:<br>• An illegal server IP address or host name is set.<br>• A timeout occurs during communications with the server.   |           |
|         |          |                               | OFF    | Unit           | OFF when SNTP server operation is normal.  |           |
|         | 12 to 13 | Reserved                      | ---    | ---            | ---  |           |
|         | 14       | Address Disagreement Flag     | ON     | Unit           | ON if the remote IP address is set to automatic generation but the local IP address host number and FINS node address do not agree.  |           |
|         |          |                               | OFF    | Unit           | OFF under all other circumstances.   |           |
|         | 15       | Reserved                      | ---    | ---            | ---  |           |

| Address | Bit(s)  | Name                       | Status | Manipulated by | Unit operation  | Access    |
|---------|---------|----------------------------|--------|----------------|---|-----------|
| A47     | 0       | FINS/TCP Connection Flag 1 | ON     | Unit           | Turned ON by the Unit when a connection is established.   | Read only |
|         |         |                            | OFF    | Unit           | Turned OFF by the Unit when the connection is terminated. |           |
|         | 1       | FINS/TCP Connection Flag 2 | ON     | Unit           | Turned ON by the Unit when a connection is established.   |           |
|         |         |                            | OFF    | Unit           | Turned OFF by the Unit when the connection is terminated. |           |
|         | 2       | FINS/TCP Connection Flag 3 | ON     | Unit           | Turned ON by the Unit when a connection is established.   |           |
|         |         |                            | OFF    | Unit           | Turned OFF by the Unit when the connection is terminated. |           |
|         | 3 to 15 | Reserved                   | ---    | ---            | ---   |           |

### Ethernet Service Request

| Address | Bit(s) | Name                      | Status | Manipulated by | Unit operation  | Access     |
|---------|--------|---------------------------|--------|----------------|---|------------|
| A566    | 2      | Socket Force-close Switch | ON     | User           | All sockets are forcibly closed when this bit turns ON. | Read/Write |
|         |        |                           | OFF    | Unit           | Turned OFF by Unit after sockets are closed.            |            |

### Socket Force-close Switch (Bit 2)

All UDP and TCP sockets used for socket services can be force-closed by turning ON this switch. This can be used for operations such as error processing.

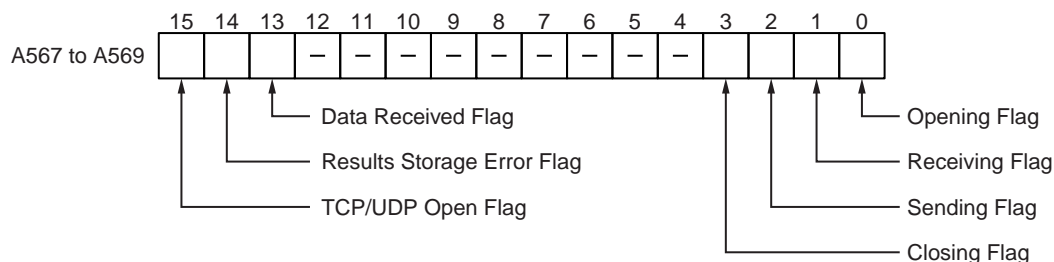
Be careful not to force-close sockets during communications, or an error will occur. After all sockets have been force-closed, the PLC will turn the switch OFF again. Do not attempt to forcibly manipulate this switch before it is automatically turned OFF by the PLC.

Ports used exclusively by the Ethernet Unit will not be closed.

## Socket Service

|      |                                   |    |                                   |   |   |
|------|-----------------------------------|----|-----------------------------------|---|---|
|      | Bit                               | 15 | 8                                 | 7 | 0 |
| A567 | TCP/UDP Socket No. 1 Status       |    |                                   |   |   |
| A568 | TCP/UDP Socket No. 2 Status       |    |                                   |   |   |
| A569 | TCP/UDP Socket No. 3 Status       |    |                                   |   |   |
| A570 | Reserved                          |    |                                   |   |   |
| A571 | Socket Service Request Switches 2 |    | Socket Service Request Switches 1 |   |   |
| A572 | Reserved                          |    | Socket Service Request Switches 3 |   |   |

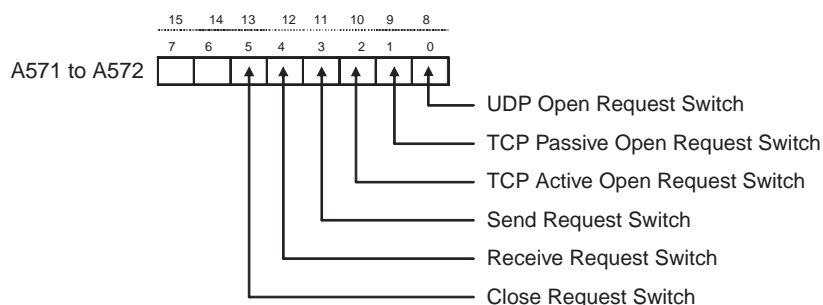
### Status of TCP/UDP Sockets 1 to 3



| Bit     | Flag                       | Status | Manipulated by | Unit operation   | Access    |
|---------|----------------------------|--------|----------------|--|-----------|
| 0       | Opening Flag               | ON     | Unit           | ON during open processing. (Turns ON when open request is received.)                               | Read only |
|         |                            | OFF    | Unit           | OFF when open processing has been completed.   |           |
| 1       | Receiving Flag             | ON     | Unit           | ON during receive processing. (Turns ON when receive request is received.)                         |           |
|         |                            | OFF    | Unit           | OFF when receive processing has been completed.  |           |
| 2       | Sending Flag               | ON     | Unit           | ON during send processing. (Turns ON when send request is received.)                               |           |
|         |                            | OFF    | Unit           | OFF when send processing has been completed.   |           |
| 3       | Closing Flag               | ON     | Unit           | ON during close processing. (Turns ON when close request is received.)                             |           |
|         |                            | OFF    | Unit           | OFF when close processing has been completed.  |           |
| 4 to 12 | (Not used.)                | ---    | ---            | ---  | ---       |
| 13      | Data Received Flag         | ON     | Unit           | ON when data from a remote node has been received at an open TCP socket.                           | Read only |
|         |                            | OFF    | Unit           | OFF when receive processing has been requested for an open TCP socket.                             |           |
| 14      | Results Storage Error Flag | ON     | Unit           | ON if there is an error in storing the results when socket services are used.                      |           |
|         |                            | OFF    | Unit           | Turns OFF when the next request is received.   |           |
| 15      | TCP/UDP Open Flag          | ON     | Unit           | ON when open processing has been completed.  |           |
|         |                            | OFF    | Unit           | OFF when close processing has been completed. (Stays OFF for abnormal open processing completion.) |           |

**Note** Do not forcibly manipulate the above status flags during socket service is used.

### Socket Service Request Switches 1 to 3



| Bit |   | Switch                          | Status | Manipulated by | Unit operation   | Access     |
|-----|---|---------------------------------|--------|----------------|--|------------|
| 8   | 0 | UDP Open Request Switch         | ON     | User           | UDP socket opened when switch is turned ON.  | Read/Write |
|     |   |                                 | OFF    | Unit           | Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).                     |            |
| 9   | 1 | TCP Passive Open Request Switch | ON     | User           | Passive TCP socket opened when switch is turned ON.  |            |
|     |   |                                 | OFF    | Unit           | Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).                     |            |
| 10  | 2 | TCP Active Open Request Switch  | ON     | User           | Active TCP socket opened when switch is turned ON.   |            |
|     |   |                                 | OFF    | Unit           | Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).                     |            |
| 11  | 3 | Send Request Switch             | ON     | User           | Send processing executed when switch is turned ON.<br>(The protocol (TCP/UDP) is determined when the socket is opened.)    |            |
|     |   |                                 | OFF    | Unit           | Unit turns OFF switch when send processing has been completed.   |            |
| 12  | 4 | Receive Request Switch          | ON     | User           | Receive processing executed when switch is turned ON.<br>(The protocol (TCP/UDP) is determined when the socket is opened.) |            |
|     |   |                                 | OFF    | Unit           | Unit turns OFF switch when receive processing has been completed.  |            |
| 13  | 5 | Close Request Switch            | ON     | User           | Close processing executed when switch is turned ON.<br>(The protocol (TCP/UDP) is determined when the socket is opened.)   |            |
|     |   |                                 | OFF    | Unit           | Unit turns OFF switch when close processing has been completed.  |            |
| 14  | 6 | Reserved                        | ---    | ---            | ---  | ---        |
| 15  | 7 | Reserved                        | ---    | ---            | ---  | ---        |

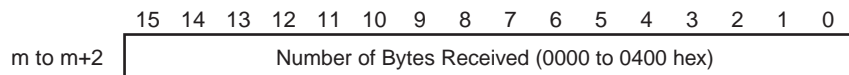
### 6-6-6 Data Memory Area Allocations

The memory allocation about socket service is shown in the following diagram. These data will be allocated to the DM area of the PLC.

Beginning word m = 32400

| Offset | Word             | Bit                                       |
|--------|------------------|---|
|        |                  | 15 08 07 00                               |
| m      | D32400           | TCP Socket No. 1 Number of Bytes Received |
| m+1    | D32401           | TCP Socket No. 2 Number of Bytes Received |
| m+2    | D32402           | TCP Socket No. 3 Number of Bytes Received |
| m+3    | D32403           | Reserved                                  |
| m+4    | D32404           | TCP Socket No. 1 Connection Status        |
| m+5    | D32405           | TCP Socket No. 2 Connection Status        |
| m+6    | D32406           | TCP Socket No. 3 Connection Status        |
| m+7    | D32407           | Reserved                                  |
| m+8    | D32408 to D32417 | Socket Services Parameter Area 1          |
| m+17   |                  |   |
| m+18   | D32418 to D32427 | Socket Services Parameter Area 2          |
| m+27   |                  |   |
| m+28   | D32428 to D32437 | Socket Services Parameter Area 3          |
| m+37   |                  |   |
| m+38   | D32438 to D32447 | Reserved                                  |
| m+47   |                  |   |

#### TCP Socket No. (1 to 3): Number of Bytes Received



For each TCP socket, the number of bytes of data in the reception buffer is stored in one word. A maximum of 4,096 bytes of data can be held in the reception buffer, but a value of only up to the maximum value (1,024 bytes) that can be set for receive requests by manipulating control bits is stored.

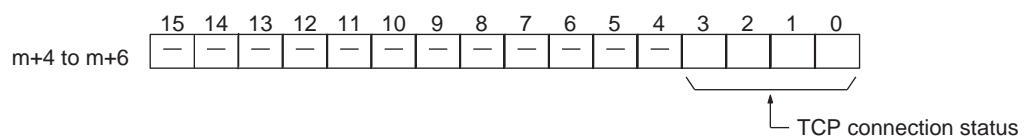
0000 hex: 0 bytes

0400 hex: 1,024 bytes

The Data Received Flag in the CIO Area turns ON and OFF linked to this word. This area is given a value of 0000 hex when a receive request is executed by manipulating control bits. If any data remains in the reception buffer after the receive request processing is completed, the remaining number of bytes is stored and the Data Received Flag turns ON again.

Before a receive request is executed, a check is performed to confirm that the required data is available.

#### TCP Socket No. (1 to 3): Connection Status



The connection status for each TCP socket is stored by code in this word. For details, refer to *Appendix H TCP Status Transitions*.

## Socket Services Parameter Area 1 to 3

| Offset | Socket<br>No. 1 | ... | Socket<br>No. 3 | 15  | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7                              | 6 | 5 | 4 | 3 | 2 | 1 | 0 |  |  |  |  |
|--------|-----------------|-----|-----------------|---|----|----|----|----|----|---|---|--------------------------------|---|---|---|---|---|---|---|--|--|--|--|
| +0     | m+8             | ... | m+28            | Socket option   |    |    |    |    |    |   |   | UDP/TCP socket number (1 to 3) |   |   |   |   |   |   |   |  |  |  |  |
| +1     | m+9             |     | m+29            | Local UDP/TCP port number (0000 to FFFF Hex)                                  |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
| +2     | m+10            |     | m+30            | Remote IP address<br>(00000000 to FFFFFFFF Hex)                               |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
|        | m+11            |     | m+31            |   |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
| +4     | m+12            | ... | m+32            | Remote UDP/TCP port number (0000 to FFFF Hex)                                 |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
| +5     | m+13            |     | m+33            | Number of send/receive bytes (0000 to 0400 Hex (1024))                        |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
| +6     | m+14            |     | m+34            | Send/receive data address<br>(Same as FINS variable area designation method.) |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
|        | m+15            |     | m+35            |   |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
| +8     | m+16            |     | m+36            | Timeout value (0000 to FFFF Hex)  |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |
| +9     | m+17            | ... | m+37            | Response code   |    |    |    |    |    |   |   |                                |   |   |   |   |   |   |   |  |  |  |  |

When socket services are requested by control bit manipulation, the settings must be made in advance in a Socket Service Parameter Area. The parameters used will vary depending on the service requested.

**Parameter Settings**

The following table shows the parameters that are required for each service and the use of the parameters by the socket service.

## UDP Socket Services

| Parameter                       | No. of words | Range<br>(decimal values in parentheses)                                     | Socket service |             |          |           |
|---------------------------------|--------------|--|----------------|-------------|----------|-----------|
|                                 |              |  | UDP open       | UDP receive | UDP send | UDP close |
| Socket option                   | 1            | Specified bit  | ---            | ---         | ---      | ---       |
| UDP/TCP socket No.              |              | 0001 to 0003 hexadecimal<br>(1 to 3)   | W              | W           | W        | W         |
| Local UDP/TCP port No.          | 1            | 0000 to FFFF hexadecimal<br>(0 to 65,535)                                    | W              | ---         | ---      | ---       |
| Remote IP address               | 2            | 00000000 to FFFFFFFF hexadecimal<br>(0.0.0.0 to 255.255.255.255)             | ---            | R           | W        | ---       |
| Remote UDP/TCP port No.         | 1            | 0000 to FFFF hexadecimal<br>(0 to 65,535)                                    | ---            | R           | W        | ---       |
| Number of bytes to send/receive | 1            | 0000 to 07C0 hexadecimal<br>(0 to 1,024 bytes)                               | ---            | RW          | RW       | ---       |
| Send/Receive data address       | 2            | Memory area address  | ---            | W           | W        | ---       |
| Time out time<br>(Unit: 100 ms) | 1            | 0000 to FFFF hexadecimal<br>(0 to 65,535)<br>(0: No limit, 0.1 to 6,553.5 s) | ---            | W           | ---      | ---       |
| Response code                   | 1            | ---  | R              | R           | R        | R         |

**Note**

W: Written by user

RW: Written by user at execution and then read for results at completion

R: Read by user for results at completion

---: Not used.

**TCP Socket Services**

| Parameter                        | No. of words | Range<br>(decimal values in parentheses)                                  | Socket service   |                 |             |          |           |
|----------------------------------|--------------|---|------------------|-----------------|-------------|----------|-----------|
|                                  |              |   | TCP passive open | TCP active open | TCP receive | TCP send | TCP close |
| Socket option                    | 1            | Specified bit   | W                | W               | ---         | ---      | ---       |
| UDP/TCP socket No.               |              | 0001 to 0003 hexadecimal (1 to 3)   | W                | W               | W           | W        | W         |
| Local UDP/TCP port No.           | 1            | 0000 to FFFF hexadecimal (0 to 65,535)                                    | W                | RW              | ---         | ---      | ---       |
| Remote IP address                | 2            | 00000000 to FFFFFFFF hexadecimal (0.0.0.0 to 255.255.255.255)             | RW               | W               | ---         | ---      | ---       |
| Remote UDP/TCP port No.          | 1            | 0000 to FFFF hexadecimal (0 to 65,535)                                    | RW               | W               | ---         | ---      | ---       |
| Number of bytes to send/ receive | 1            | 0000 to 04D0 hexadecimal (0 to 1,024 bytes)                               | ---              | ---             | RW          | RW       | ---       |
| Send/Receive data address        | 2            | Memory area address   | ---              | ---             | W           | W        | ---       |
| Time out time (Unit: 100 ms)     | 1            | 0000 to FFFF hexadecimal (0 to 65,535)<br>(0: No limit, 0.1 to 6,553.5 s) | W                | ---             | W           | ---      | ---       |
| Response code                    | 1            | ---   | R                | R               | R           | R        | R         |

**Note** W: Written by user  
 RW: Written by user at execution and then read for results at completion  
 R: Read by user for results at completion  
 n---: Not used.

**Parameters****Socket Option**

For the TCP OPEN REQUEST (ACTIVE or PASSIVE) command, specifies whether or not the keep-alive function is to be used. When the keep-alive function is used, bit 8 is ON.

**UDP/TCP Socket No.**

Specify the number of the UDP or TCP socket to open.

**Local UDP/TCP Port No.**

Specify the number of the UDP or TCP port for the socket to use for communications.

- Do not specify the port being used as the FINS UDP port (default: 9600) in an open request for a UDP socket.
- Do not specify the port being used as the FINS TCP port (default: 9600) in an open request for a TCP (active or passive) socket.
- Do not specify auto connection UDP port number 9600 in an open request for a UDP socket.
- Do not specify auto connection TCP port number 9600 in an open request for a TCP (active or passive) socket.
- As a rule, use port numbers 1,024 and higher.

If port number 0 is specified when for an active TCP open, the TCP port number will be automatically allocated and the number of the port that was opened will be stored in the local UDP/TCP port number in the Socket Service Parameter Area (i.e., the actual port number will be overwritten on the value of 0 set by the user).

**Remote IP Address**

Specify the IP address of the remote device.

- Offset +2 in the Socket Service Parameter Area contains the upper bytes of the Remote IP Address, and offset +3 contains the lower bytes.  
Example: The contents of offsets +2 and +3 would be as shown below when the Remote IP Address is 196.36.32.55 (C4.24.20.37 hexadecimal).

+2: C424

+3: 2037

- This parameter is not used when making a receive request for a UDP socket. The remote IP address will be stored with the response data and will be written as the Remote IP Address in the Socket Service Parameter Area.
- When opening a passive TCP socket, the combination of the remote IP address and the remote TCP port number can be used to affect processing as shown in the following table.

| Remote IP Address | Remote TCP Port No. | Processing   |
|-------------------|---------------------|--|
| 0                 | 0                   | All connection requests accepted.  |
| 0                 | Not 0               | Connection requests accepted only for the same port number.                |
| Not 0             | 0                   | Connection requests accepted only for the same IP address.                 |
| Not 0             | Not 0               | Connection requests accepted only for the same port number and IP address. |

If the Remote IP Address is set to 0, a connection can be made to any remote node and the remote IP address of the node that is connected will be stored as the Remote IP Address in the Socket Service Parameter Area. If a specific remote IP address is set, then a connection can be made only to the node with the specified address.

If the Remote TCP Port No. is set to 0, a connection can be made to any remote node regardless of the TCP port number it is using. If a specific remote TCP port number is set, then a connection can be made only to a node using the specified TCP port number.

**Remote UDP/TCP Port No.**

Specify the UDP or TCP port number used by the remote device.

- This parameter is not used when making a receive request for a UDP socket. The remote UDP/TCP port number will be stored with the response data and will be written as the Remote UDP/TCP Port No. in the Socket Service Parameter Area.
- When opening a passive TCP socket, the combination of the remote IP address and the remote TCP port number can be used to affect processing as shown in the table for the Remote IP Address, above. If the Remote UDP/TCP Port No. is set to 0, the UDP/TCP port number of the remote device will be written as the Remote UDP/TCP Port No. in the Socket Service Parameter Area.

**Time Out Time**

Set the time limit in units of 0.1 s for completion of communications from the time that the Receive Request Switch (TCP or UDP) or the TCP Passive Open Request Switch is turned ON. A response code of 0080 hexadecimal (timeout) will be stored if communications time out. If 0 is set, the requested service will not be timed.



**Number of Bytes to Send/Receive**

Send the number of bytes to be sent or the number of bytes to receive. When the transfer has been completed, the actual number of bytes that have been sent or received will be written here.

**Send/Receive Data Address**

Specify the address of the first word to send or the address of the first word where data is to be received. Always set the bit number to 00 hexadecimal.

|        |                                    |   |   |                                   |
|--------|------------------------------------|---|---|-----------------------------------|
| Offset | 15                                 | 8 | 7 | 0                                 |
| +6     | Area designation                   |   | : | Leftmost 2 digits of word address |
| +7     | Rightmost 2 digits of word address |   | : | Bit number (always 00 Hex)        |

The following specifications can be used.

| Area                  |     | Word address     | Area designation (hexadecimal) | Word address (hexadecimal) |
|-----------------------|-----|------------------|--------------------------------|----------------------------|
| CIO, HR, and AR Areas | CIO | 0000 to 6143     | B0                             | 0000 to 17FF               |
|                       | HR  | H000 to H511     | B2                             | 0000 to 01FF               |
|                       | AR  | A448 to A959     | B3                             | 01C0 to 03BF               |
| DM Area               | DM  | D00000 to D32767 | 82                             | 0000 to 7FFF               |

**Response Codes**

When processing of a request has been completed for socket services executed using Socket Service Request Switches, a response code will be stored in the Response Code word in the Socket Service Parameter Area. The following response codes will be stored depending on the service that was requested.

**UDP Socket Open Request**

| Response code | Meaning   |
|---------------|---|
| 0000          | Normal end  |
| 0105          | Local IP address setting error.   |
| 1100          | UDP socket number is not 1 to 8 or local UDP port number is 0.                    |
| 110C          | Request Switch turned ON during other processing.                                 |
| 220F          | Specified socket is already open.   |
| 2211          | Unit is busy; cannot execute.   |
| 2606          | Specified socket is already open as TCP socket; cannot open UDP socket.           |
| 2607          | Specified Socket Service Parameter Area is already being used for another socket. |
| 0049          | The same UDP port number has been specified more than once (EADDRINUSE).          |
| 0081          | The specified socket was closed during open processing.                           |

**UDP Socket Receive Request**

| Response code | Meaning  |
|---------------|--|
| 0000          | Normal end   |
| 0302          | CPU Unit error; cannot execute.  |
| 1100          | Number of bytes to receive is not in allowable range.                            |
| 1101          | The area designation of the Send/Receive Data Address is not inallowable range.  |
| 1103          | The bit number in the Send/Receive Data Address is not 00.                       |
| 110C          | Request Switch turned ON during other processing.                                |
| 220F          | Specified socket is already processing a receive request.                        |
| 2210          | The specified socket is not open.  |
| 2211          | Unit is busy; cannot execute service.  |
| 2607          | Specified Socket Service Parameter Area is already being used foranother socket. |
| 0080          | Receive request timed out.   |
| 0081          | The specified socket was closed during reception processing.                     |

**UDP Socket Send Request**

| Response code | Meaning   |
|---------------|---|
| 0000          | Normal end  |
| 0302          | CPU Unit error; cannot execute.   |
| 1100          | Number of bytes to send is not in allowable range or the remote IPaddress is 0.   |
| 1101          | The area designation of the Send/Receive Data Address is not inallowable range.   |
| 1103          | The bit number in the Send/Receive Data Address is not 00.  |
| 110C          | Request Switch turned ON during other processing.   |
| 220F          | Specified socket is already processing a send request.  |
| 2210          | The specified socket is not open.   |
| 2211          | Unit is busy; cannot execute.   |
| 2607          | Specified Socket Service Parameter Area is already being used foranother socket.  |
| 003E          | Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).   |
| 004C          | The network ID is incorrect or the remote IP address is incor-rect(EADDRNOTAVAIL)   |
| 004E          | The network ID is not in the IP router table, router settings are incorrect, or the remote IP address is incorrect (ENETUNREACH). |
| 0051          | The router settings are incorrect or the remote IP address is incor-rect (EHOSTUNREACH).  |
| 0081          | The specified socket was closed during send processing.   |

**UDP Socket Close Request**

| Response code | Meaning  |
|---------------|--|
| 0000          | Normal end   |
| 0302          | CPU Unit error; cannot execute.  |
| 2210          | The specified socket is not open.  |
| 2607          | Specified Socket Service Parameter Area is already being used foranother socket. |

**TCP Socket Passive Open Request**

| Response code    | Meaning  |
|------------------|--|
| 0000             | Normal end   |
| 0105             | Local IP address setting error.  |
| 1100             | TCP socket number is not 1 to 8 or local TCP port number is 0.                     |
| 110C             | Request Switch turned ON during other processing.                                  |
| 220F             | Specified socket is already open or already processing an openrequest.             |
| 2211             | Unit is busy; cannot execute.  |
| 2606             | Specified socket is already open as UDP socket; cannot open TCPsocket.             |
| 2607             | Specified Socket Service Parameter Area is already being used foranother socket.   |
| 0045             | Error in communications with remote node (ECONNABORTED).                           |
| 0049             | The same TCP port number has been specified more than once(EADDRINUSE).            |
| 004A (See note.) | Error (ECONNREFUSED).  |
| 004B (See note.) | Error in communications with remote node (ECONNRESET).                             |
| 0053             | Error in communications with remote node (ETIMEDOUT) or remotenode does not exist. |
| 0080             | Open request timed out.  |
| 0081             | The specified socket was closed during open processing.                            |
| 0082             | Connection could not be established with specified remote node.                    |

**Note** These response codes will be returned only on large, multilevel networks.

**TCP Socket Active Open Request**

| Response code    | Meaning  |
|------------------|--|
| 0000             | Normal end   |
| 0105             | Local IP address setting error.  |
| 1100             | TCP socket number is not 1 to 8 or local TCP port number is 0.   |
| 110C             | Request Switch turned ON during other processing.  |
| 220F             | Specified socket is already open or already processing an openrequest.   |
| 2211             | Unit is busy; cannot execute.  |
| 2606             | Specified socket is already open as UDP socket; cannot open TCPsocket.   |
| 2607             | Specified Socket Service Parameter Area is already being used foranother socket.   |
| 000D             | Remote IP address parameter error (EACCES).  |
| 0045             | Error in communications with remote node (ECONNABORTED).   |
| 0049             | The same port number has been specified more than once (EADDRINUSE).   |
| 004B (See note.) | Error in communications with remote node (ECONNRESET).   |
| 004C             | Remote IP address parameter error (EADDRNOTAVAIL).Wrong parameter designation.An attempt was made to set the local TCP port of the local node toActive Open. |
| 0053             | Communications error with remote node (ETIMEDOUT).No remote node.  |
| 0081             | The specified socket was closed during open processing.  |

**Note** These response codes will be returned only on large, multilevel networks.

**TCP Socket Receive Request**

| Response code    | Meaning  |
|------------------|--|
| 0000             | Normal end   |
| 0302             | CPU Unit error; cannot execute.  |
| 1100             | Number of receive bytes not in allowable range.                                  |
| 1101             | The area designation of the Send/Receive Data Address is not inallowable range.  |
| 1103             | The bit number in the Send/Receive Data Address is not 00.                       |
| 110C             | Request Switch turned ON during other processing.                                |
| 220F             | Specified socket is already processing a receive request.                        |
| 2210             | Specified socket has not been connected.   |
| 2211             | Unit is busy; cannot execute.  |
| 2607             | Specified Socket Service Parameter Area is already being used foranother socket. |
| 0045 (See note.) | Error in communications with remote node (ECONNABORTED).                         |
| 0053             | Error in communications with remote host (ETIMEDOUT).                            |
| 0080             | Receive request timed out.   |
| 0081             | The specified socket was closed during receive processing.                       |

**Note** These response codes will be returned only on large, multilevel networks.

**TCP Socket Send Request**

| Response code    | Meaning  |
|------------------|--|
| 0000             | Normal end   |
| 0302             | CPU Unit error; cannot execute.  |
| 1100             | Number of bytes to send not in allowable range.                                  |
| 1101             | The area designation of the Send/Receive Data Address is not inallowable range.  |
| 1103             | The bit number in the Send/Receive Data Address is not 00.                       |
| 110C             | Request Switch turned ON during other processing.                                |
| 220F             | Specified socket is already processing a send request.                           |
| 2210             | The specified socket is not been connected.                                      |
| 2211             | Unit is busy; cannot execute.  |
| 2607             | Specified Socket Service Parameter Area is already being used foranother socket. |
| 0020             | Connection with remote socket broken during send (EPIPE).                        |
| 003E             | Internal buffer cannot be obtained due to high reception traf-fic(ENOBUFS).      |
| 0045 (See note.) | Error in communications with remote node (ECONNABORTED).                         |
| 004A             | Error in communications with remote node (ECONNREFUSED).                         |
| 004E (See note.) | Remote IP address parameter error (ENETUNREACH).                                 |
| 0053 (See note.) | Error in communications with remote node (ETIMEDOUT).                            |
| 0081             | The specified socket was closed during send processing.                          |

**TCP Socket Close Request**

| Responsecode | Meaning   |
|--------------|---|
| 0000         | Normal end  |
| 0302         | CPU Unit error; cannot execute.   |
| 2210         | The specified socket is not been connected.                                       |
| 2607         | Specified Socket Service Parameter Area is already being used for another socket. |

**Note** These response codes will be returned only on large, multilevel networks.

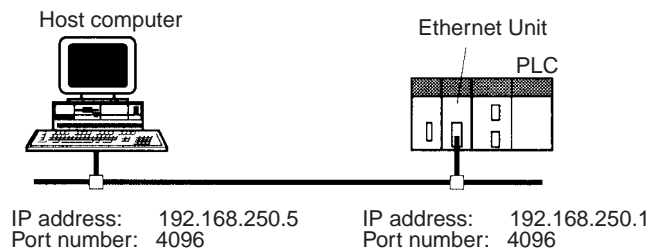
**Note** For details, refer to *SECTION 6 Socket Services* in the *Ethernet Units Construction of Applications Operation Manual (Cat. No. W421-E1)*.

**6-6-7 Socket Application Example****TCP/IP Communications Programming Example**

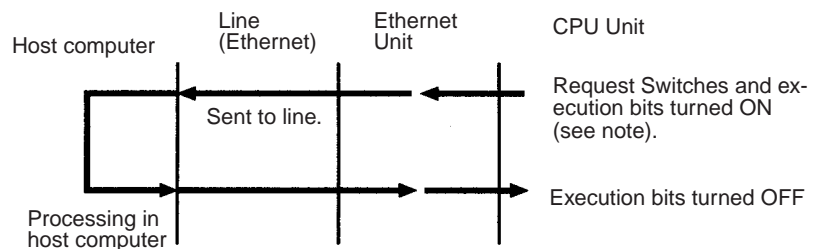
The following programming example illustrates transferring 100 bytes of data between an Ethernet Unit and a host computer using TCP/IP communications.

**System Configuration**

The programming example uses the following system configuration. For the TCP connection, the Ethernet Unit uses a passive open and the host computer uses an active open.

**Data Flow**

The data will flow between the CPU Unit, Ethernet Unit, and host computer as shown in the following diagram.



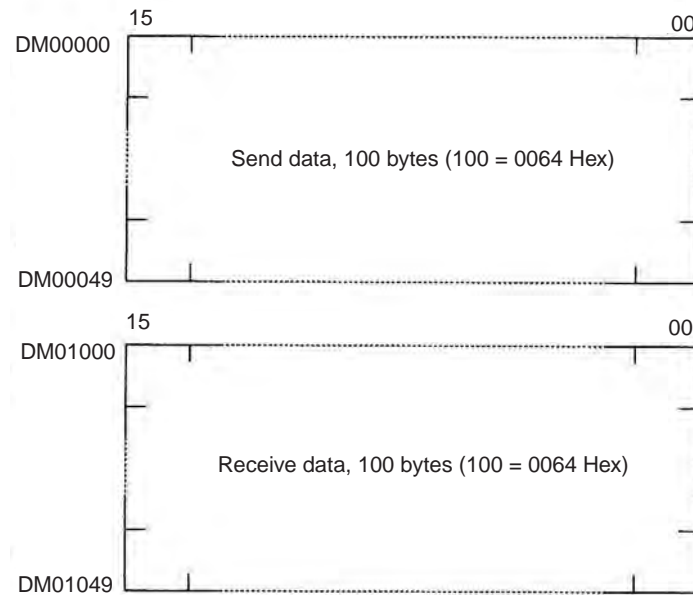
**Note** Here, "execution bits" refer to W0.00 to W0.03, which are used in the ladder diagram to control execution of communications.

**Basic Operations**

- W0.00 is turned ON to request opening a TCP socket from the Ethernet Unit.
- W0.01 is turned ON to request closing the TCP socket from the Ethernet Unit.
- W0.02 is turned ON to request sending data from the Ethernet Unit. Data (100 bytes) is sent beginning at D00000.
- W0.03 is turned ON to request receiving data from the Ethernet Unit. The data that is received (100 bytes) is stored beginning at D01000.
- One of the bits between W1.00 and W1.03 will turn ON if an error occurs. Refer to 6-7-5 Socket Service Request Switches for information on errors.

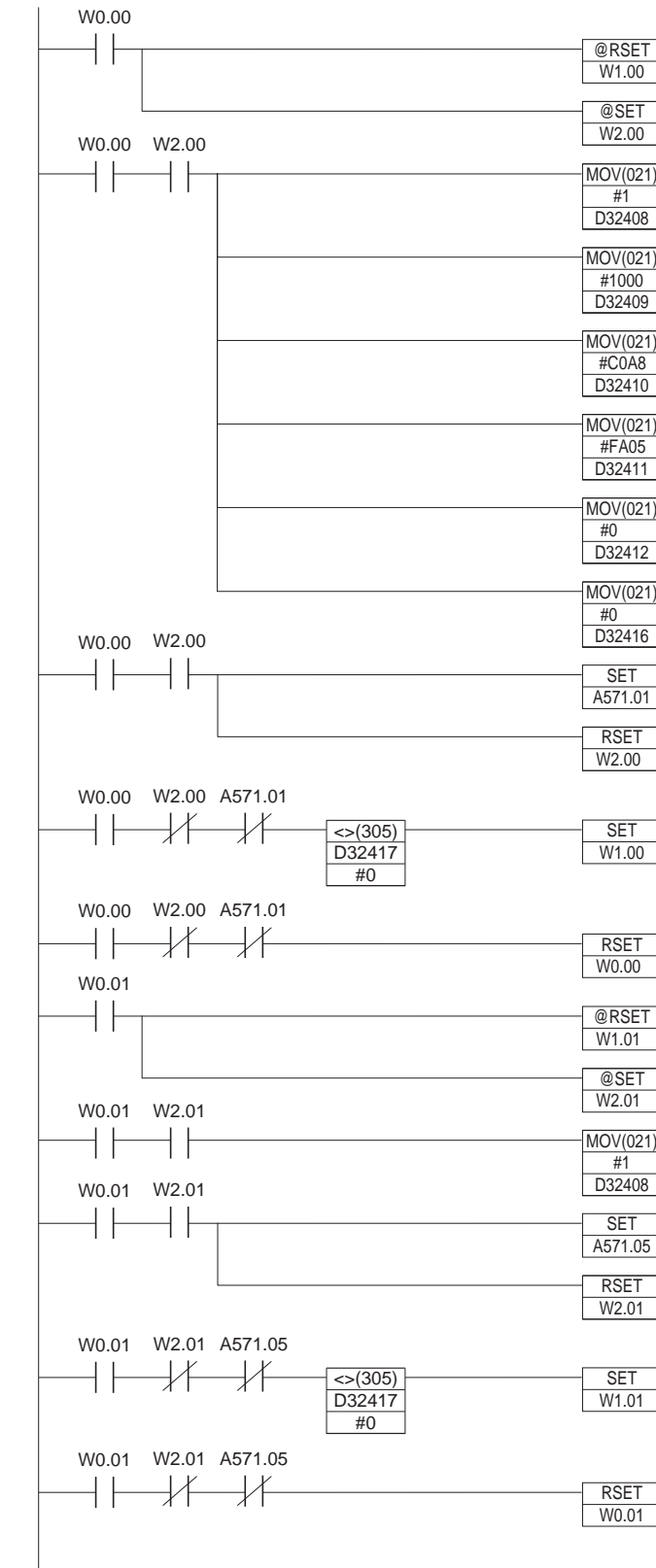
**Program Memory Map**

The send and receive data and bits (flags) used by the program are shown in the following diagram.

**DM Area****WR Area**

|    | 15 |  | 03                           | 02                     | 01                         | 00                        |
|----|----|--|------------------------------|------------------------|----------------------------|---------------------------|
| W0 |    |  | TCP<br>Receive<br>Bit        | TCP<br>Send Bit        | TCP<br>Close Bit           | TCP<br>Open Bit           |
| W1 |    |  | TCP<br>Receive<br>Error Flag | TCP Send<br>Error Flag | TCP<br>Close<br>Error Flag | TCP<br>Open<br>Error Flag |
| W2 |    |  | TCP<br>Receiving<br>Flag     | TCP<br>Sending<br>Flag | TCP<br>Closing<br>Flag     | TCP<br>Opening<br>Flag    |

## Programming Example



### TCP Passive Open

When the TCP Open Bit (W0.00) turns ON, the TCP Open Error Flag (W1.00) is turned OFF and the TCP Opening Flag (W2.00) is turned ON to initialize processing.

When the TCP Opening Flag (W2.00) turns ON, the following parameters are written to the parameter area for socket number 1.

D32408: 0001 Hex = UDP/TCP socket No. 1

D32409: 1000 Hex = Local UDP/TCP port No. 4096

D32410 and D32411:

C0A8 FA05 Hex =

Remote IP address 192.168.250.5

D32412: 0000 Hex = Any remote UDP/TCP port No.

D32416: 0000 Hex = No timeout time

After the parameters have been set, the TCP Passive Open Request Switch (A571.01) is turned ON and the TCP Opening Flag (W2.00) is turned OFF.

If the TCP Passive Open Request Switch (A571.01) turns OFF while the TCP Opening Flag (W2.00) is OFF, the contents of the response code (D32417) in the Socket Service Parameter Area is checked, and if it is not 0000 Hex (normal end), the TCP Open Error Flag (W1.00) is turned ON.

After the execution results have been checked, the TCP Open Bit (W0.00) is turned OFF.

### TCP Close

When the TCP Close Bit (W0.01) turns ON, the TCP Close Error Flag (W1.01) is turned OFF and the TCP Closing Flag (W2.01) is turned ON to initialize processing.

When the TCP Closing Flag (W2.01) turns ON, the following parameter is written to the parameter area for socket number 1.

D32408: 0001 Hex = UDP/TCP socket No. 1

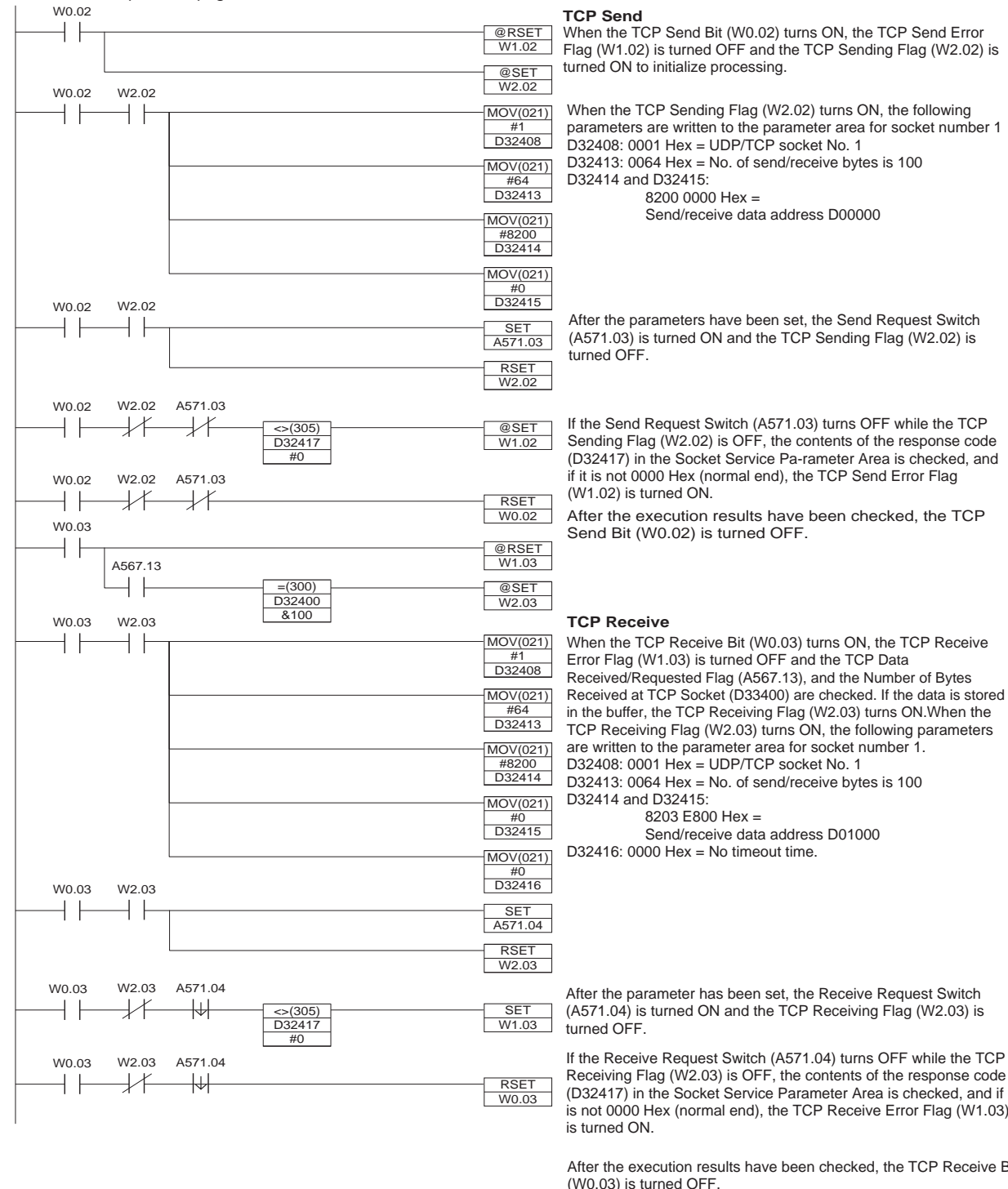
After the parameter has been set, the Close Request Switch (A571.05) is turned ON and the TCP Closing Flag (W2.01) is turned OFF.

If the Close Request Switch (A571.05) turns OFF while the TCP Closing Flag (W2.01) is OFF, the contents of the response code (D32417) in the Socket Service Parameter Area is checked, and if it is not 0000 Hex (normal end), the TCP Close Error Flag (W1.01) is turned ON.

After the execution results have been checked, the TCP Close Bit (W0.01) is turned OFF.

Continued on next page.

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**Note** When using the above programming example, change the bit and word addresses as necessary to avoid using the same areas used by other parts of the user program or the CPU Bus Unit.

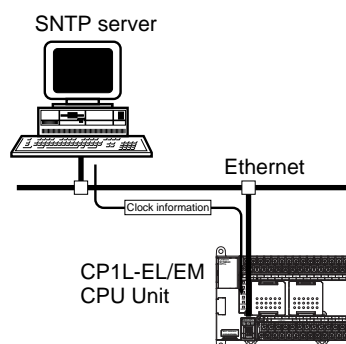


## 6-7 Automatic Clock Adjustment and Specifying Servers by Host Name

### 6-7-1 Automatic Clock Adjustment Function

The built-in clock of the PLC connected to the Ethernet can be automatically adjusted, with the SNTP server clock taken as the standard. Automatic adjustments through the entire system enable the various records generated by production equipment to be managed according to clock information and analyzed.

The PLC can acquire clock information from the SNTP server at a particular time or when a dedicated bit turns ON, and it can refresh the internal clock information automatically.

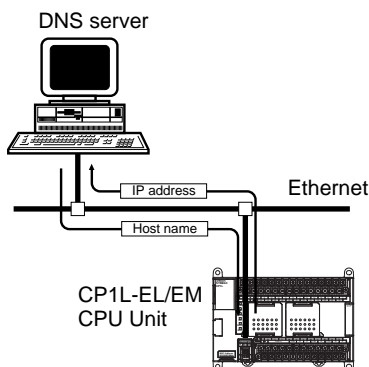


- Note**
- (1) An SNTP server is required to use this function.
  - (2) SNTP server settings require specialized knowledge, so they should always be handled by the network administrator.
  - (3) When using the Internet, depending on the condition of the network it may not be possible to acquire the clock information.

### 6-7-2 Specifying Servers by Host Name

SNTP servers can be specified by host name rather than by IP address by using of the DNS client function.

This enables automatic searches for IP addresses for purposes such as system checking, even when the IP addresses for servers have been changed.



- Note**
- (1) A DNS server is required to specify servers by IP address.
  - (2) The IP address is specified directly for the DNS server.

### 6-7-3 Procedure for Using the Automatic Clock Adjustment Function

1. Make the basic settings.  
Refer to 6-4-3 Basic Settings.



2. With the CX-Programmer online, set the following items in the PLC Setup.

- SNTP server specification (required)
- Access to the SNTP server is enabled when writing clock information from the SNTP server to the CPU Unit when the Automatic Clock Adjustment Switch is turned from OFF to ON and at a set automatic adjustment time.
- Automatic clock adjustment setting



3. To perform automatic clock adjustment manually, turn the Automatic Clock Adjustment Switch (A566.4) from OFF to ON.



4. Select **Transfer to PLC** from the Options Menu and click the **Yes** button.  
The PLC Setup will be transferred to the CPU Unit.

### 6-7-4 PLC Setup for DNS and Automatic clock Adjustment

#### DNS and Automatic Clock Adjustment

All these settings are in the Built-in Ethernet Tab. Click on the relative button can open the setup dialog.

| Button name           | Settings            |
|-----------------------|---------------------|
| DNS Setting           | IP Address          |
|                       | Port No.            |
|                       | Retry Timer         |
| Clock Auto Adjustment | SNTP Server Setting |
|                       | Auto Adjustment     |
|                       | Designation Method  |
|                       | IP Address          |
|                       | Host Name           |
|                       | Port No.            |
|                       | Retry Timer         |
|                       | Time Lag Adjustment |

## CX-Programmer Setup

### DNS Setting

Move the cursor to the **Settings** and double click. Select the Built-in Ethernet Tab. Click the **DNS Setting** button to display the DNS setup dialog.

DNS Server Setting

IP Address: 0 . 0 . 0 . 0

Port No.: 0 [0: Default(53)]

Retry Timer: 0 secs [0: Default(10)]

OK

| Item        | Contents  | Default                   |
|-------------|---|---------------------------|
| IP Address  | Set the IP address for the DNS server.<br>The DNS server is required when specifying the SNTP servers by host name.                     | None                      |
| Port No.    | Set the port to be used for connecting to the DNS server.<br>This setting does not normally need to be changed.                         | 0<br>(Number 53 is used.) |
| Retry timer | Set the time to elapse before retrying when a connection to the DNS server fails.<br>This setting does not normally need to be changed. | 0 (10 s)                  |

### Clock Auto Adjustment

Move the cursor to the **Settings** and double click. Select the Built-in Ethernet Tab. Click the **Clock Auto Adjustment** button to display the Clock Auto Adjustment setup dialog.

Clock Auto Adjustment

SNTP Server Setting

☐ Obtain clock data from SNTP Server

Auto Adjustment: 0 : 0 : 0 (h:m:s)

Designation Method: ☒ IP Address ☐ Host name

IP Address: 0 . 0 . 0 . 0

Host Name:

Port No.: 0 [0: Default(123)]

Retry Timer: 0 secs [0: Default(10)]

Time Lag Adjustment: ☒ + ☐ - 0 : 0 (h:m -12:00 to +13:00)

OK

| Item                               | Contents   | Default                    |
|------------------------------------|--|----------------------------|
| Obtain clock data from SNTP server | If this option is selected, the CPU Unit's clock is set to the time at the SNTP server's clock.  | Not checked                |
| Auto Adjustment                    | Set the time at which the SNTP server is to be accessed to synchronize the clocks.<br><br>When the time that is set here arrives, the SNTP server is accessed and the CPU Unit clock is adjusted to match the SNTP server clock. | 0:0:0                      |
| Designation Method                 | Select whether the SNTP server used for automatic clock adjustment is to be specified by IP address or by host domain name (i.e., by host name).   | IP Address                 |
| IP Address                         | Set the IP address for the SNTP server that is to be used for automatic clock adjustment.<br><br>This setting is enabled only when server specification by IP address has been selected.   | 0.0.0.0                    |
| Host Name                          | Set the host domain name (i.e., the host name) for the SNTP server that is to be used for automatic clock adjustment.<br><br>This setting is enabled only when server specification by host name has been selected.              | None                       |
| Port No.                           | Set the port number for connecting to the SNTP server that is to be used for automatic clock adjustment.<br><br>This setting does not normally need to be changed.   | 0<br>(Number 123 is used.) |
| Retry Timer                        | Set the time to elapse before retrying when a connection to the SNTP server fails.<br><br>This setting does not normally need to be changed.   | 0<br>(10 s)                |
| Time Lag Adjustment                | This sets in the CPU Unit's clock data the time difference made up from the SNTP server's clock data.<br><br>To use the clock data from the SNTP server just as it is, input 0.  | +0:0                       |

## 6-7-5 Memory Allocations

**Auxiliary Area Allocation** The following table and descriptions cover the words and bits in the Auxiliary Area of PLC memory that are related to the Automatic Clock Adjustment and Specifying Servers by Host Name function.

### Service Status

| Address | Bit(s) | Name                  | Status | Manipulated by | Unit operation   | Access    |
|---------|--------|-----------------------|--------|----------------|--|-----------|
| A46     | 5      | DNS Server Error Flag | ON     | Unit           | ON when the following errors occur during DNS server operation:<br>• An illegal server IP address is set.<br>• A timeout occurs during communications with the server.               | Read only |
|         |        |                       | OFF    | Unit           | OFF when DNS server operation is normal.   |           |
|         | 11     | SNTP Server Error     | ON     | Unit           | ON when the following errors occur during SNTP server operation:<br>• An illegal server IP address or host name is set.<br>• A timeout occurs during communications with the server. |           |
|         |        |                       | OFF    | Unit           | OFF when SNTP server operation is normal.  |           |

### Service Request

| Address | Bit(s) | Name                              | Status | Manipulated by | Unit operation  | Access     |
|---------|--------|-----------------------------------|--------|----------------|---|------------|
| A566    | 4      | Automatic Clock Adjustment Switch | ON     | User           | The automatic clock adjustment is executed when this bit turns ON.      | Read/Write |
|         |        |                                   | OFF    | Unit           | Turned OFF by Unit after automatic clock adjustment has been completed. |            |

#### Automatic Clock Adjustment Switch (Bit 4)

The automatic clock adjustment can be executed by turning this switch ON.

The SNTP server required for the automatic clock adjustment is set in the PLC Setup.

After the automatic clock adjustment has been completed, the Unit will automatically turn this switch OFF. Until then, do not forcibly manipulate the switch.



# SECTION 7

## Pulse and Counter Functions

This section describes the CP1L-EL/EM's interrupt and high-speed counter functions.

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## 7-1 High-speed Counters

### 7-1-1 Overview

- A rotary encoder can be connected to a built-in input to produce a high-speed pulse input.
- The PRV(881) instruction can be used to measure the input pulse frequency (one input only).
- The high-speed counter PVs can be maintained or refreshed.
- The High-speed Counter Gate Bit can be turned ON/OFF from the ladder program to select whether the high-speed counter PVs will be maintained or refreshed.
- Any one of the following input signals can be selected as the counter input mode.

Response Frequencies for 24 VDC Inputs to High-speed Counters 0 and 1:

- Differential phase inputs (4x): 50 kHz
- Pulse + direction inputs: 100 kHz
- Up/Down pulse inputs: 100 kHz
- Increment pulse inputs: 100 kHz
- The counting mode can be set to linear mode or circular (ring) mode.
- The counter reset method can be set to Z phase signal + software reset, software reset, Z phase signal + software reset (continue comparing), or software reset (continue comparing).

### Pulse Input Functions

| Purpose  | Function used                       | Description  |
|--|-------------------------------------|--|
| Receive incremental rotary encoder inputs to calculate length or position.   | High-speed counter function         | Built-in input terminals can be used for high-speed counter inputs.<br>The PV for the high-speed counters are stored in the Auxiliary Area.<br>The counters can be operated in ring mode or linear mode. |
| Measure a workpiece's length or position.<br>(Start counting when a certain condition is established or pause counting when a certain condition is established.) | High-speed Counter Gate Bit         | The high-speed counter can be started or stopped (PV held) from the Unit's program by turning ON/OFF the High-speed Counter Gate Bit when the desired condition is met.                                  |
| Measure a workpiece's speed from its position data (frequency measurement.)  | PRV(881) HIGH-SPEED COUNTER PV READ | The PRV(881) instruction can be used to measure the pulse frequency.<br>• Range with differential phase inputs: 0 to 50 kHz<br>• Range with all other input modes: 0 to 100 kHz                          |
|  | PRV2(883) PULSE FREQUENCY CONVERT   | PRV2(883) reads the pulse frequency and converts it to a rotational speed (r/min) or it converts the counter PV to a total number of rotations. Results are calculated by the number of pulses/rotation. |



## 7-1-2 High-speed Counter Specifications

### Specifications

| Item  |                         | Specification  |                         |                                       |                                |
|---|-------------------------|--|-------------------------|---------------------------------------|--------------------------------|
| Number of high-speed counters                 |                         | 2 (High-speed counters 0 and 1)  |                         |                                       | 4 (High-speed counters 0 to 3) |
| Pulse input modes (Selected in the PLC Setup) |                         | Differential phase inputs  | Up/down inputs          | Pulse + direction inputs              | Increment inputs               |
| Input terminal allocation                     |                         | Phase-A input  | Increment pulse input   | Pulse input                           | Increment pulse input          |
|   |                         | Phase-B input  | Decrement pulse input   | Direction input                       | ---                            |
|   |                         | Phase-Z input  | Reset input             | Reset input                           | Reset input                    |
| Input method                                  |                         | Differential phase, 4x (Fixed)   | Two single-phase inputs | Single-phase pulse + direction inputs | Single-phase input             |
| Response frequency                            |                         | 50 kHz   | 100 kHz                 | 100 kHz                               | 100 kHz                        |
| Counting mode                                 |                         | Linear mode or circular (ring) mode (Select in the PLC Setup.)   |                         |                                       |                                |
| Count values                                  |                         | Linear mode: 8000 0000 to 7FFF FFFF hex<br>Ring mode: 0000 0000 to Ring SV<br>(The Ring SV (Circular Max. Count) is set in the PLC Setup and the setting range is 00000001 to FFFFFFFF hex.)   |                         |                                       |                                |
| High-speed counter PV storage locations       |                         | High-speed counter 0: A271 (leftmost 4 digits) and A270 (rightmost 4 digits)<br>High-speed counter 1: A273 (leftmost 4 digits) and A272 (rightmost 4 digits)<br>High-speed counter 2: A317 (leftmost 4 digits) and A316 (rightmost 4 digits)<br>High-speed counter 3: A319 (leftmost 4 digits) and A318 (rightmost 4 digits)<br>Target value comparison interrupts or range comparison interrupts can be executed based on these PVs.<br><b>Note</b> The PVs are refreshed in the overseeing processes at the start of each cycle. Use PRV(881) to read the most recent PVs. |                         |                                       |                                |
|   |                         | Data format: 8 digit hexadecimal<br>Range in linear mode: 8000 0000 to 7FFF FFFF hex<br>Range in ring mode: 0000 0000 to Ring SV (Circular Max. Count)   |                         |                                       |                                |
|   |                         |  |                         |                                       |                                |
| Control method                                | Target value comparison | Up to 48 target values and corresponding interrupt task numbers can be registered.   |                         |                                       |                                |
|   | Range comparison        | Up to 8 ranges can be registered, with a separate upper limit, lower limit, and interrupt task number for each range.  |                         |                                       |                                |
| Counter reset method                          |                         | Select one of the following methods in the PLC Setup.<br><ul style="list-style-type: none"> <li>•Phase-Z + Software reset<br/>The counter is reset when the phase-Z input goes ON while the Reset Bit is ON.</li> <li>•Software reset<br/>The counter is reset when the Reset Bit goes ON.<br/>(Set the counter reset method in the PLC Setup.)</li> </ul> <b>Note</b> Operation can be set to stop or continue the comparison operation when the high-speed counter is reset.   |                         |                                       |                                |

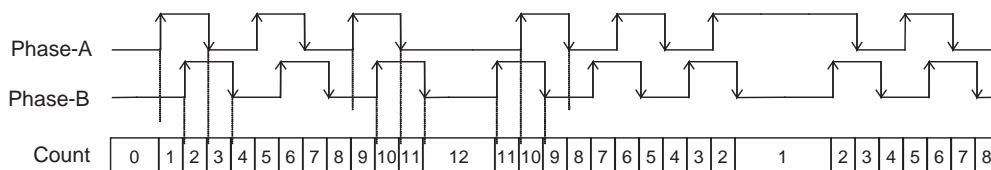
## Auxiliary Area Data Allocation

| Function                             |  | High-speed counter number |         |         |         |
|--------------------------------------|--|---------------------------|---------|---------|---------|
|                                      |  | 0                         | 1       | 2       | 3       |
| PV storage words                     | Leftmost 4 digits  | A271                      | A273    | A317    | A319    |
|                                      | Rightmost 4 digits   | A270                      | A272    | A316    | A318    |
| Range Comparison Condition Met Flags | Range 1 Comparison Condition Met Flag  | A274.00                   | A275.00 | A320.00 | A321.00 |
|                                      | Range 2 Comparison Condition Met Flag  | A274.01                   | A275.01 | A320.01 | A321.01 |
|                                      | Range 3 Comparison Condition Met Flag  | A274.02                   | A275.02 | A320.02 | A321.02 |
|                                      | Range 4 Comparison Condition Met Flag  | A274.03                   | A275.03 | A320.03 | A321.03 |
|                                      | Range 5 Comparison Condition Met Flag  | A274.04                   | A275.04 | A320.04 | A321.04 |
|                                      | Range 6 Comparison Condition Met Flag  | A274.05                   | A275.05 | A320.05 | A321.05 |
|                                      | Range 7 Comparison Condition Met Flag  | A274.06                   | A275.06 | A320.06 | A321.06 |
|                                      | Range 8 Comparison Condition Met Flag  | A274.07                   | A275.07 | A320.07 | A321.07 |
| Comparison In-progress Flags         | ON when a comparison operation is being executed for the high-speed counter.   | A274.08                   | A275.08 | A320.08 | A321.08 |
| Overflow/Underflow Flags             | ON when an overflow or underflow has occurred in the high-speed counter's PV.<br>(Used only when the counting mode is set to Linear Mode.) | A274.09                   | A275.09 | A320.09 | A321.09 |
| Count Direction Flags                | 0: Decrementing<br>1: Incrementing   | A274.10                   | A275.10 | A320.10 | A321.10 |

## Counter Input Modes

### Differential Phase Mode (4x)

The differential phase mode uses two phase signals (phase A and phase B) and increments/decrements the count according to the status of these two signals.

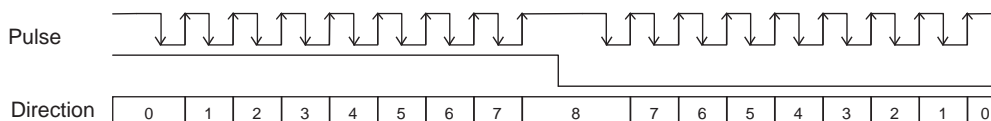


### Conditions for Incrementing/Decrementing the Count

| Phase A | Phase B | Count value |
|---------|---------|-------------|
| ↑       | L       | Increment   |
| H       | ↑       | Increment   |
| ↓       | H       | Increment   |
| L       | ↓       | Increment   |
| L       | ↑       | Decrement   |
| ↑       | H       | Decrement   |
| H       | ↓       | Decrement   |
| ↓       | L       | Decrement   |

### Pulse + Direction Mode

The pulse + direction mode uses a direction signal input and pulse signal input. The count is incremented or decremented depending on the status (ON or OFF) of the direction signal.



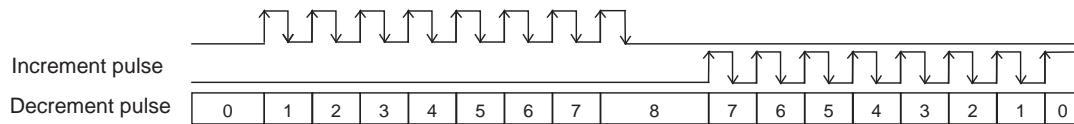
**Conditions for Incrementing/Decrementing the Count**

| Direction signal | Pulse signal | Count value |
|------------------|--------------|-------------|
| ↑                | L            | No change   |
| H                | ↑            | Increment   |
| ↓                | H            | No change   |
| L                | ↓            | No change   |
| L                | ↑            | Decrement   |
| ↑                | H            | No change   |
| H                | ↓            | No change   |
| ↓                | L            | No change   |

- The count is incremented when the direction signal is ON and decremented when it is OFF.
- Only up-differentiated pulses (rising edges) can be counted.

**Up/Down Mode**

The up/down mode uses two signals, an increment pulse input and a decrement pulse input.

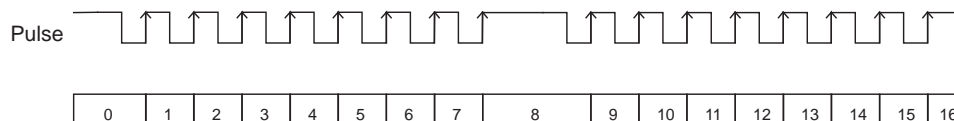
**Conditions for Incrementing/Decrementing the Count**

| Decrement pulse | Increment pulse | Count value |
|-----------------|-----------------|-------------|
| ↑               | L               | Decrement   |
| H               | ↑               | Increment   |
| ↓               | H               | No change   |
| L               | ↓               | No change   |
| L               | ↑               | Increment   |
| ↑               | H               | Decrement   |
| H               | ↓               | No change   |
| ↓               | L               | No change   |

- The count is incremented for each increment pulse input and decremented for each decrement pulse input.
- Only up-differentiated pulses (rising edges) can be counted.

**Increment Mode**

The increment mode counts single-phase pulse signal inputs. This mode only increments the count.

**Conditions for Incrementing/Decrementing the Count**

| Pulse | Count value |
|-------|-------------|
| ↑     | Increment   |
| H     | No change   |
| ↓     | No change   |
| L     | No change   |

- Only up-differentiated pulses (rising edges) can be counted.

**Note** The count of the high-speed counter can be monitored to see if it is currently being incremented or decremented. The count in the current cycle is compared with the count in the previous cycle to determine if it is being incremented or decremented. The results are reflected in the High-speed Counter Count Direction Flags (A274.10 for high-speed counter 0, A275.10 for high-speed counter 1, A320.10 for high-speed counter 2, and A321.10 for high-speed counter 3.)

## Counting Modes

### Linear Mode

Input pulses can be counted in the range between the lower limit and upper limit values. If the pulse count goes beyond the lower/upper limit, an under-flow/overflow will occur and counting will stop.

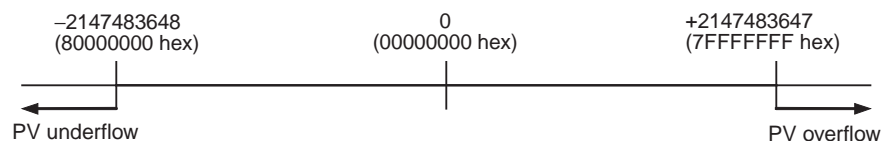
#### Lower and Upper Limits of the Range

The following diagrams show the lower limit and upper limit values for increment mode and up/down mode.

##### Increment Mode



##### Up/Down Mode

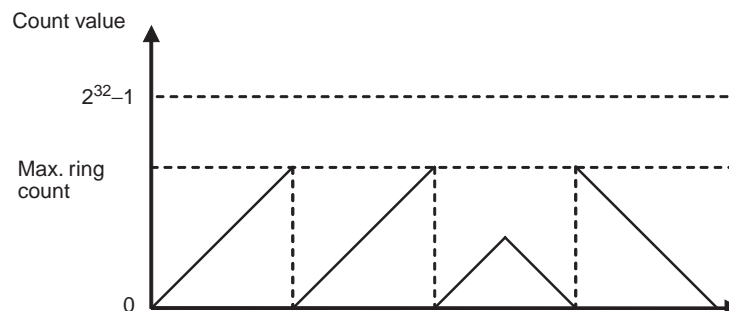


### Circular (Ring) Mode

Input pulses are counted in a loop within the set range. The loop operates as follows:

- If the count is incremented from the max. ring count, the count will be reset to 0 automatically and incrementing will continue.
- If the count is decremented from 0, the count will be set to the max. ring count automatically and decrementing will continue.

Consequently, underflows and overflows cannot occur when ring mode is used.



#### Max. Ring Count

Use the PLC Setup to set the max. ring count (Circular Max. Count), which is the max. value of the input pulse counting range. The max. ring count can be set to any value between 00000001 and FFFFFFFF hex.

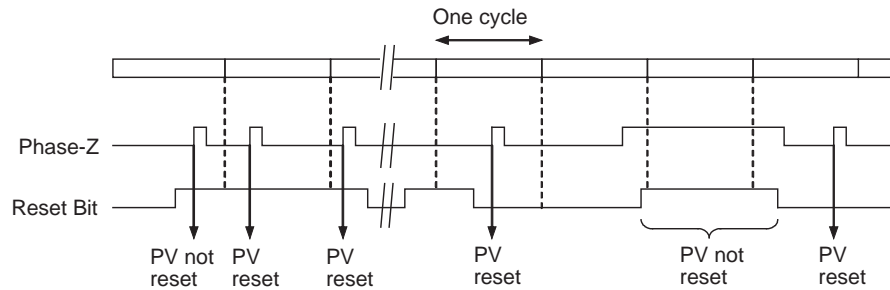
**Restrictions**

- There are no negative values in ring mode.
- If the max. ring count is set to 0 in the PLC Setup, the counter will operate with a max. ring count of FFFFFFFF hex.

**Reset Methods****Phase-Z Signal + Software Reset**

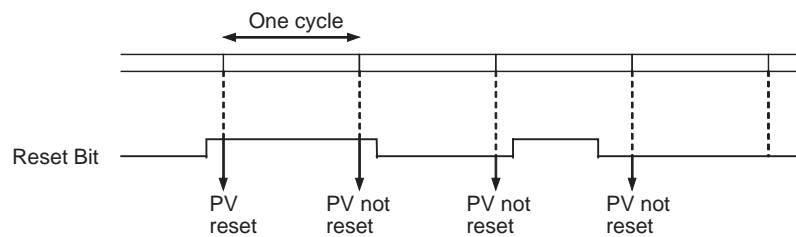
The high-speed counter's PV is reset when the phase-Z signal (reset input) goes from OFF to ON while the corresponding High-speed Counter Reset Bit is ON.

The CPU Unit recognizes the ON status of the High-speed Counter Reset Bit only at the beginning of the PLC cycle during the overseeing processes. Consequently, when the Reset Bit is turned ON in the ladder program, the phase-Z signal does not become effective until the next PLC cycle.

**Software Reset**

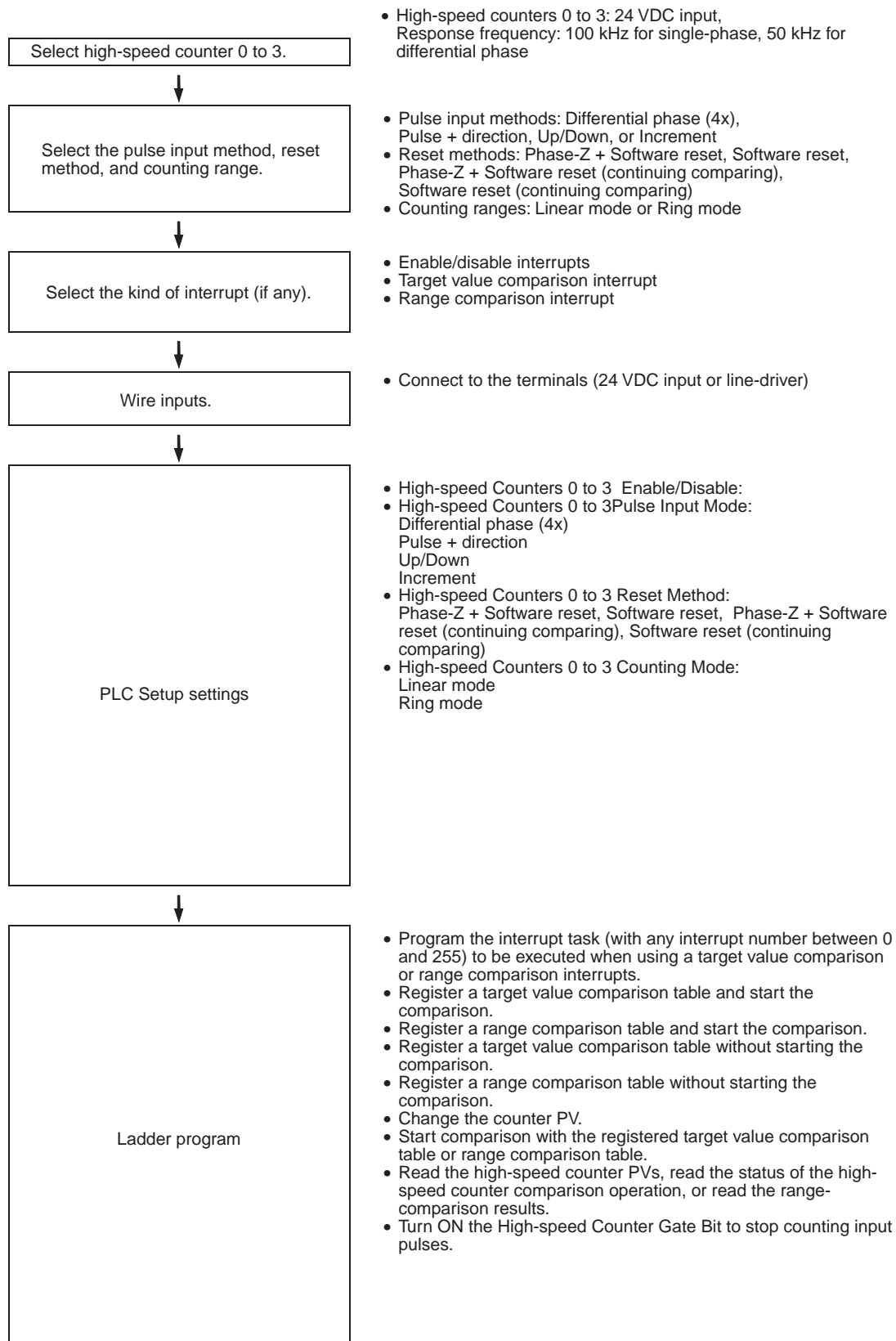
The high-speed counter's PV is reset when the corresponding High-speed Counter Reset Bit goes from OFF to ON.

The CPU Unit recognizes the OFF-to-ON transition of the High-speed Counter Reset Bit only at the beginning of the PLC cycle during the overseeing processes. Reset processing is performed at the same time. The OFF-to-ON transition will not be recognized if the Reset Bit goes OFF again within the same cycle.



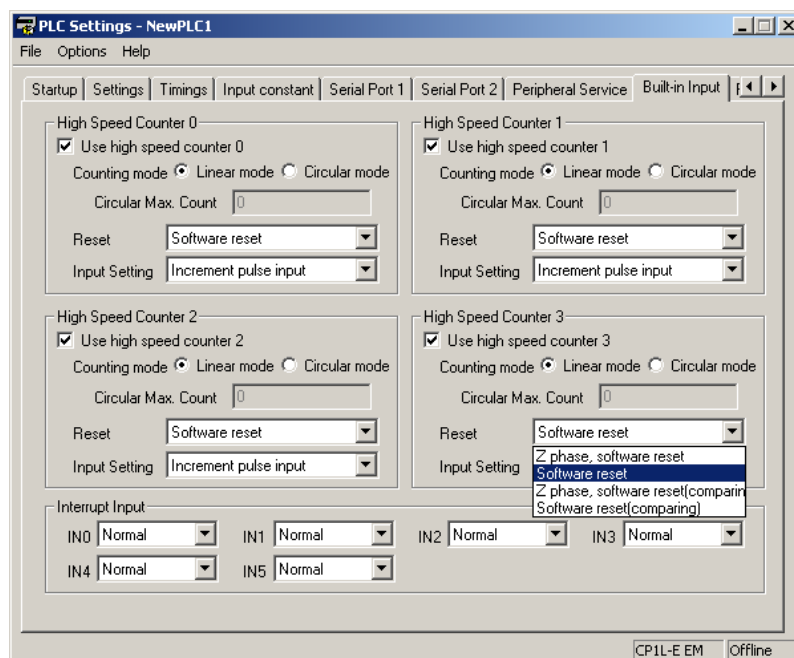
**Note** The comparison operation can be set to stop or continue when a high-speed counter is reset. This enables applications where the comparison operation can be restarted from a counter PV of 0 when the counter is reset.

### 7-1-3 Procedure



### 7-1-4 PLC Setup

The settings for high-speed counters 0 to 3 are located in the Built-in Input Tab of the CX-Programmer's PLC Settings Window.



#### Settings in the Built-in Input Tab

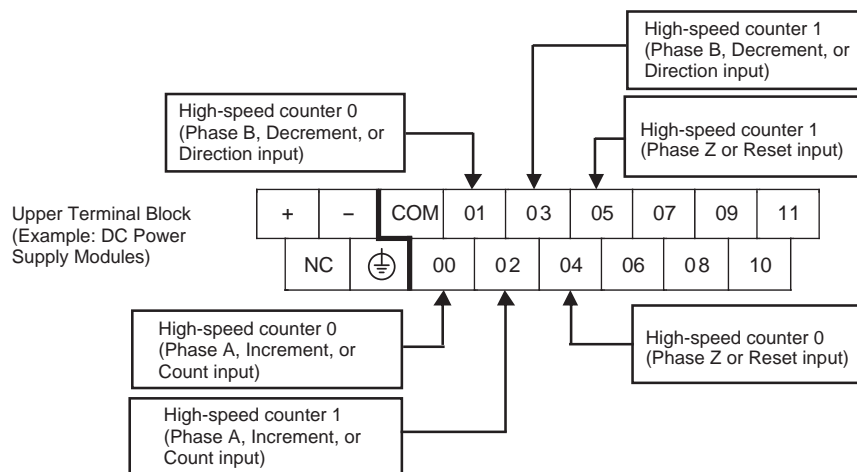
| Item                                  | Setting   |
|---------------------------------------|---|
| Use high speed counter 0 to 3         | Use counter                                     |
| Counting mode                         | Linear mode                                     |
|                                       | Circular mode (ring mode)                       |
| Circular Max. Count (max. ring count) | 0 to 4,294,967,295 (0 to FFFF FFFF hex)         |
| Reset method                          | Phase Z and software reset                      |
|                                       | Software reset                                  |
|                                       | Phase Z and software reset (continue comparing) |
|                                       | Software reset (continue comparing)             |
| Input Setting                         | Differential phase inputs (4x)                  |
|                                       | Pulse + direction inputs                        |
|                                       | Up/Down inputs                                  |
|                                       | Increment pulse input                           |

### 7-1-5 High-speed Counter Terminal Allocation

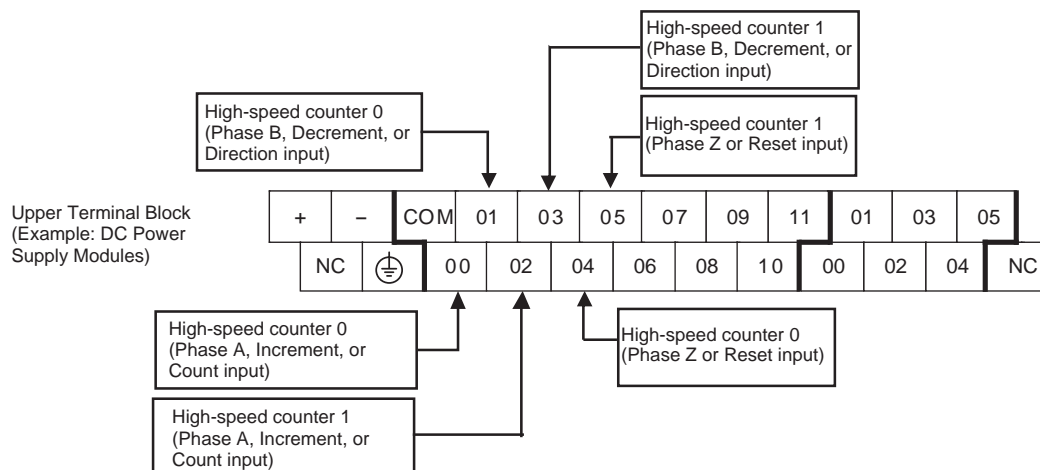
The following diagrams show the input terminals that can be used for high-speed counters in each CPU Unit.

Differential Phases, Up/Down, or Pulse + Direction

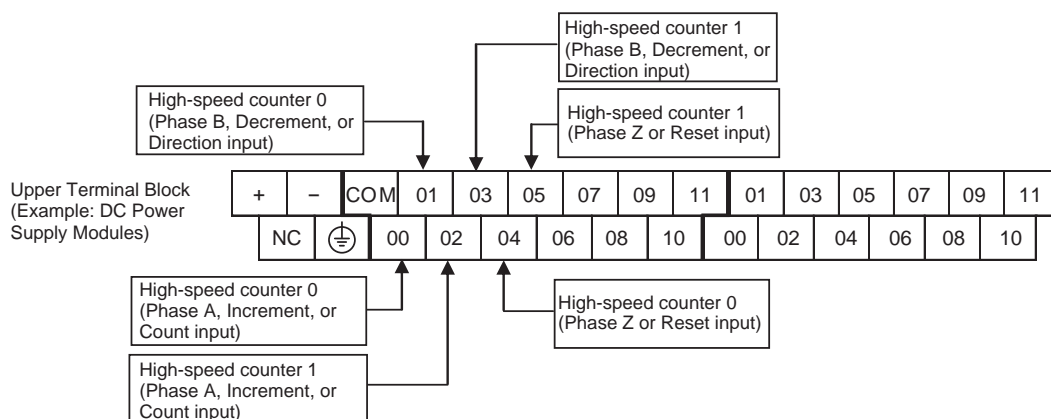
#### Input Terminal Arrangement for CPU Units with 20 I/O Points



#### Input Terminal Arrangement for CPU Units with 30 I/O Points

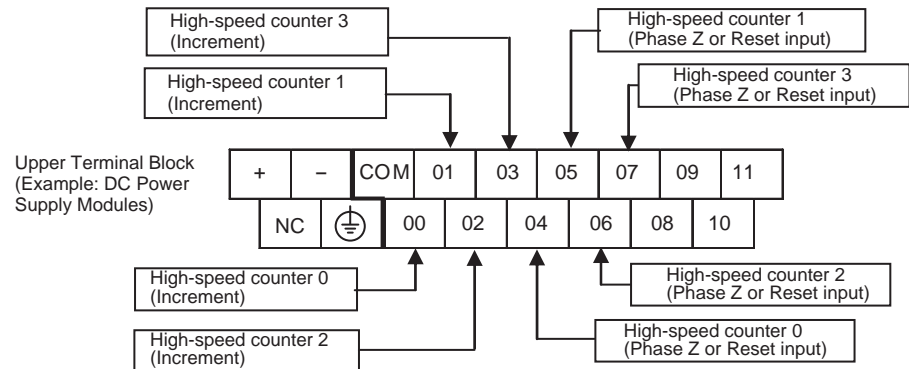
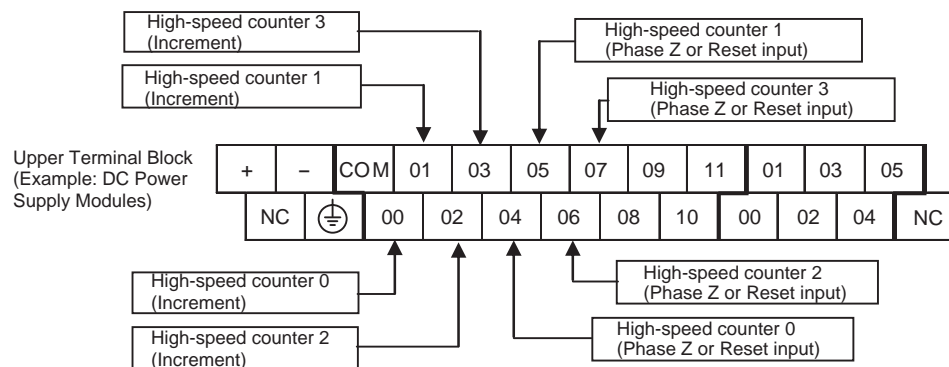
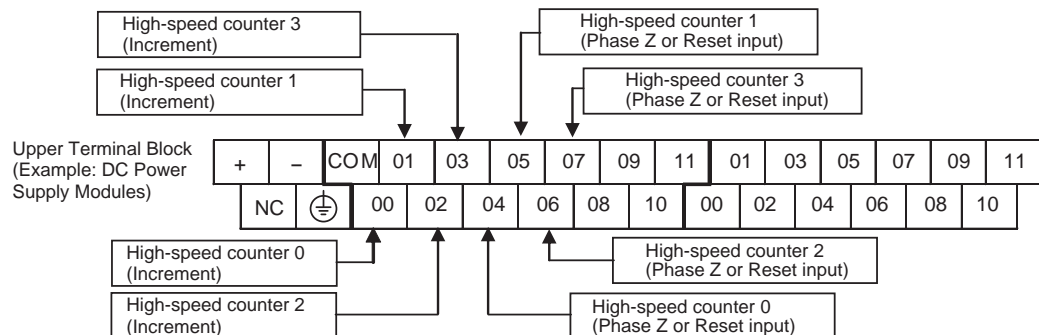


#### Input Terminal Arrangement for CPU Units with 40 I/O Points





## Increment Pulse Inputs

**Input Terminal Arrangement for CPU Units with 20 I/O Points****Input Terminal Arrangement for CPU Units with 30 I/O Points****Input Terminal Arrangement for CPU Units with 40 I/O Points****Input Function Settings in the PLC Setup**

The CPU Unit's built-in inputs can be set for use as high-speed counter inputs in the PLC Setup's Built-in Input Tab using the CX-Programmer. (When an input is set for use as a high-speed counter input, the corresponding words and bits cannot be used for general-purpose (normal) inputs, input interrupts, or quick-response inputs.)

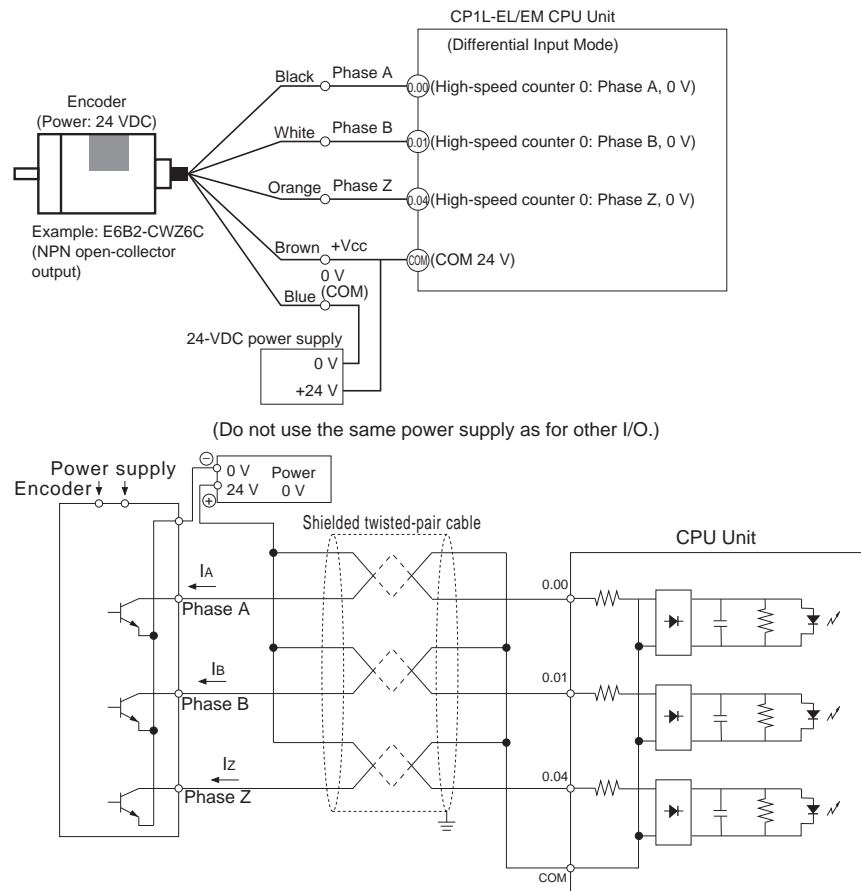
## CPU Units with 20, 30 or 40 I/O Points

| Address |          | Default setting              |                              |                              | High-speed counter operation settings: |   | Origin searches                                   |
|---------|----------|------------------------------|------------------------------|------------------------------|--|---|---|
| Word    | Bit      | CPU Units with 40 I/O Points | CPU Units with 30 I/O Points | CPU Units with 20 I/O Points | Single-phase (increment pulse input)   | Two-phase (differential phases x4, up/down, or pulse/direction) | Origin searches enabled for pulse outputs 0 and 1 |
| CIO 0   | 00       | Normal input 0               | Normal input 0               | Normal input 0               | Counter 0, increment input             | Counter 0, A phase, up, or count input                          | ---   |
|         | 01       | Normal input 1               | Normal input 1               | Normal input 1               | Counter 1, increment input             | Counter 0, B phase, down, or direction input                    | ---   |
|         | 02       | Normal input 2               | Normal input 2               | Normal input 2               | Counter 2, increment input             | Counter 1, A phase, up, or count input                          | ---   |
|         | 03       | Normal input 3               | Normal input 3               | Normal input 3               | Counter 3, increment input             | Counter 1, B phase, down, or direction input                    | ---   |
|         | 04       | Normal input 4               | Normal input 4               | Normal input 4               | Counter 0, phase-Z reset input         | Counter 0, phase-Z reset input                                  | ---   |
|         | 05       | Normal input 5               | Normal input 5               | Normal input 5               | Counter 1, phase-Z reset input         | Counter 1, phase-Z reset input                                  | ---   |
|         | 06       | Normal input 6               | Normal input 6               | Normal input 6               | Counter 2, phase-Z reset input         | ---   | Pulse output 0: Origin input signal               |
|         | 07       | Normal input 7               | Normal input 7               | Normal input 7               | Counter 3, phase-Z reset input         | ---   | Pulse output 1: Origin input signal               |
|         | 08       | Normal input 8               | Normal input 8               | Normal input 8               | ---                                    | ---   | ---   |
|         | 09       | Normal input 9               | Normal input 9               | Normal input 9               | ---                                    | ---   | ---   |
|         | 10       | Normal input 10              | Normal input 10              | Normal input 10              | ---                                    | ---   | Pulse output 0: Origin proximity input signal     |
|         | 11       | Normal input 11              | Normal input 11              | Normal input 11              | ---                                    | ---   | Pulse output 1: Origin proximity input signal     |
| CIO 1   | 00 to 05 | Normal input 12 to 17        | Normal input 12 to 17        | ---                          | ---                                    | ---   | ---   |
|         | 06 to 11 | Normal input 18 to 23        | ---                          | ---                          | ---                                    | ---   | ---   |

## 7-1-6 Pulse Input Connection Examples

### Encoders with 24 VDC Open-collector Outputs

This example shows how to connect an encoder that has phase-A, phase-B, and phase-Z outputs.



## 7-1-7 Ladder Program Example

### Inspecting a Dimension by Counting Pulse Inputs

- This example is for a CPU Unit with 40 I/O Points.
- High-speed counter 0 is used.
- When the edge of the workpiece is detected, the counter PV is reset by a phase-Z pulse.
- The workpiece is passes inspection if the final count is between 30,000 and 30,300, otherwise the workpiece fails.
- If the workpiece passes, output CIO 100.00 is turned ON by an interrupt and the indicator PL1 is lit. If the workpiece fails, output CIO 100.01 is turned ON by an interrupt and indicator PL2 is lit.
- The interrupt program is interrupt task 10.

## ■ I/O Allocations

**Input Terminals**

| Input terminal |          | Usage   |
|----------------|----------|---|
| Word           | Bit      |   |
| CIO 0          | 00       | High-speed counter 0 phase-A input (See note.)  |
|                | 01       | High-speed counter 0 phase-B input (See note.)  |
|                | 02       | Start measurement by pushbutton switch (normal input).  |
|                | 03       | Detect trailing edge of measured object (normal input).   |
|                | 04       | Detect leading edge of measured object for high-speed counter 0 phase-Z/reset input (see note). Bit status is reflected in A531.00. |
|                | 05 to 11 | Not used. (normal input)  |
| CIO 1          | 00 to 11 | Not used. (normal input)  |

**Note** The high-speed counter inputs are enabled when the *Use high speed counter 0* Option is selected in the PLC Setup's Built-in Input Tab.

**Output Terminals**

| Output terminal |          | Usage        |                            |
|-----------------|----------|--------------|----------------------------|
| Word            | Bit      |              |                            |
| CIO 100         | 00       | Normal input | PL1: Dimension pass output |
|                 | 01       | Normal input | PL2: Dimension fail output |
|                 | 02 to 07 | Normal input | Not used.                  |
| CIO 101         | 00 to 07 | Normal input | Not used.                  |

**Auxiliary Area Addresses for High-speed Counter 0**

| Function                            |   | Address |
|-------------------------------------|---|---------|
| PV storage words                    | Leftmost 4 digits   | A271    |
|                                     | Rightmost 4 digits  | A270    |
| Range Comparison Condition Met Flag | Range 1 Comparison Condition Met Flag   | A274.00 |
| Comparison In-progress Flag         | ON when a comparison operation is being executed for the high-speed counter.  | A274.08 |
| Overflow/Underflow Flag             | ON when an overflow or underflow has occurred in the high-speed counter's PV. (Used only when the counting mode is set to Linear Mode.) | A274.09 |
| Count Direction Flag                | 0: Decrementing<br>1: Incrementing  | A274.10 |
| Reset Bit                           | Used for the PV software reset.   | A531.00 |
| High-speed Counter Gate Bit         | When ON, the counter's PV will not be changed even if pulse inputs are received for the counter.  | A531.08 |

**Range Comparison Table**

The range comparison table is stored in D10000 to D10039.

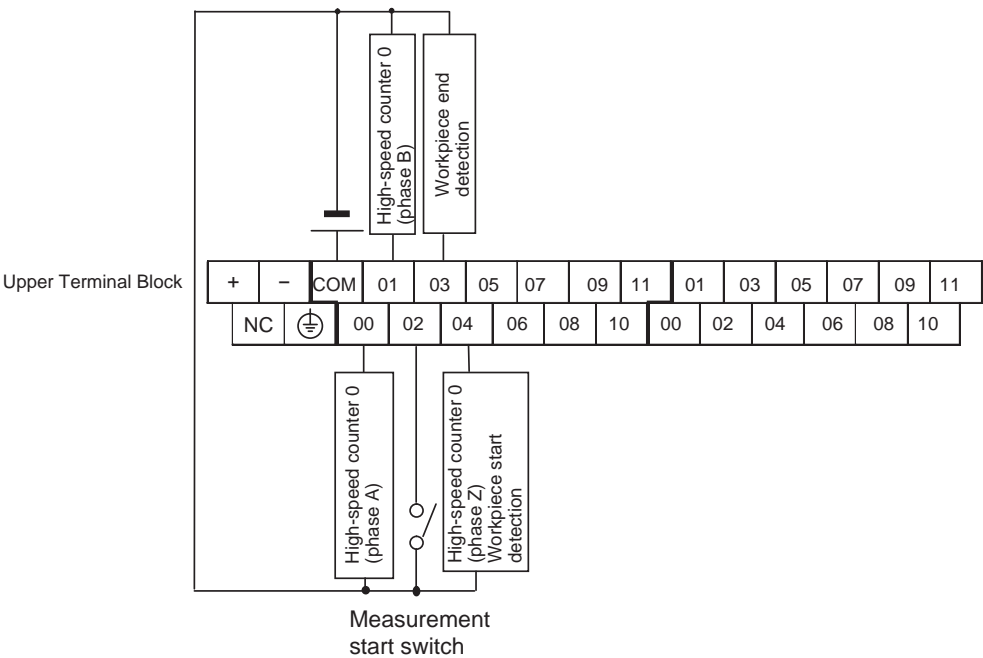
## ■ PLC Setup

Select the *Use high speed counter 0* Option in the PLC Setup's Built-in Input Tab.

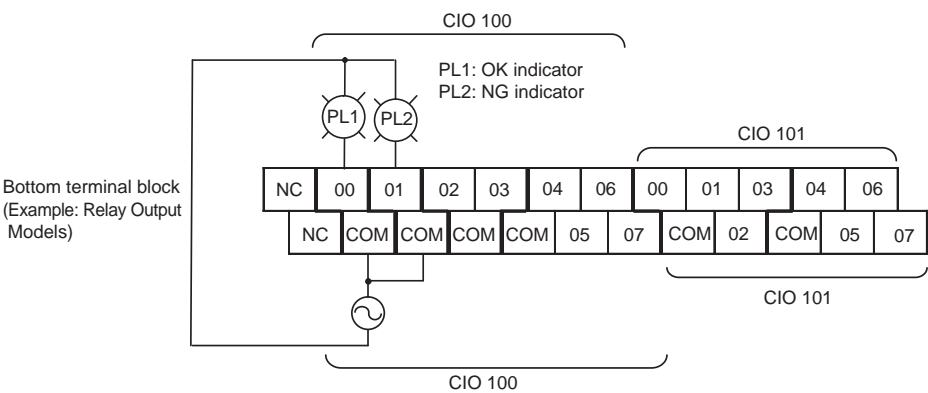
| Item                 | Setting                  |
|----------------------|--------------------------|
| High-speed counter 0 | Use high speed counter 0 |
| Counting mode        | Linear mode              |
| Circular Max. Count  | ---                      |
| Reset method         | Software reset           |
| Input Setting        | Up/Down inputs           |

I/O Wiring

Input Wiring



Output Wiring



Range Comparison Table Settings

The inspection standards data is set in the DM Area with the CX-Programmer. Even though range 1 is the only range being used, all 40 words must still be dedicated to the range comparison table.

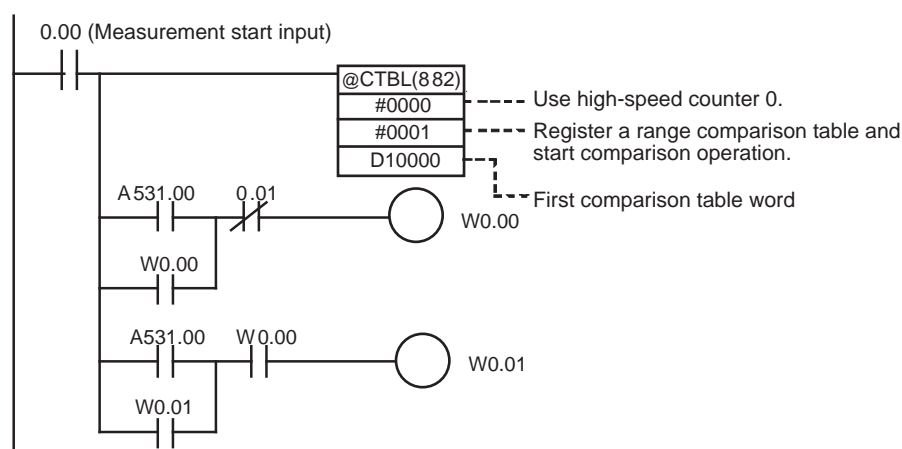
| Word                | Setting  | Function   |                              |
|---------------------|----------|--|------------------------------|
| D10000              | 7430     | Rightmost 4 digits of range 1 lower limit                                    | Lower limit value:<br>30,000 |
| D10001              | 0000     | Leftmost 4 digits of range 1 lower limit                                     |                              |
| D10002              | 765C     | Rightmost 4 digits of range 1 upper limit                                    | Upper limit value:<br>30,300 |
| D10003              | 0000     | Leftmost 4 digits of range 1 upper limit                                     |                              |
| D10004              | 000A     | Range 1 interrupt task number = 10 (A hex)                                   |                              |
| D10005 to<br>D10008 | All 0000 | Range 2 lower and upper limit values<br>(Not used and don't need to be set.) | Range 2 settings             |
| D10009              | FFFF     | Disables range 2.  |                              |
| ~                   |          |  |                              |

| Word   | Setting  | Function   |                  |
|--|----------|--|------------------|
| D10014<br>D10019<br>D10024<br>D10029<br>D10034 | FFFF     | Set the fifth word for ranges 3 to 7 (listed at left) to FFFF to disable those ranges. |                  |
| :  |          |  |                  |
| D10035 to<br>D10038                            | All 0000 | Range 8 lower and upper limit values<br>(Not used and don't need to be set.)           | Range 8 settings |
| D10039   | FFFF     | Disables range 8.  |                  |

### ■ Creating the Ladder Program

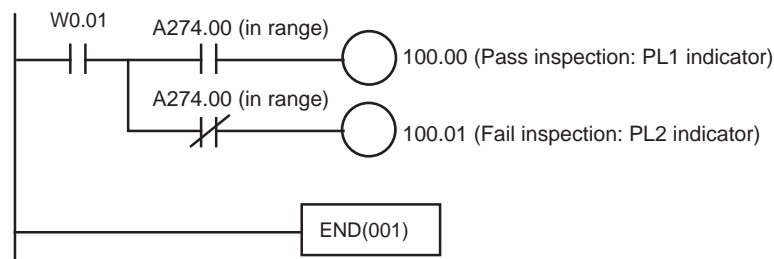
#### Programming in Cyclic Task

Use CTBL(882) to start the comparison operation with high-speed counter 0 and interrupt task 10.



#### Programming in Interrupt Task 10

Create the processing performed by interrupt task 10.



## 7-1-8 Additional Capabilities and Restrictions

### Restrictions on High-speed Counter Inputs

- The Phase-Z signal + Software reset method cannot be used when the high speed counters are operating in Differential Phase or Pulse + Direction Input Modes and the origin search function is enabled for the pulse output (in the PLC Setup).
- When a high-speed counter is being used (enabled in the PLC Setup), the input cannot be used as a general-purpose (normal) input, interrupt input, or quick-response input.

## Starting Interrupt Tasks based on Comparison Conditions

Data registered in advance in a comparison table can be compared with the actual counter PVs during operation. The specified interrupt tasks (registered in the table) will be started when the corresponding comparison condition is met.

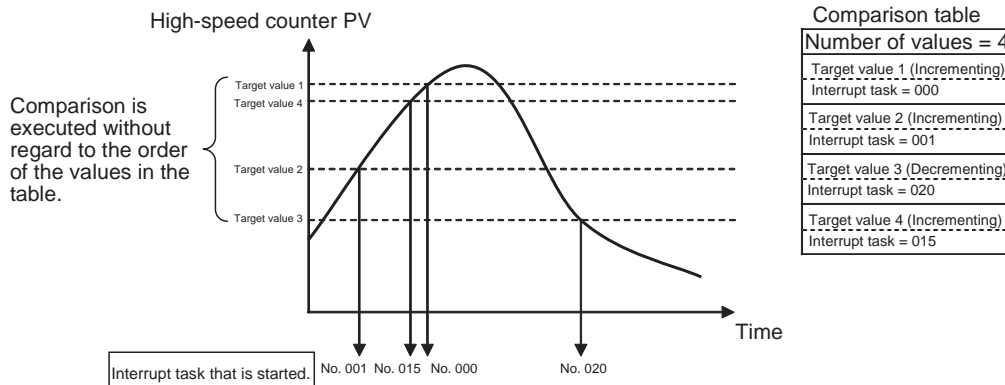
There are two comparison methods available: Target value comparison and range comparison.

- Use the CTBL(882) instruction to register the comparison table.
- Use either the CTBL(882) instruction or INI(880) instruction to start the comparison operation.
- Use the INI(880) instruction to stop the comparison operation.

### Target Value Comparison

The specified interrupt task is executed when the high-speed counter PV matches a target value registered in the table.

- The comparison conditions (target values and counting directions) are registered in the comparison table along with the corresponding interrupt task number. The specified interrupt task will be executed when the high-speed counter PV matches the registered target value.
- Up to 48 target values (between 1 and 48) can be registered in the comparison table.
- A different interrupt task can be registered for each target value.
- The target value comparison is performed on all of the target values in the table, regardless of the order in which the target values are registered.
- If the PV is changed, the changed PV will be compared with the target values in the table, even if the PV is changed while the target value comparison operation is in progress.

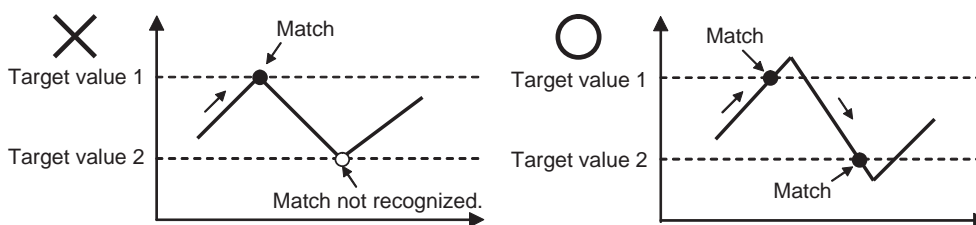


### Restrictions

A comparison condition (target value and count direction) cannot appear in the table more than once. An error will occur if a comparison condition is specified two or more times.

**Note** When the count direction (incrementing/decrementing) changes at a PV that matches a target value, the next target value cannot be matched in that direction.

Set the target values so that they do not occur at the peak or trough of count value changes.



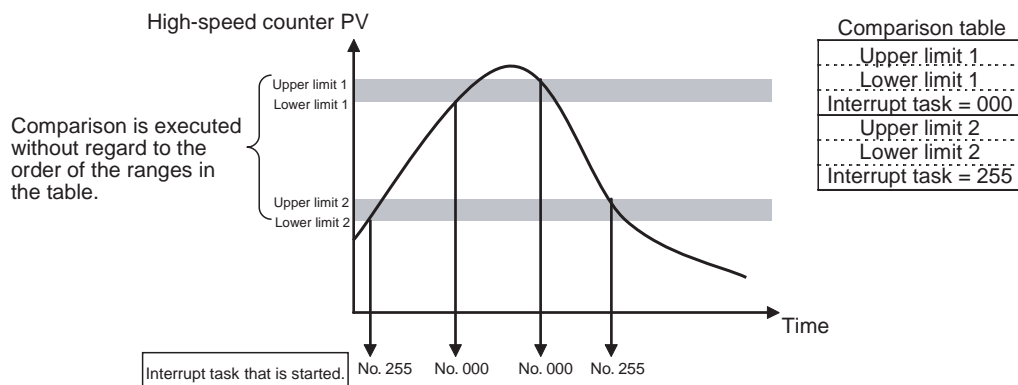
## Range Comparison

The specified interrupt task is executed when the high-speed counter PV is within the range defined by the upper and lower limit values.

- The comparison conditions (upper and lower limits of the range) are registered in the comparison table along with the corresponding interrupt task number. The specified interrupt task will be executed once when the high-speed counter PV is in the range ( $\text{Lower limit} \leq \text{PV} \leq \text{Upper limit}$ ).
- A total of 8 ranges (upper and lower limits) are registered in the comparison table.
- The ranges can overlap.
- A different interrupt task can be registered for each range.
- The counter PV is compared with the 8 ranges once each cycle.
- The interrupt task is executed just once when the comparison condition goes from unmet to met.

## Restrictions

When more than one comparison condition is met in a cycle, the first interrupt task in the table will be executed in that cycle. The next interrupt task in the table will be executed in the next cycle.



**Note** The range comparison table can be used without starting an interrupt task when the comparison condition is met. The range comparison function can be useful when you just want to know whether or not the high-speed counter PV is within a particular range.

Use the Range Comparison Condition Met Flags to determine whether the high-speed counter PV is within a registered range.

## Pausing Input Signal Counting (Gate Function)

If the High-speed Counter Gate Bit is turned ON, the corresponding high-speed counter will not count even if pulse inputs are received and the counter PV will be maintained at its current value. Bits A53108 to A53111 are the High-speed Counter Gate Bits for high-speed counters 0 to 3.



When the High-speed Counter Gate Bit is turned OFF again, the high-speed counter will resume counting and the counter PV will be refreshed.

#### Restrictions

- The Gate Bit will be disabled if the high-speed counter's reset method is set to Phase-Z signal + Software reset and the Reset Bit is ON (waiting for the phase-Z input to reset the counter PV.)

### High-speed Counter Frequency Measurement

This function measures the frequency of the high-speed counter (input pulses.)

The input pulse frequency can be read by executing the PRV(881) instruction. The measured frequency is output in 8-digit hexadecimal and expressed in Hz. The frequency measurement function can be used with high-speed counter 0 only.

The frequency can be measured while a high-speed counter 0 comparison operation is in progress. Frequency measurement can be performed at the same time as functions such as the high-speed counter and pulse output without affecting the performance of those functions.

#### Procedure

- 1,2,3...**
1. High-speed Counter Enable/Disable Setting (Required)  
Select the *Use high speed counter 0* Option in the PLC Setup.
  2. Pulse Input Mode Setting (Required)  
Set the High-speed Counter 0 Pulse Input Mode (*Input Setting*) in the PLC Setup.
  3. Counting Mode Setting (Required)  
Set the High-speed Counter 0 *Counting Mode* in the PLC Setup.  
If ring mode counting is selected, set the High-speed Counter 0 *Circular Max. Count* (max. ring count) in the PLC Setup.
  4. Reset Method Setting (Required)  
Set the High-speed Counter 0 Reset Method in the PLC Setup.
  5. PRV(881) Instruction Execution (Required)  
N: Specify the high-speed counter number. (High-speed counter 0: 0010)  
C: 0003 (Read frequency)  
D: Destination word for frequency data

#### Restrictions

- The frequency measurement function can be used with high-speed counter 0 only.

#### Specifications

| Item                                   | Specifications   |
|--|--|
| Number of frequency measurement inputs | 1 input (high-speed counter 0 only)  |
| Frequency measurement range            | High-speed counter 0:<br>Differential phase inputs: 0 to 50 kHz<br>All other input modes: 0 to 100 kHz<br><br><b>Note:</b> If the frequency exceeds the maximum value, the maximum value will be stored. |
| Measurement method                     | Execution of the PRV(881) instruction  |
| Output data range                      | Units: Hz<br>Range:<br>Differential phase input: 0000 0000 to 0003 0D40 hex<br>All other input modes: 0000 0000 to 0001 86A0 hex   |

## **Pulse Frequency Conversion**

The pulse frequency input to a high-speed counter can be converted to a rotational speed (r/min) or the PV of the counter can be converted to the total number of rotations. The converted value is output as 8-digit hexadecimal. This function is supported only for high-speed counter 0.

### **Frequency–Rotational Speed Conversion**

The rotational speed in r/min is calculated from the pulse frequency input to a high-speed counter and the number of pulses per rotation.

### **Counter PV–Total Number of Rotations Conversion**

The total number of rotations is calculated from the present value of the counter and the number of pulses per rotation.

## **Procedure**

- 1,2,3...**
1. High-speed Counter Enable/Disable Setting (Required)  
Select the *Use high speed counter 0* Option in the PLC Setup.
  2. Pulse Input Mode Setting (Required)  
Set the High-speed Counter 0 Pulse Input Mode (*Input Setting*) in the PLC Setup.
  3. Counting Mode Setting (Required)  
Set the High-speed Counter 0 *Counting Mode* in the PLC Setup.  
If ring mode counting is selected, set the *Circular Max. Count* (max. ring count) in the PLC Setup.
  4. Reset Method Setting (Required)  
Set the High-speed Counter 0 Reset Method in the PLC Setup.
  5. Execute PRV2(883) as described below (required).

### **Converting the Frequency to a Rotational Speed**

Execute PRV2(883) with the following operands.

C: Control data (Set to 0000 for frequency-rotational speed conversion.)

P: Coefficient (pulses/rotation (hex))

D: First word for result

### **Converting the Counter PV to the Total Number of Rotations**

Execute PRV2(883) with the following operands.

C: Control data (Set to 0001 for counter PV-total number of rotations conversion.)

P: Coefficient (pulses/rotation (hex))

D: First word for result

## **Restrictions**

Pulse frequency conversion is possible only for high-speed counter 0.

## **7-2 Pulse Outputs**

### **7-2-1 Overview**

Fixed duty factor pulses can be output from the CPU Unit's built-in outputs to perform positioning or speed control with a servo driver that accepts pulse inputs.

#### **■ CW/CCW Pulse Outputs or Pulse + Direction Outputs**

The pulse output mode can be set to match the motor driver's pulse input specifications.

### ■ Automatic Direction Selection for Easy Positioning with Absolute Coordinates

When operating in absolute coordinates (origin defined or PV changed with the INI(880) instruction), the CW/CCW direction will be selected automatically when the pulse output instruction is executed. (The CW/CCW direction is selected by determining whether the number of pulses specified in the instruction is greater than or less than the pulse output PV.)

### ■ Triangular Control

Triangular control (trapezoidal control without a constant-speed plateau) will be performed during positioning executed by an ACC(888) instruction (independent) or PLS2(887) instruction if the number of output pulses required for acceleration/deceleration exceeds the specified target pulse Output Amount.

### ■ Change Target Position during Positioning (Multiple Start)

When positioning was started with a PULSE OUTPUT (PLS2(887)) instruction and the positioning operation is still in progress, another PLS2(887) instruction can be executed to change the target position, target speed, acceleration rate, and deceleration rate.

### ■ Switch from Speed Control to Positioning (Fixed Distance Feed Interrupt)

A PLS2(887) instruction can be executed during a speed control (continuous mode) operation to change to positioning mode (independent mode). This feature allows a fixed distance feed interrupt (moving a specified amount) to be executed when specific conditions occur.

### ■ Change Target Speed and Acceleration/Deceleration Rate during Acceleration or Deceleration

When trapezoidal acceleration/deceleration is being executed according to a pulse output instruction (speed control or positioning), the target speed and acceleration/deceleration rate can be changed during acceleration or deceleration.

### ■ Use Variable Duty Factor Pulse Outputs for Lighting, Power Control, Etc.

The PULSE WITH VARIABLE DUTY FACTOR instruction (PWM(891)) can be used to output variable duty factor pulses from the CPU Unit's built-in outputs for applications such as lighting and power control.

## Controlling Pulse Outputs

| Purpose  | Function  | Description  |
|--|---|--|
| Perform simple positioning by outputting pulses to a motor driver that accepts pulse-train inputs. | Pulse output functions <ul style="list-style-type: none"> <li>Single-phase pulse output without acceleration/deceleration<br/>Controlled by SPED.</li> <li>Single-phase pulse output with acceleration/deceleration (equal acceleration and deceleration rates for trapezoidal form)<br/>Controlled by ACC.</li> <li>Single-phase pulse output with trapezoidal acceleration/deceleration (Supports a startup frequency and different acceleration/deceleration rates.)<br/>Controlled by PLS2(887).</li> </ul> | Built-in outputs can be used as pulse outputs 0 and 1.<br>Target frequency ranges: 1 Hz to 100 kHz<br>Duty factor: 50%<br>The pulse output mode can be set to CW/CCW pulse control or Pulse plus direction control, but the same output mode must be used for pulse outputs 0 and 1.<br><b>Note</b> The pulse output PVs are stored in the Auxiliary Area. |

| Purpose  | Function   | Description   |
|--|--|---|
| Perform origin search and origin return operations.  | Origin functions (Origin search and origin return)   | <p>Origin search and origin return operations can be executed through pulse outputs.</p> <ul style="list-style-type: none"> <li>• Origin search:<br/>To start the origin search, set the PLC Setup to enable the origin search operation, set the various origin search parameters, and execute the ORIGIN SEARCH instruction (ORG(889)). The Unit will determine the location of the origin based on the Origin Proximity Input Signal and Origin Input Signal. The coordinates of the pulse output's PV will automatically be set as the absolute coordinates.</li> <li>• Origin return:<br/>To return to the predetermined origin, set the various origin return parameters and execute the ORIGIN SEARCH instruction (ORG(889)).</li> </ul> |
| Change the target position during positioning.<br>(For example, perform an emergency avoid operation with the Multiple Start feature.)                       | Positioning with the PLS2(887) instruction   | When a positioning operation started with the PULSE OUTPUT (PLS2(887)) instruction is in progress, another PLS2(887) instruction can be executed to change the target position, target speed, acceleration rate, and deceleration rate.   |
| Change speed in steps (polyline approximation) during speed control.   | Use the ACC(888) instruction (continuous) to change the acceleration rate or deceleration rate.                                      | When a speed control operation started with the ACC(888) instruction (continuous) is in progress, another ACC(888) instruction (continuous) can be executed to change the acceleration rate or deceleration rate.   |
| Change speed in steps (polyline approximation) during positioning.   | Use the ACC(888) instruction (independent) or PLS2(887) to change the acceleration rate or deceleration rate.                        | When a positioning operation started with the ACC(888) instruction (independent) or PLS2(887) instruction is in progress, another ACC(888) (independent) or PLS2(887) instruction can be executed to change the acceleration rate or deceleration rate.   |
| Perform fixed distance feed interrupt.   | Execute positioning with the PLS2(887) instruction during an operation started with SPED(885) (continuous) or ACC(888) (continuous). | When a speed control operation started with the SPED(885) instruction (continuous) or ACC(888) instruction (continuous) is in progress, the PLS2(887) instruction can be executed to switch to positioning, output a fixed number of pulses, and stop.  |
| After determining the origin, perform positioning simply in absolute coordinates without regard to the direction of the current position or target position. | The positioning direction is selected automatically in the absolute coordinate system.   | When operating in absolute coordinates (with the origin determined or INI(880) instruction executed to change the PV), the CW or CCW direction is selected automatically based on the relationship between the pulse output PV and the pulse Output Amount specified when the pulse output instruction is executed.   |
| Perform triangular control.  | Positioning with the ACC(888) instruction (independent) or PLS2(887) instruction.  | <p>When a positioning operation started with the ACC(888) instruction (independent) or PLS2(887) instruction is in progress, triangular control (trapezoidal control without the constant-speed plateau) will be performed if the number of output pulses required for acceleration/deceleration exceeds the specified target pulse Output Amount.</p> <p>(The number of pulses required for acceleration/deceleration equals the time required to reach the target frequency x the target frequency.)</p>  |
| Use variable duty factor outputs for time-proportional temperature control.  | Control with analog inputs and the variable duty factor pulse output function (PWM(891)).  | Two built-in outputs can be used as PWM(891) outputs 0 and 1 by executing the PWM(891) instruction.   |

## 7-2-2 Pulse Output Specifications

### Specifications

| Item  | Specifications   |
|---|--|
| Output mode   | Continuous mode (for speed control) or independent mode (for position control)   |
| Positioning (independent mode) instructions                   | PULS(886) and SPED(885), PULS(886) and ACC(888), or PLS2(887)  |
| Speed control (continuous mode) instructions                  | SPED(885) or ACC(888)  |
| Origin (origin search and origin return) instructions         | ORG(889)   |
| Output frequency  | Pulse outputs 0, 1: 1 Hz to 100 kHz (1 Hz units)   |
| Frequency acceleration and deceleration rates                 | Set in 1 Hz units for acceleration/deceleration rates from 1 Hz to 65,635 Hz (every 4 ms). The acceleration and deceleration rates can be set independently only with PLS2(887).   |
| Changing SVs during instruction execution                     | The target frequency, acceleration/deceleration rate, and target position can be changed.  |
| Duty factor   | Fixed at 50%   |
| Pulse output method   | CW/CCW inputs or Pulse + direction inputs<br>The method is selected with an instruction operand. The same method must be used for pulse outputs 0 and 1.   |
| Number of output pulses                                       | Relative coordinates: 0000 0000 to 7FFF FFFF hex<br>(Each direction accelerating or decelerating: 2,147,483,647)<br>Absolute coordinates: 8000 0000 to 7FFF FFFF hex<br>(-2147483648 to 2147483647)  |
| Pulse output PV's relative/absolute coordinate specification  | Absolute coordinates are specified automatically when the origin location has been determined by setting the pulse output PV with INI(880) or performing an origin search with ORG(889). Relative coordinates are used when the origin location is undetermined.   |
| Relative pulse specification/<br>Absolute pulse specification | The pulse type can be specified with an operand in PULS(886) or PLS2(887).<br><b>Note</b> The absolute pulse specification can be used when absolute coordinates are specified for the pulse output PV, i.e. the origin location has been determined.<br>The absolute pulse specification cannot be used when relative coordinates are specified, i.e. the origin location is undetermined. An instruction error will occur. |
| Pulse output PV's storage location                            | The following Auxiliary Area words contain the pulse output PVs:<br>Pulse output 0: A277 (leftmost 4 digits) and A276 (rightmost 4 digits)<br>Pulse output 1: A279 (leftmost 4 digits) and A278 (rightmost 4 digits)<br>The PVs are refreshed during regular I/O refreshing.   |
| Acceleration/deceleration curve specification                 | Trapezoidal or S-curve acceleration/deceleration   |

### Pulse Output Modes

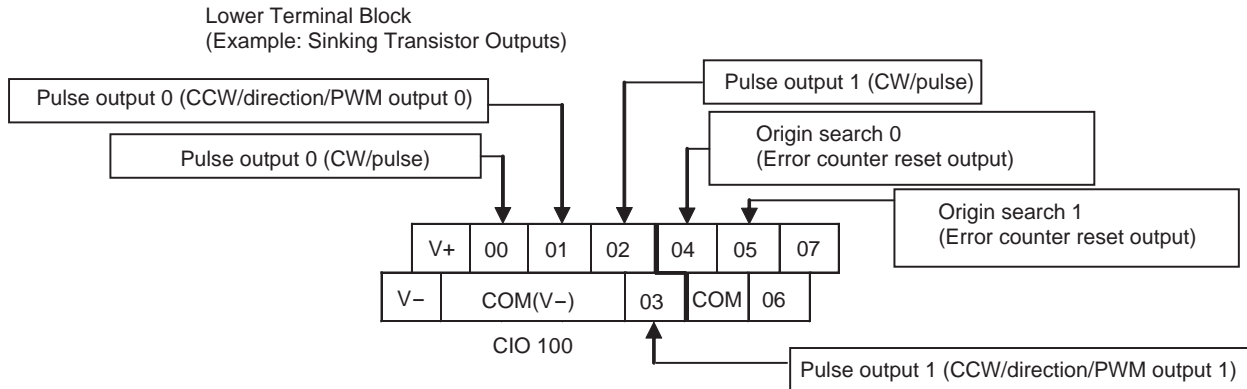
There are two pulse output modes. In independent mode the number of output pulses is specified and in continuous mode the number of output pulses is not specified.

| Mode             | Description   |
|------------------|---|
| Independent mode | This mode is used for positioning.<br>Operation stops automatically when the preset number of pulses has been output. It is also possible to stop the pulse output early with INI(880). |
| Continuous mode  | This mode is used for speed control.<br>The pulse output will continue until it is stopped by executing another instruction or switching the PLC to PROGRAM mode.                       |

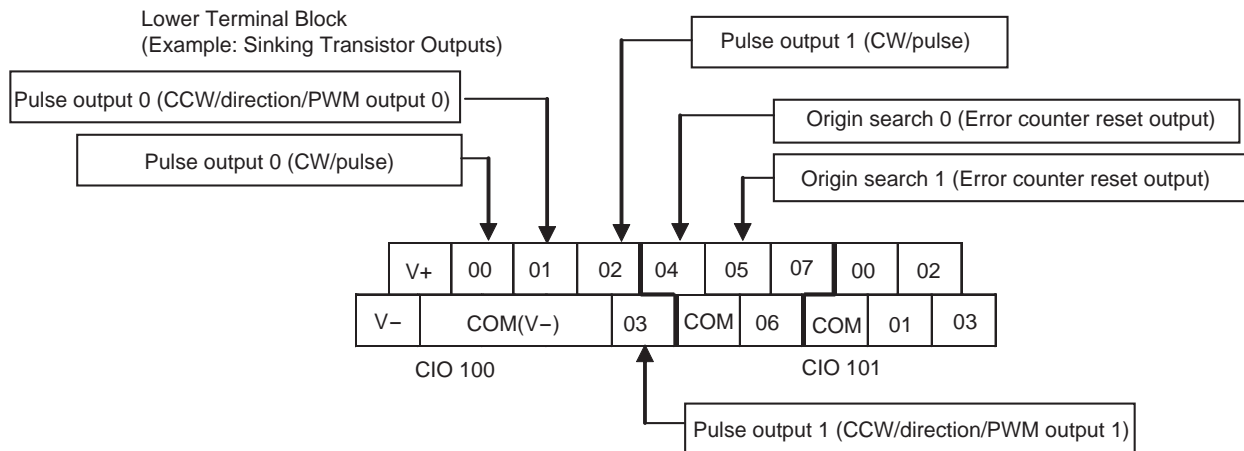
### 7-2-3 Pulse Output Terminal Allocations

The following diagrams show the terminals that can be used for pulse outputs in each CPU Unit.

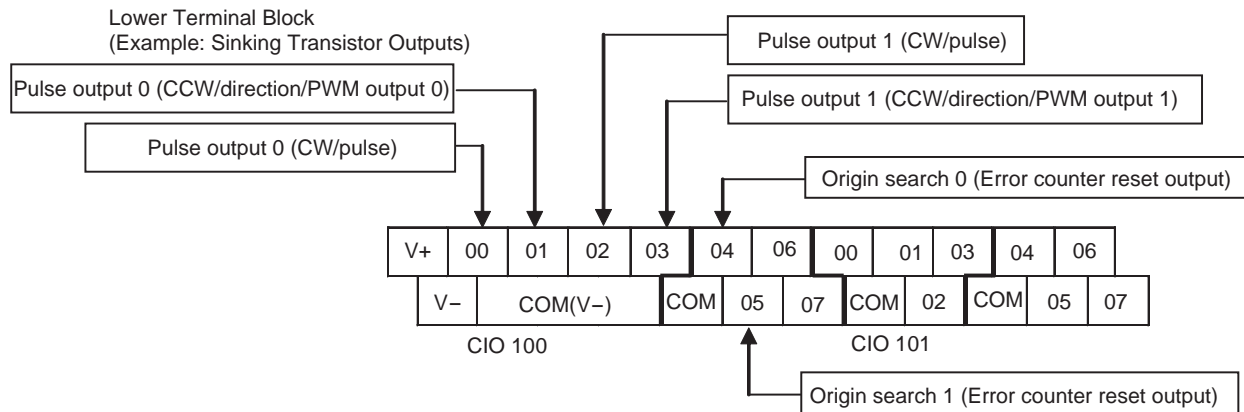
#### ■ CPU Unit with 20 I/O Points



#### ■ CPU Unit with 30 I/O Points



#### ■ CPU Unit with 40 I/O Points

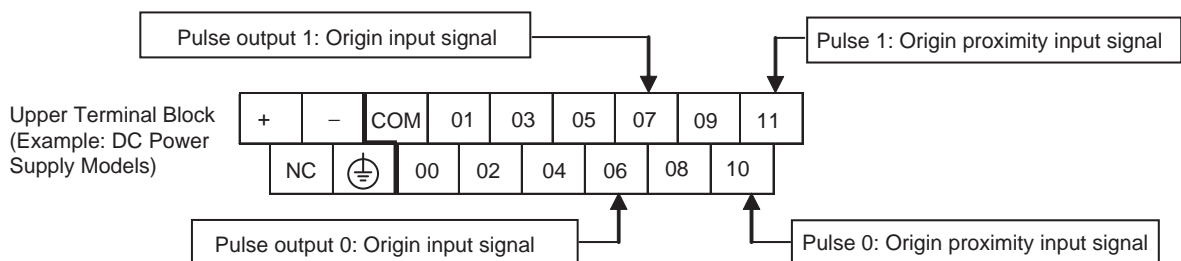


### ■ Setting Functions Using Instructions and PLC Setup

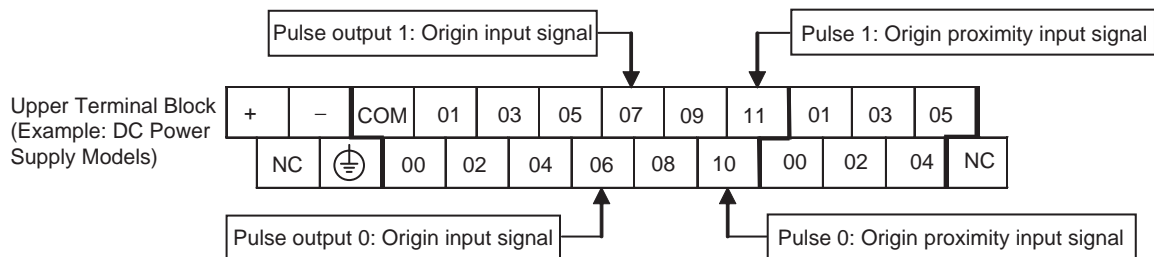
| Output terminal block |          | When the instructions to the right are not executed | When a pulse output instruction (SPED, ACC, PLS2, or ORG) is executed |                                  | When the origin search function is enabled in the PLC Setup, and an origin search is executed by the ORG instruction | When the PWM instruction is executed |
|-----------------------|----------|---|---|----------------------------------|--|--------------------------------------|
| Word                  | Bit      | Normal output                                       | Fixed duty factor pulse output  |                                  |  | Variable duty factor pulse output    |
|                       |          |   | CW/CCW  | Pulse plus direction             | When the origin search function is used  | PWM output                           |
| CIO 100               | 00       | Normal output 0                                     | Pulse output 0 (CW) fixed   | Pulse output 0 (pulse) fixed     | ---  | ---                                  |
|                       | 01       | Normal output 1                                     | Pulse output 0 (CCW) fixed  | Pulse output 0 (direction) fixed | ---  | PWM output 0                         |
|                       | 02       | Normal output 2                                     | Pulse output 1 (CW) fixed   | Pulse output 1 (pulse) fixed     | ---  | ---                                  |
|                       | 03       | Normal output 3                                     | Pulse output 1 (CCW) fixed  | Pulse output 1 (direction) fixed | ---  | PWM output 1                         |
|                       | 04       | Normal output 4                                     | ---   | ---                              | Origin search 0 (Error counter reset output)   | ---                                  |
|                       | 05       | Normal output 5                                     | ---   | ---                              | Origin search 1 (Error counter reset output)   | ---                                  |
|                       | 06       | Normal output 6                                     | ---   | ---                              | ---  | ---                                  |
|                       | 07       | Normal output 7                                     | ---   | ---                              | ---  | ---                                  |
| CIO 101               | 00 to 07 | Normal output 8 to 15                               | ---   | ---                              | ---  |                                      |

### ■ Input Terminal Block Arrangements

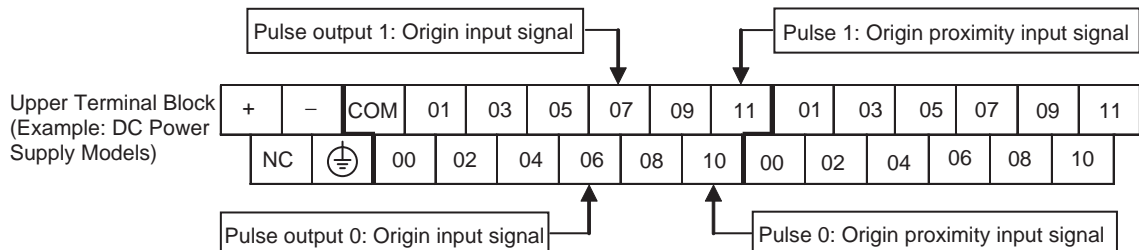
#### CPU Unit with 20 I/O Points



#### CPU Unit with 30 I/O Points



#### CPU Unit with 40 I/O Points



### ■ Setting Functions Using Instructions and PLC Setup

#### CPU Units with 20, 30 or 40 I/O Points

| Address |          | Default setting              |                              |                              | High-speed counter operation settings: |   | Origin searches                                   |
|---------|----------|------------------------------|------------------------------|------------------------------|--|---|---|
| Word    | Bit      | CPU Units with 40 I/O Points | CPU Units with 30 I/O Points | CPU Units with 20 I/O Points | Single-phase (increment pulse input)   | Two-phase (differential phases x4, up/down, or pulse/direction) | Origin searches enabled for pulse outputs 0 and 1 |
| CIO 0   | 00       | Normal input 0               | Normal input 0               | Normal input 0               | Counter 0, increment input             | Counter 0, A phase, up, or count input                          | ---   |
|         | 01       | Normal input 1               | Normal input 1               | Normal input 1               | Counter 1, increment input             | Counter 0, B phase, down, or direction input                    | ---   |
|         | 02       | Normal input 2               | Normal input 2               | Normal input 2               | Counter 2, increment input             | Counter 1, A phase, up, or count input                          | ---   |
|         | 03       | Normal input 3               | Normal input 3               | Normal input 3               | Counter 3, increment input             | Counter 1, B phase, down, or direction input                    | ---   |
|         | 04       | Normal input 4               | Normal input 4               | Normal input 4               | Counter 0, phase-Z reset input         | Counter 0, phase-Z reset input                                  | ---   |
|         | 05       | Normal input 5               | Normal input 5               | Normal input 5               | Counter 1, phase-Z reset input         | Counter 1, phase-Z reset input                                  | ---   |
|         | 06       | Normal input 6               | Normal input 6               | Normal input 6               | Counter 2, phase-Z reset input         | ---   | Pulse output 0: Origin input signal               |
|         | 07       | Normal input 7               | Normal input 7               | Normal input 7               | Counter 3, phase-Z reset input         | ---   | Pulse output 1: Origin input signal               |
|         | 08       | Normal input 8               | Normal input 8               | Normal input 8               | ---                                    | ---   | ---   |
|         | 09       | Normal input 9               | Normal input 9               | Normal input 9               | ---                                    | ---   | ---   |
|         | 10       | Normal input 10              | Normal input 10              | Normal input 10              | ---                                    | ---   | Pulse output 0: Origin proximity input signal     |
|         | 11       | Normal input 11              | Normal input 11              | Normal input 11              | ---                                    | ---   | Pulse output 1: Origin proximity input signal     |
| CIO 1   | 00 to 05 | Normal input 12 to 17        | Normal input 12 to 17        | ---                          | ---                                    | ---   | ---   |
|         | 06 to 11 | Normal input 18 to 23        | ---                          | ---                          | ---                                    | ---   | ---   |



**Auxiliary Area Data Allocation**

| Function  |  | Pulse output number |         |
|---|--|---------------------|---------|
|   |  | 0                   | 1       |
| Pulse output PV storage words<br>PV range: 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647)  | Leftmost 4 digits                                    | A277                | A279    |
|   | Rightmost 4 digits                                   | A276                | A278    |
| Reset Bits<br>The pulse output PV will be cleared when this bit is turned from OFF to ON.   | 0: Not cleared.<br>1: Clear PV.                      | A540.00             | A541.00 |
| CW Limit Input Signal Flags<br>This is the CW limit input signal, which is used in the origin search.   | ON when turned ON from an external input.            | A540.08             | A541.08 |
| CCW Limit Input Signal Flags<br>This is the CCW limit input signal, which is used in the origin search.   | ON when turned ON from an external input.            | A540.09             | A541.09 |
| Positioning completed input signals<br>This is the positioning completed input signal, which is used in the origin search.  | ON when turned ON from an external input.            | A540.10             | A541.10 |
| Accel/Decel Flags<br>ON when pulses are being output according to an ACC(888) or PLS2(887) instruction and the output frequency is being changed in steps (accelerating or decelerating). | 0: Constant speed<br>1: Accelerating or decelerating | A280.00             | A281.00 |
| Overflow/Underflow Flags<br>ON when an overflow or underflow has occurred in the pulse output PV.   | 0: Normal<br>1: Overflow or underflow                | A280.01             | A281.01 |
| Output Amount Set Flags<br>ON when the number of output pulses has been set with the PULS instruction.  | 0: No setting<br>1: Setting made                     | A280.02             | A281.02 |
| Output Completed Flags<br>ON when the number of output pulses set with the PULS(886)/PLS2(887) instruction has been output.   | 0: Output not completed.<br>1: Output completed.     | A280.03             | A281.03 |
| Output In-progress Flags<br>ON when pulses are being output from the pulse output.  | 0: Stopped<br>1: Outputting pulses.                  | A280.04             | A281.04 |
| No-origin Flags<br>ON when the origin has not been determined for the pulse output.   | 0: Origin established.<br>1: Origin not established. | A280.05             | A281.05 |
| At-origin Flags<br>ON when the pulse output PV matches the origin (0).  | 0: Not stopped at origin.<br>1: Stopped at origin.   | A280.06             | A281.06 |
| Output Stopped Error Flags<br>ON when an error occurred while outputting pulses in the origin search function.  | 0: No error<br>1: Stop error occurred.               | A280.07             | A281.07 |
| Stop Error Codes<br>When a Pulse Output Stop Error occurs, the error code is stored in that pulse outputs corresponding Stop Error Code word.   | ---  | A444                | A445    |

## 7-2-4 Pulse Output Patterns

The following tables show the kinds of pulse output operations that can be performed by combining various pulse output instructions.

### Continuous Mode (Speed Control)

#### Starting a Pulse Output

| Operation                                    | Example application                                | Frequency changes | Description   | Procedure                 |  |
|--|--|-------------------|---|---------------------------|--|
|  |  |                   |   | Instruction               | Settings   |
| Output with specified speed                  | Changing the speed (frequency) in one step         |                   | Outputs pulses at a specified frequency.                  | SPED(885)<br>(Continuous) | <ul style="list-style-type: none"> <li>Port "CW/CCW" or "Pulse + direction"</li> <li>Continuous</li> <li>Target frequency</li> </ul>   |
| Output with specified acceleration and speed | Accelerating the speed (frequency) at a fixed rate |                   | Outputs pulses and changes the frequency at a fixed rate. | ACC(888)<br>(Continuous)  | <ul style="list-style-type: none"> <li>Port "CW/CCW" or "Pulse + direction"</li> <li>Continuous</li> <li>Acceleration/deceleration rate</li> <li>Target frequency</li> </ul> |

#### Changing Settings

| Operation                  | Example application                                     | Frequency changes | Description  | Procedure  |  |
|----------------------------|---|-------------------|--|--|--|
|                            |   |                   |  | Instruction  | Settings   |
| Change speed in one step   | Changing the speed during operation                     |                   | Changes the frequency (higher or lower) of the pulse output in one step.   | SPED(885)<br>(Continuous)<br>↓<br>SPED(885)<br>(Continuous)            | <ul style="list-style-type: none"> <li>Port</li> <li>Continuous</li> <li>Target frequency</li> </ul>   |
| Change speed smoothly      | Changing the speed smoothly during operation            |                   | Changes the frequency from the present frequency at a fixed rate. The frequency can be accelerated or decelerated. | ACC(888) or SPED(885)<br>(Continuous)<br>↓<br>ACC(888)<br>(Continuous) | <ul style="list-style-type: none"> <li>Port</li> <li>Continuous</li> <li>Target frequency</li> <li>Acceleration/deceleration rate</li> </ul> |
|                            | Changing the speed in a polyline curve during operation |                   | Changes the acceleration or deceleration rate during acceleration or deceleration.                                 | ACC(888)<br>(Continuous)<br>↓<br>ACC(888)<br>(Continuous)              | <ul style="list-style-type: none"> <li>Port</li> <li>Continuous</li> <li>Target frequency</li> <li>Acceleration/deceleration rate</li> </ul> |
| Change direction           | Not supported.  |                   |  |  |  |
| Change pulse output method | Not supported.  |                   |  |  |  |

## Stopping a Pulse Output

| Operation                  | Example application  | Frequency changes   | Description  | Procedure   |  |
|----------------------------|----------------------|---|--|---|--|
|                            |                      |   |  | Instruction   | Settings   |
| Stop pulse output          | Immediate stop       | <p>Pulse frequency</p> <p>Present frequency</p> <p>Time</p> <p>Execution of INI(880)</p>  | Stops the pulse output immediately.  | SPED(885)<br>or ACC(888)<br>(Continuous)<br>↓<br>INI(880)                 | <ul style="list-style-type: none"> <li>Port</li> <li>Stop pulse output</li> </ul>                      |
| Stop pulse output          | Immediate stop       | <p>Pulse frequency</p> <p>Present frequency</p> <p>Time</p> <p>Execution of SPED(885)</p>   | Stops the pulse output immediately.  | SPED(885)<br>↓<br>SPED(885)<br>(Continuous)                               | <ul style="list-style-type: none"> <li>Port</li> <li>Continuous</li> <li>Target frequency=0</li> </ul> |
| Stop pulse output smoothly | Decelerate to a stop | <p>Pulse frequency</p> <p>Present frequency</p> <p>Target frequency = 0</p> <p>Time</p> <p>Execution of ACC(888)</p> <p>Acceleration/ deceleration rate<br/>(Rate set at the start of the operation.)</p> | <p>Decelerates the pulse output to a stop.</p> <p><b>Note</b> If ACC(888) started the operation, the original acceleration/ deceleration rate will remain in effect. If SPED(885) started the operation, the acceleration/ deceleration rate will be invalid and the pulse output will stop immediately.</p> | SPED(885)<br>or ACC(888)<br>(Continuous)<br>↓<br>ACC(888)<br>(Continuous) | <ul style="list-style-type: none"> <li>Port</li> <li>Continuous</li> <li>Target frequency=0</li> </ul> |

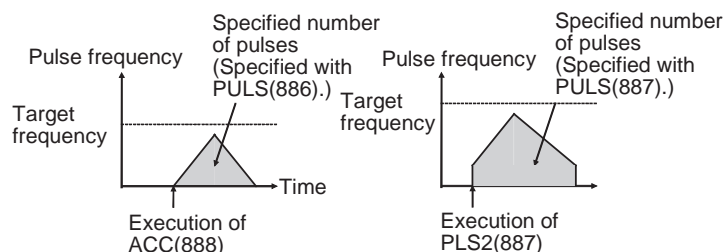
## Independent Mode (Positioning)

### Starting a Pulse Output

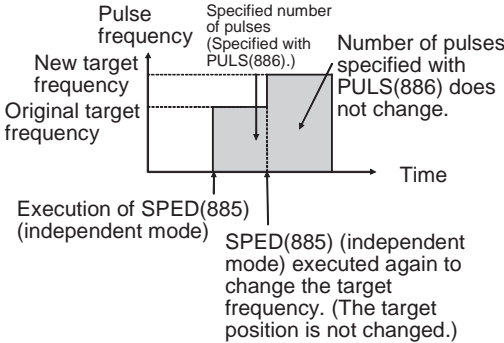
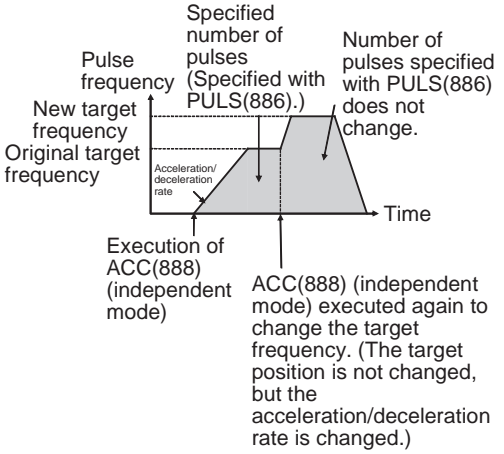
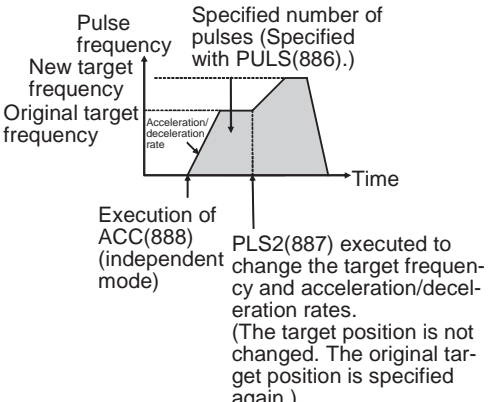
| Operation                   | Example application   | Frequency changes   | Description  | Procedure                                |   |
|-----------------------------|---|---|--|--|---|
|                             |   |   |  | Instruction                              | Settings  |
| Output with specified speed | Positioning without acceleration or deceleration  | <p>Execution of SPED(885)</p> <p>Outputs the specified number of pulses and then stops.</p> | <p>Starts outputting pulses at the specified frequency and stops immediately when the specified number of pulses has been output.</p> <p><b>Note</b> The target position (specified number of pulses) cannot be changed during positioning.</p>            | PULS(886)<br>↓<br>SPED(885)              | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Independent</li> <li>• Target frequency</li> </ul>  |
| Simple trapezoidal control  | Positioning with trapezoidal acceleration and deceleration (Same rate used for acceleration and deceleration; no starting speed) The number of pulses cannot be changed during positioning. | <p>Execution of ACC(888)</p> <p>Outputs the specified number of pulses and then stops.</p>  | <p>Accelerates and decelerates at the same fixed rate and stops immediately when the specified number of pulses has been output. (See note.)</p> <p><b>Note</b> The target position (specified number of pulses) cannot be changed during positioning.</p> | PULS(886)<br>↓<br>ACC(888) (Independent) | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Independent</li> <li>• Acceleration and deceleration rate</li> <li>• Target frequency</li> </ul>                    |
| Complex trapezoidal control | Positioning with trapezoidal acceleration and deceleration (Separate rates used for acceleration and deceleration; starting speed) The number of pulses can be changed during positioning.  | <p>Execution of PLS2(887)</p> <p>Target frequency reached.</p> <p>Output stops.</p>         | <p>Accelerates and decelerates at a fixed rates. The pulse output is stopped when the specified number of pulses has been output. (See note.)</p> <p><b>Note</b> The target position (specified number of pulses) can be changed during positioning.</p>   | PLS2(887)                                | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Acceleration rate</li> <li>• Deceleration rate</li> <li>• Target frequency</li> <li>• Starting frequency</li> </ul> |

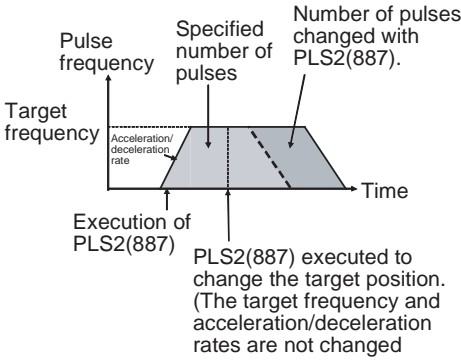
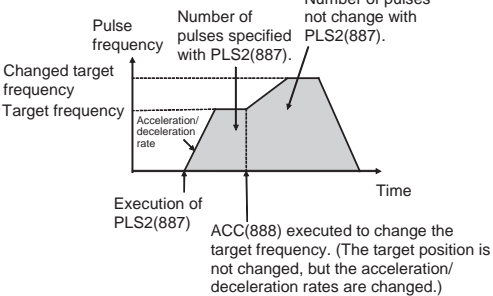
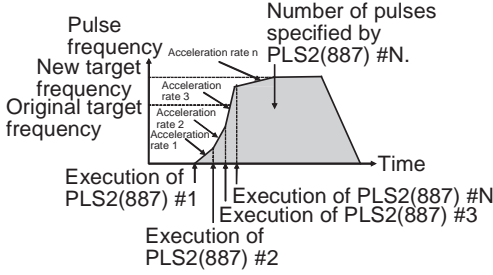
### Note Triangular Control

If the specified number of pulses is less than the number required just to reach the target frequency and return to zero, the function will automatically reduce the acceleration/deceleration time and perform triangular control (acceleration and deceleration only.) An error will not occur.



## Changing Settings

| Operation  | Example application  | Frequency changes  | Description   | Procedure  |   |
|--|--|--|---|--|---|
|  |  |  |   | Instruction  | Settings  |
| Change speed in one step   | Changing the speed in one step during operation  |  <p>Execution of SPED(885) (independent mode)</p> <p>SPED(885) (independent mode) executed again to change the target frequency. (The target position is not changed.)</p>  | <p>SPED(885) can be executed during positioning to change (raise or lower) the pulse output frequency in one step.</p> <p>The target position (specified number of pulses) is not changed.</p>  | PULS(886)<br>↓<br>SPED(885) (Independent)<br>↓<br>SPED(885) (Independent)  | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Independent</li> <li>• Target frequency</li> </ul>  |
| Change speed smoothly (with acceleration rate = deceleration rate)       | Changing the target speed (frequency) during positioning (acceleration rate = deceleration rate)         |  <p>Execution of ACC(888) (independent mode)</p> <p>ACC(888) (independent mode) executed again to change the target frequency. (The target position is not changed, but the acceleration/deceleration rate is changed.)</p>            | <p>ACC(888) can be executed during positioning to change the acceleration/deceleration rate and target frequency.</p> <p>The target position (specified number of pulses) is not changed.</p>   | PULS(886)<br>↓<br>ACC(888) or SPED(885) (Independent)<br>↓<br>ACC(888) (Independent)<br>PLS2(887)<br>↓<br>ACC(888) (Independent) | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Independent</li> <li>• Acceleration and deceleration rate</li> <li>• Target frequency</li> </ul>                    |
| Change speed smoothly (with unequal acceleration and deceleration rates) | Changing the target speed (frequency) during positioning (different acceleration and deceleration rates) |  <p>Execution of ACC(888) (independent mode)</p> <p>PLS2(887) executed to change the target frequency and acceleration/deceleration rates. (The target position is not changed. The original target position is specified again.)</p> | <p>PLS2(887) can be executed during positioning to change the acceleration rate, deceleration rate, and target frequency.</p> <p><b>Note</b> To prevent the target position from being changed intentionally, the original target position must be specified in absolute coordinates.</p> | PULS(886)<br>↓<br>ACC(888) (Independent)<br>↓<br>PLS2(887)<br>PLS2(887)<br>↓<br>PLS2(887)  | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Acceleration rate</li> <li>• Deceleration rate</li> <li>• Target frequency</li> <li>• Starting frequency</li> </ul> |

| Operation   | Example application  | Frequency changes   | Description  | Procedure  |   |
|---|--|---|--|--|---|
|   |  |   |  | Instruction  | Settings  |
| Change target position  | Change the target position during positioning (multiple start function)                              |  <p>PLS2(887) executed to change the target position. (The target frequency and acceleration/deceleration rates are not changed)</p>                           | <p>PLS2(887) can be executed during positioning to change the target position (number of pulses).</p> <p><b>Note</b> When the target position cannot be changed without maintaining the same speed range, an error will occur and the original operation will continue to the original target position.</p>  | PULS(886)<br>↓<br>ACC(888) (Independent)<br>↓<br>PLS2(887)<br>↓<br>PLS2(887)<br>↓<br>PLS2(887)<br>↓<br>PLS2(887) | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Acceleration rate</li> <li>• Deceleration rate</li> <li>• Target frequency</li> <li>• Starting frequency</li> </ul> |
| Change target position and speed smoothly   | Change the target position and target speed (frequency) during positioning (multiple start function) |  <p>ACC(888) executed to change the target frequency. (The target position is not changed, but the acceleration/deceleration rates are changed.)</p>          | <p>PLS2(887) can be executed during positioning to change the target position (number of pulses), acceleration rate, deceleration rate, and target frequency.</p> <p><b>Note</b> When the settings cannot be changed without maintaining the same speed range, an error will occur and the original operation will continue to the original target position.</p> | PULS(886)<br>↓<br>ACC(888) (Independent)<br>↓<br>PLS2(887)   | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Relative or absolute pulse specification</li> <li>• Port</li> <li>• "CW/CCW" or "Pulse + direction"</li> <li>• Acceleration rate</li> <li>• Deceleration rate</li> <li>• Target frequency</li> <li>• Starting frequency</li> </ul> |
| Change the acceleration and deceleration rates during positioning (multiple start function) | Change the acceleration and deceleration rates during positioning (multiple start function)          |  <p>Execution of PLS2(887) #1<br/>           Execution of PLS2(887) #2<br/>           Execution of PLS2(887) #3<br/>           Execution of PLS2(887) #N</p> | <p>PLS2(887) can be executed during positioning (acceleration or deceleration) to change the acceleration rate or deceleration rate.</p>   | PULS(886)<br>↓<br>ACC(888) (Independent)<br>↓<br>PLS2(887)<br>↓<br>PLS2(887)<br>↓<br>PLS2(887)                   | <ul style="list-style-type: none"> <li>• Number of pulses</li> <li>• Acceleration rate</li> <li>• Deceleration rate</li> </ul>  |

| Operation                  | Example application                     | Frequency changes | Description  | Procedure   |   |
|----------------------------|---|-------------------|--|---|---|
|                            |   |                   |  | Instruction   | Settings  |
| Change direction           | Change the direction during positioning |                   | PLS2(887) can be executed during positioning with relative pulse specification to change to absolute pulses and reverse direction. | PULS(886)<br>↓<br>ACC(888) (Independent)<br>↓<br>PLS2(887)<br>PLS2(887)<br>↓<br>PLS2(887) | <ul style="list-style-type: none"> <li>•Number of pulses</li> <li>•Absolute pulse specification</li> <li>•Port</li> <li>•“CW/CCW” or “Pulse + direction”</li> <li>•Acceleration rate</li> <li>•Deceleration rate</li> <li>•Target frequency</li> <li>•Starting frequency</li> </ul> |
| Change pulse output method | Not supported.                          |                   |  |   |   |

## Stopping a Pulse Output

| Operation  | Example application  | Frequency changes | Description   | Procedure  |  |
|--|----------------------|-------------------|---|--|--|
|  |                      |                   |   | Instruction  | Settings   |
| Stop pulse output<br>(Number of pulses setting is not preserved.)                  | Immediate stop       |                   | Stops the pulse output immediately and clears the number of output pulses setting.  | PULS(886)<br>↓<br>ACC(888) or SPED(885) (Independent)<br>↓<br>INI(880)<br>PLS2(887)<br>↓<br>INI(880)                             | <ul style="list-style-type: none"> <li>•Stop pulse output</li> </ul>   |
| Stop pulse output<br>(Number of pulses setting is not preserved.)                  | Immediate stop       |                   | Stops the pulse output immediately and clears the number of output pulses setting.  | PULS(886)<br>↓<br>SPED(885) (Independent)<br>↓<br>SPED(885)  | <ul style="list-style-type: none"> <li>•Port</li> <li>•Independent</li> <li>•Target frequency = 0</li> </ul> |
| Stop sloped pulse output smoothly.<br>(Number of pulses setting is not preserved.) | Decelerate to a stop |                   | Decelerates the pulse output to a stop.<br><b>Note</b> If ACC(888) started the operation, the original acceleration/deceleration rate will remain in effect. If SPED(885) started the operation, the acceleration/deceleration rate will be invalid and the pulse output will stop immediately. | PULS(886)<br>↓<br>ACC(888) or SPED(885) (Independent)<br>↓<br>ACC(888) (Independent)<br>PLS2(887)<br>↓<br>ACC(888) (Independent) | <ul style="list-style-type: none"> <li>•Port</li> <li>•Independent</li> <li>•Target frequency = 0</li> </ul> |

## Switching from Continuous Mode (Speed Control) to Independent Mode (Positioning)

| Example application  | Frequency changes   | Description  | Procedure  |   |
|--|---|--|--|---|
|  |   |  | Instruction                                      | Settings  |
| Change from speed control to fixed distance positioning during operation | <p>Outputs the number of pulses specified in PLS2(887) (Both relative and absolute pulse specification can be used.)</p>  | <p>PLS2(887) can be executed during a speed control operation started with ACC(888) to change to positioning operation.</p> <p><b>Note</b> An error will occur if a constant speed cannot be achieved after switching the mode. If this happens, the instruction execution will be ignored and the previous operation will be continued.</p> | <p>ACC(888) (Continuous)<br/>↓<br/>PLS2(887)</p> | <ul style="list-style-type: none"> <li>•Port</li> <li>•Acceleration rate</li> <li>•Deceleration rate</li> <li>•Target frequency</li> <li>•Number of pulses</li> </ul> <p><b>Note</b> The starting frequency is ignored.</p> |
| Fixed distance feed interrupt  | <p>Execution of PLS2(887) with the following settings</p> <ul style="list-style-type: none"> <li>• Number of pulses = number of pulses until stop</li> <li>• Relative pulse specification</li> <li>• Target frequency = present frequency</li> <li>• Acceleration rate = Not 0</li> <li>• Deceleration rate = target deceleration rate</li> </ul> |  |  |   |

## Relative Pulse Outputs and Absolute Pulse Outputs

### Selecting Relative or Absolute Coordinates

The pulse output PV's coordinate system (absolute or relative) is selected automatically, as follows:

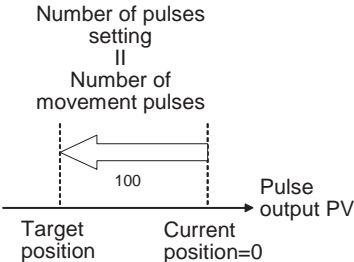
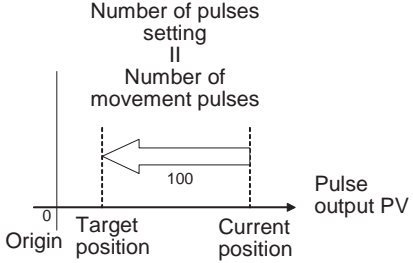
- When the origin is undetermined, the system operates in relative coordinates.
- When the origin has been determined, the system operates in absolute coordinates.

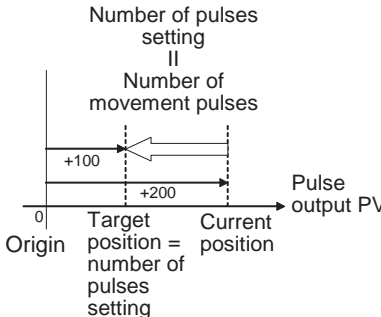
| Conditions                          | Origin has been determined by an origin search | Origin has been determined by executing INI(880) to change the PV | Origin not established (Origin search has not been performed and PV has not been changed with INI(880).) |
|-------------------------------------|--|---|--|
| Pulse output PV's coordinate system | Absolute coordinates                           |   | Relative coordinates   |



### Relationship between the Coordinate System and Pulse Specification

The following table shows the pulse output operation for the four possible combinations of the coordinate systems (absolute or relative) and the pulse output (absolute or relative) specified when PULS(886) or PLS2(887) is executed.

| Pulse output specified in PULS(886) or PLS2(887) | Coordinate system   |  |
|--|---|--|
|  | Relative coordinate system  | Absolute coordinate system   |
|  | Origin not established:<br>The No-origin Flag will be ON in this case.  | Origin established:<br>The No-origin Flag will be OFF in this case.  |
| Relative pulse specification                     | Positions the system to another position relative to the current position.<br>Number of movement pulses = number of pulses setting  |  |
|  | <p>The pulse output PV after instruction execution = Number of movement pulses = Number of pulses setting</p> <p><b>Note</b> The pulse output PV is reset to 0 just before pulses are output. After that, the specified number of pulses is output.</p> <p>The following example shows the number of pulses setting = 100 counterclockwise.</p>  <p>Pulse output PV range:<br/>8000 0000 to 7FFF FFFF hex</p> <p>Number of pulses setting range:<br/>0000 0000 to 7FFF FFFF hex</p> | <p>The pulse output PV after instruction execution = PV + Number of movement pulses.</p> <p>The following example shows the number of pulses setting = 100 counterclockwise.</p>  <p>Pulse output PV range:<br/>8000 0000 to 7FFF FFFF hex</p> <p>Number of pulses setting range:<br/>0000 0000 to 7FFF FFFF hex</p> |

| Pulse output specified in PULS(886) or PLS2(887) | Coordinate system  |  |
|--|--|--|
|  | Relative coordinate system   | Absolute coordinate system   |
|  | Origin not established:<br>The No-origin Flag will be ON in this case.   | Origin established:<br>The No-origin Flag will be OFF in this case.  |
| <b>Absolute pulse specification</b>              | The absolute pulse specification cannot be used when the origin location is undetermined, i.e., when the system is operating in the relative coordinate system. An instruction execution error will occur. | <p>Positions the system to an absolute position relative to the origin.</p> <p>The number of movement pulses and movement direction are calculated automatically from the current position (pulse output PV) and target position.</p> <p>The following example shows the number of pulses setting = +100.</p>  <p>Number of movement pulses = Number of pulses setting - Pulse output PV when instruction is executed</p> <p>The movement direction is determined automatically.</p> <p>Pulse output PV when instruction is executed = Number of pulses setting</p> <p>Pulse output PV range:<br/>8000 0000 to 7FFF FFFF hex</p> <p>Number of pulses setting range:<br/>8000 0000 to 7FFF FFFF hex</p> |

### Operations Affecting the Origin Status (Established/Not Established Status)

The following table shows the operations that can affect the origin status (origin established or no-origin), such as changing the operating mode and executing certain instructions.

The No-origin Flag will be ON when the corresponding pulse output's origin is not established and OFF when the origin is established.

| Operation             |                          | PROGRAM mode                                |  | RUN mode or MONITOR mode               |  |
|-----------------------|--------------------------|---|--|--|--|
|                       |                          | Origin established                          | Origin not established                     | Origin established                     | Origin not established                     |
| Operating mode change | Switch to RUN or MONITOR | Status changes to "Origin not established." | "Origin not established" status continues. | ---                                    | ---  |
|                       | Switch to PROGRAM        | ---   | ---  | "Origin established" status continues. | "Origin not established" status continues. |

| Current status   |                                     | PROGRAM mode                                |  | RUN mode or MONITOR mode                    |  |
|--|-------------------------------------|---|--|---|--|
| Operation  |                                     | Origin established                          | Origin not established                     | Origin established                          | Origin not established                     |
| Instruction execution  | Origin search performed by ORG(889) | ---   | ---  | Status changes to "Origin established."     | Status changes to "Origin established."    |
|  | PV changed by INI(880)              | ---   | ---  | "Origin established" status continues.      | Status changes to "Origin established."    |
| The Pulse Output Reset Bit (A54000 or A54100) goes from OFF to ON. |                                     | Status changes to "Origin not established." | "Origin not established" status continues. | Status changes to "Origin not established." | "Origin not established" status continues. |

### **Movement Direction when Using Absolute Pulse Specification**

When operating with the absolute pulse specification, the movement direction is selected automatically based on the relationship between the pulse output PV when the instruction is executed and the specified target position. The direction (CW/CCW) specified in an ACC(888) or SPED(885) instruction is not effective.

### **Using CW/CCW Limit Inputs for Pulse Output Functions Other than Origin Searches**

Pulse outputs will stop when either the CW or CCW limit input signals turns ON. It is also possible to select whether or not the established origin will be cleared when a CW or CCW limit input signal turns ON for an origin search or other pulse output function.

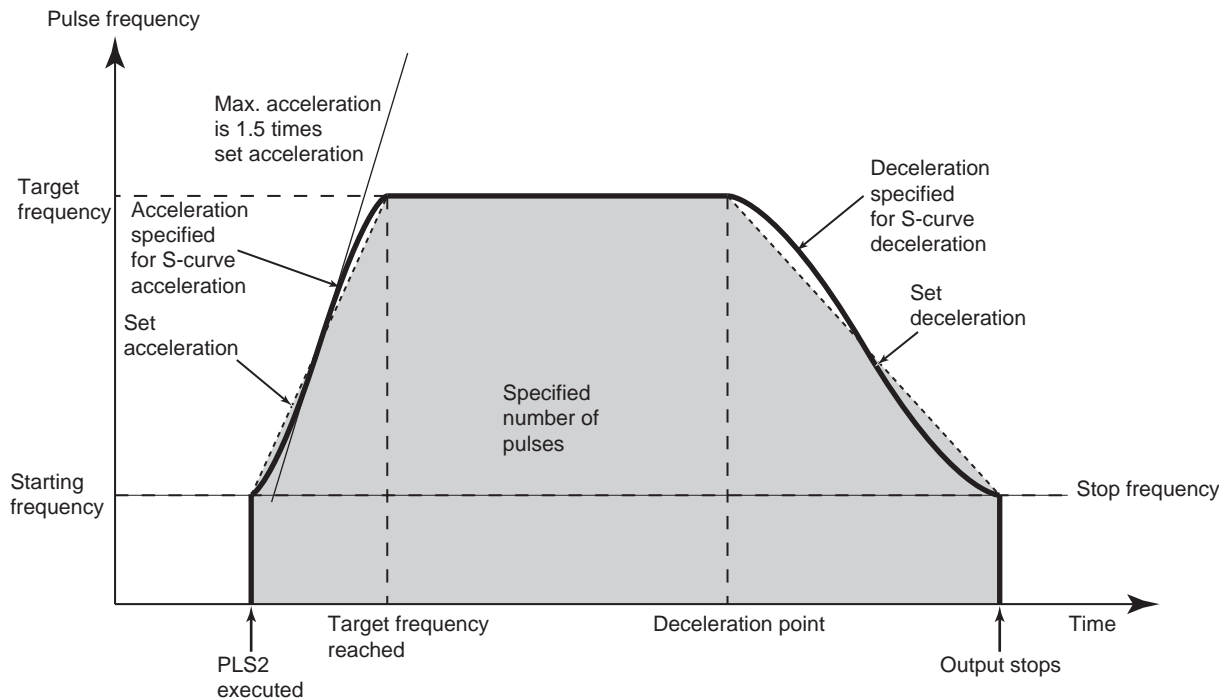
### **S-curve Acceleration/Deceleration**

S-curve acceleration/deceleration can be used for pulse output instructions involving acceleration/deceleration. When there is leeway in the maximum allowable speed, S-curve accelerations/decelerations will help control shock and vibration by reducing the initial acceleration rate in comparison with linear acceleration/deceleration.

**Note** The setting for S-curve acceleration/deceleration applies to all pulse outputs.

**Output Pattern**

The output pattern for S-curve acceleration/deceleration is shown below.

**Example for PLS2(887)**

The same type of S-curve acceleration/deceleration can be used for ACC(888) as well.

**Note** The curve for S-curve acceleration/deceleration is formed by applying a cubic equation to the straight line of the set acceleration/deceleration rates (a cubic polynomial approximation). The curve's parameters cannot be changed. The maximum acceleration will be 1.5 times that of trapezoidal acceleration/deceleration for the same acceleration/deceleration rate.

**Procedure**

Make the following settings in the PLC Setup.

**Pulse Output 0 to 3**

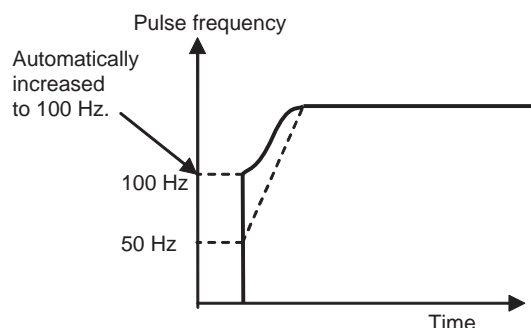
|             |           |   |
|-------------|-----------|---|
| Speed Curve | Trapezium | When a pulse output is executed with acceleration/deceleration, this setting determines whether the acceleration/deceleration rate is linear (trapezium) or S-shaped. |
|             | S-shaped  |   |

**Restrictions**

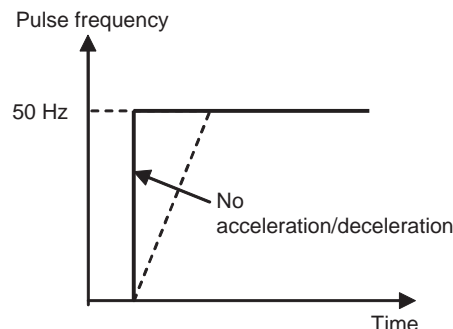
The following restrictions apply when using S-curve acceleration/deceleration.

**Starting Frequency**

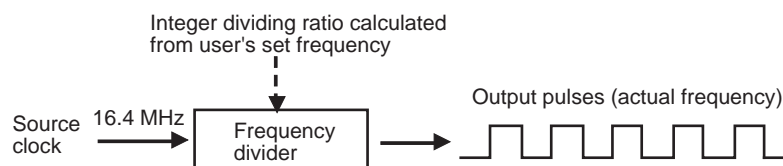
The starting frequency must be 100 Hz or greater. If the starting frequency is set to less than 100 Hz, it will automatically be increased to 100 Hz if S-curve acceleration/deceleration is set.

**Target Frequency**

S-curve acceleration/deceleration will not be performed if the target frequency is less than 100 Hz.

**Precautions when using the Pulse Output Function**

The CP1L-EL/EM CPU Unit's pulse output frequency is determined by dividing the source clock frequency by an integer ratio. (The source clock frequency for ports 0 and 1 is 20 MHz and the frequency for ports 2 and 3 is 16.4 MHz.) Consequently, there may be a slight difference between the set frequency and the actual frequency, and that difference increases as the frequency increases. The actual frequency can be calculated from the following equations.

**Pulse Output System**

## Equations

$$\text{Actual frequency (Hz)} = \frac{\text{Source clock frequency}}{\text{Dividing ratio}}$$

$$\text{Dividing ratio} = \text{INT} \left[ \frac{(\text{Clock frequency} \times 2) + \text{Set frequency}}{\text{Set frequency (Hz)} \times 2} \right]$$

The INT function extracts an integer from the fraction. The non-integer remainder is rounded.

## Differences between Set Frequencies and Actual Frequencies

- Source clock frequency: 16.4 MHz

| Set frequency (kHz) | Actual frequency (kHz) |
|---------------------|------------------------|
| 99.696 to 100.000   | 100.000                |
| 99.093 to 99.696    | 99.393                 |
| 98.498 to 99.093    | 98.795                 |
| :                   | :                      |
| 50.076 to 50.229    | 50.152                 |
| 49.923 to 50.076    | 50.000                 |
| 49.772 to 49.923    | 49.848                 |
| :                   | :                      |
| 20.012 to 20.036    | 20.024                 |
| 19.987 to 20.012    | 20.000                 |
| 19.963 to 19.987    | 19.975                 |
| :                   | :                      |
| 10.003 to 10.009    | 10.006                 |
| 9.996 to 10.003     | 10.000                 |
| 9.990 to 9.996      | 9.993                  |
| :                   | :                      |
| 5.000 to 5.002      | 5.001                  |
| 4.999 to 5.000      | 5.000                  |
| 4.997 to 4.999      | 4.998                  |
| :                   | :                      |
| 3.001 to 3.001      | 3.001                  |
| 3.000 to 3.000      | 3.000                  |
| 2.998 to 2.999      | 2.999                  |

## 7-2-5 Origin Search and Origin Return Functions

The CP1L-EL/EM CPU Units have two functions that can be used to determine the machine origin for positioning.

1,2,3...

## 1. Origin Search

The ORG instruction outputs pulses to turn the motor according to the pattern specified in the origin search parameters. As the motor turns, the origin search function determines the machine origin from the following 3 kinds of position input signals.

- Origin input signal
- Origin proximity input signal
- CW limit input signal and CCW limit input signal

## 2. Changing the Pulse Output PV

When you want to set the current position as the origin, execute INI(880) to reset the pulse output PV to 0.

The origin location can be determined after using either method.

The CP1L-EL/EM CPU Units are also equipped with the origin return function, which can be executed to return the system to the origin after the origin location has been determined by one of the methods above.

- Origin Return

If the motor is stopped, ORG(889) can be executed to perform an origin return operation that moves the motor back to the origin position. The origin position must be determined in advance by performing an origin search or changing the pulse output PV.

**Note** The motor can be moved even if the origin position has not been determined, but positioning operations will be limited as follows:

- Origin return: Cannot be used.
- Positioning with absolute pulse specification: Cannot be used.
- Positioning with relative pulse specification: Outputs the specified number of pulses after setting the current position to 0.

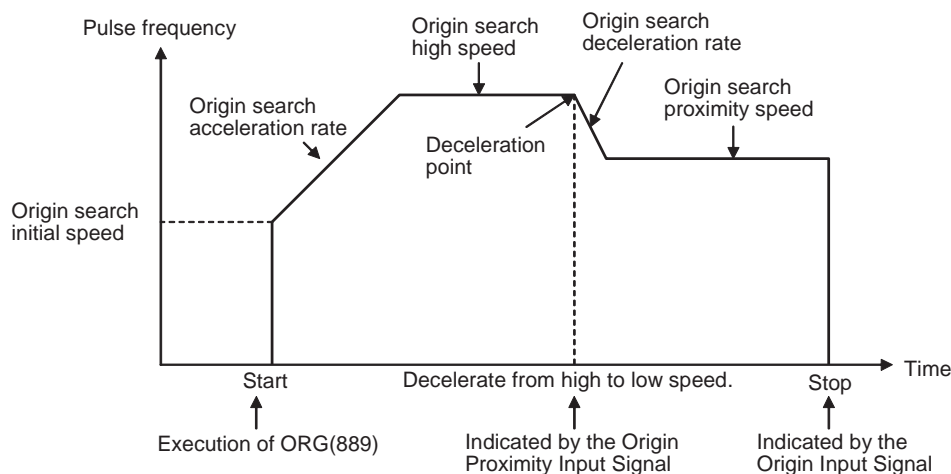
### 7-2-5-1 Origin Search

When ORG(889) executes an origin search, it outputs pulses to actually move the motor and determines the origin position using the input signals that indicate the origin proximity and origin positions.

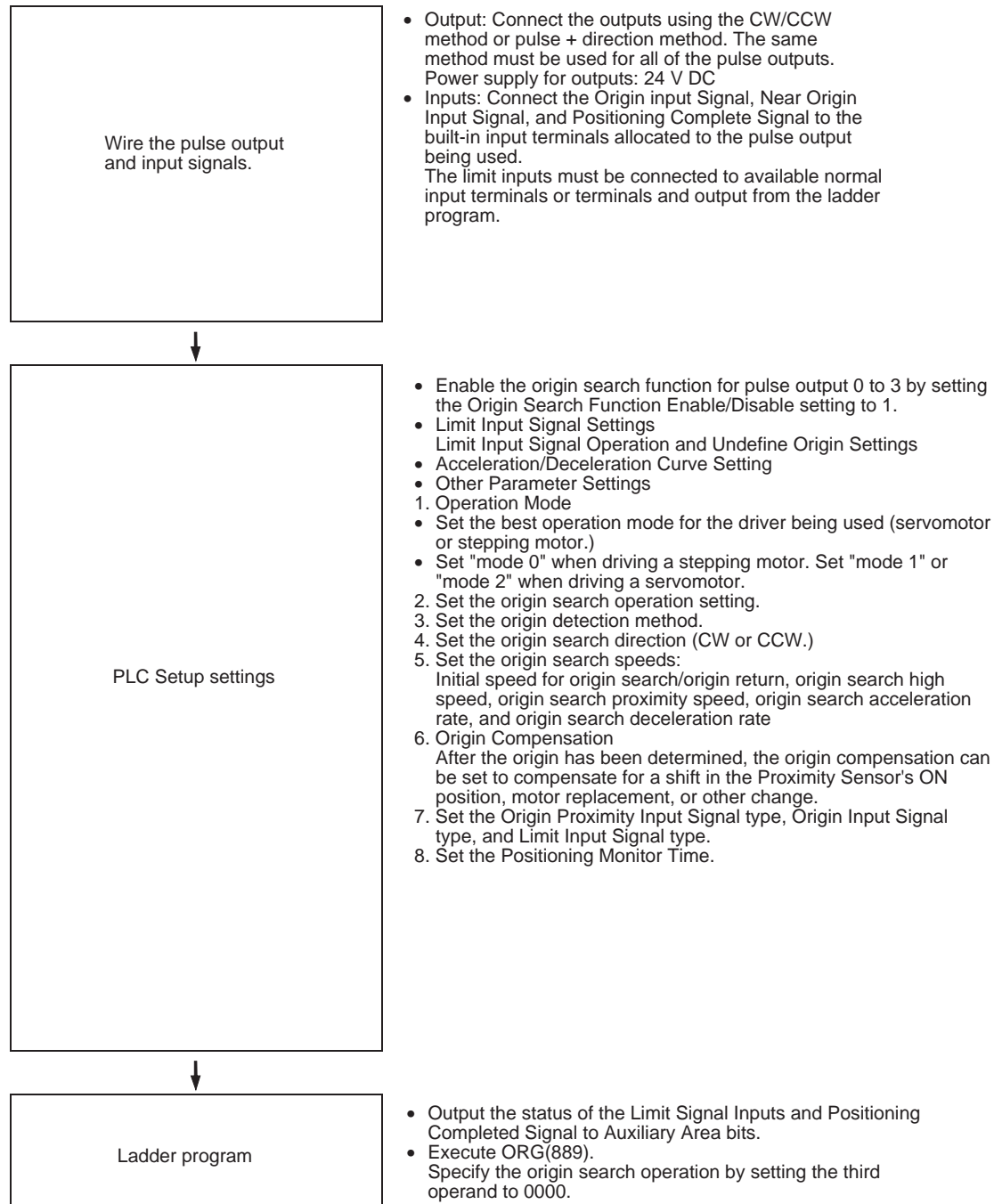
The input signals that indicate the origin position can be received from the servomotor's built-in phase-Z signal or external sensors such as photoelectric sensors, proximity sensors, or limit switches.

Several origin search patterns can be selected.

In the following example, the motor is started at a specified speed, accelerated to the origin search high speed, and run at that speed until the origin proximity position is detected. After the Origin Proximity Input is detected, the motor is decelerated to the origin search low speed and run at that speed until the origin position is detected. The motor is stopped at the origin position.



## Procedure



## Restrictions

- The Phase-Z signal + Software reset method cannot be used for a high-speed counter when the origin search function has been enabled in the PLC Setup.

## PLC Setup

■ **Origin Search Function Enable/Disable Settings**

These PLC Setup indicate whether or not the origin search function will be used for each pulse output.



### ■ Limit Input Signal Setting

Specify in the following PLC Setup whether to use the CW/CCW limit input signals only for origin searches or for all pulse output functions. These settings affect all pulse outputs.

(This setting is called the *Limited Input Signal Operation* setting.)

### ■ Pulse Output 0 Undefined Origin Setting

### ■ Acceleration/Deceleration Curve Settings

**Note** The acceleration/deceleration curve setting applies to all pulse outputs, not just to origin searches. Refer to S-curve Acceleration/Deceleration on page 253 for details.

### Origin Search Parameters

The various origin search parameters are set in the PLC Setup.

| Name                            |                                    | Settings  | Time when read          |
|---------------------------------|------------------------------------|---|-------------------------|
| Operating mode                  |                                    | Operating mode 0, 1, or 2   | Start of operation      |
| Origin search operation setting |                                    | 0: Reversal mode 1<br>1: Reversal mode 2  | Start of operation      |
| Origin detection method         |                                    | 0: Read the Origin Input Signal after the Origin Proximity Input Signal goes from OFF→ON→OFF.<br>1: Read the Origin Input Signal after the Origin Proximity Input Signal goes from OFF→ON.<br>2: Just read the Origin Input Signal without using the Origin Proximity Input Signal. | Start of operation      |
| Origin search direction         |                                    | 0: CW direction<br>1: CCW direction   | Start of operation      |
| Origin search speed (See note.) | Origin search/return initial speed | 00000000 to 000186A0 hex (0 Hz to 100 kHz)  | Start of operation      |
|                                 | Origin search high speed           | 00000001 to 000186A0 hex (1 Hz to 100 kHz)  | Start of operation      |
|                                 | Origin search proximity speed      | Same as above.  | Start of operation      |
|                                 | Origin search acceleration rate    | 0001 to FFFF hex (1 to 65,535 Hz/4 ms)  | Start of operation      |
|                                 | Origin search deceleration rate    | 0001 to FFFF hex (1 to 65,535 Hz/4 ms)  | Start of operation      |
| Origin compensation             |                                    | 8000 0000 to 7FFF FFFF hex (–2147483648 to 2147483647)  | Start of operation      |
| I/O settings                    |                                    | Limit Input Signal type<br>0: Normally closed (NC)<br>1: Normally open (NO)   | Start of operation      |
|                                 |                                    | Origin Proximity Input Signal type<br>0: Normally closed (NC)<br>1: Normally open (NO)  | Start of operation      |
|                                 |                                    | Origin Input Signal type<br>0: Normally closed (NC)<br>1: Normally open (NO)  | When power is turned ON |
| Positioning monitor time        |                                    | 0000 to 270F hex (0 to 9,999 ms)  | Start of operation      |

**Note** An origin search will not be started unless the origin search proximity speed is less than the origin search high speed and unless the origin search/return initial speed is less than the origin search proximity speed.

### Explanation of the Origin Search Parameters

#### Operating Mode

The operating mode parameter specifies the kind of I/O signals that are used in the origin search. The 3 operating modes indicate whether the Error Counter Reset Output and Positioning Completed Input are used.

| Operating mode | I/O signal  |   |  | Remarks   |
|----------------|---|---|--|---|
|                | Origin Input Signal   | Error Counter Reset Output  | Positioning Completed Input  | Operation when the origin is detected during deceleration from the origin search's high speed   |
| 0              | The origin position is determined when the Origin Input Signal goes from OFF to ON. | Not used.<br>The origin search operation ends after the origin is detected. | Not used.  | The Origin Input Signal will be detected during deceleration. An Origin Input Signal Error (error code 0202) will occur and the motor will decelerate to a stop.  |
| 1              |   | Goes ON for 20 to 30 ms when the origin is detected.                        | After the origin is detected, the origin search will not be end until the Positioning Completed Input is received from the driver. | The Origin Input Signal will not be detected during deceleration. When the Origin Input Signal is detected after the motor has reached the proximity speed for origin search, the motor will be stopped and the origin search operation will end. |
| 2              |   |   |  |   |

The following table shows the proper operating mode settings for different drivers and applications.

| Driver                            | Remarks   | Operating mode |
|-----------------------------------|---|----------------|
| Stepping motor driver (See note.) |   | 0              |
| Servo driver                      | Use this mode when you want to reduce the processing time, even at the expense of positioning accuracy. (The Servo Driver's positioning complete signal is not used.) | 1              |
|                                   | Use this mode when you want high positioning accuracy. (The Servo Driver's positioning complete signal is used.)  | 2              |

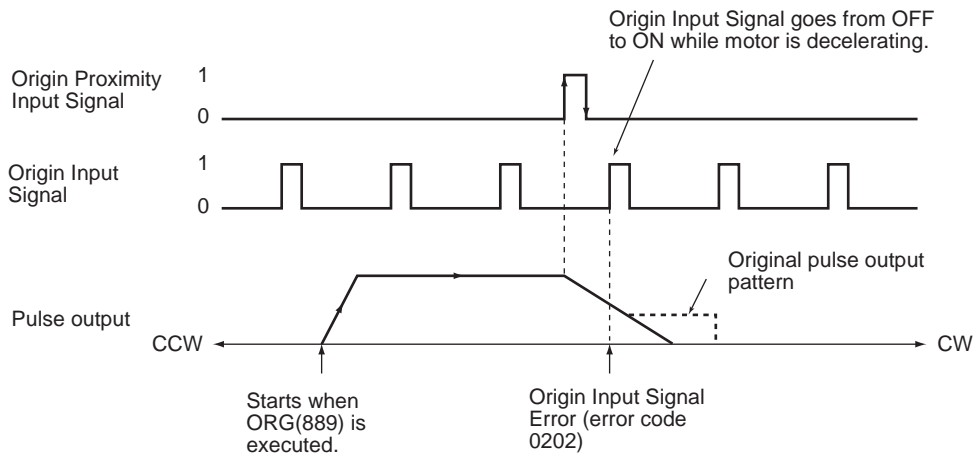
**Note** There are stepping motor drivers that are equipped with a positioning completed signal like a Servo driver. Operating modes 1 and 2 can be used with these stepping motor drivers.

#### ■ Remarks: Operations Detecting the Origin During Deceleration from High Speed

##### Operating Mode 0 (without Error Counter Reset Output, without Positioning Completed Input)

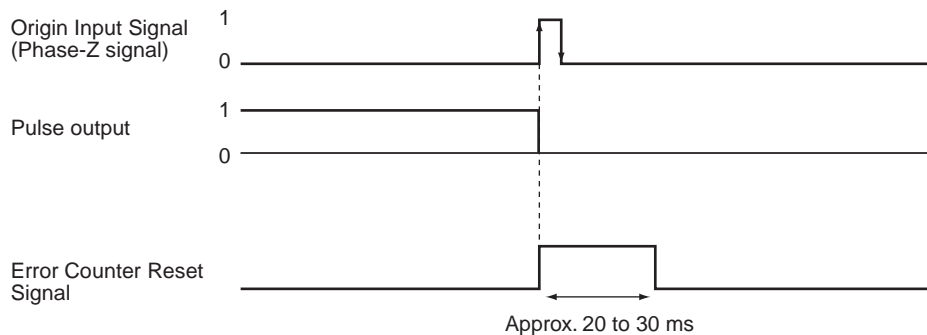
Connect the sensor's open collector output signal to the Origin Input Signal. The Origin Input Signal's response time is 0.1 ms when set as a NO contact.

When the Origin Proximity Input Signal is received, the motor will begin decelerating from the origin search high speed to the origin search proximity speed. In this operating mode, the Origin Input Signal will be detected if it is received during this deceleration and an Origin Input Signal Error (error code 0202) will be generated. In this case, the motor will decelerate to a stop.



### **Operating Mode 1 (with Error Counter Reset Output, without Positioning Completed Input)**

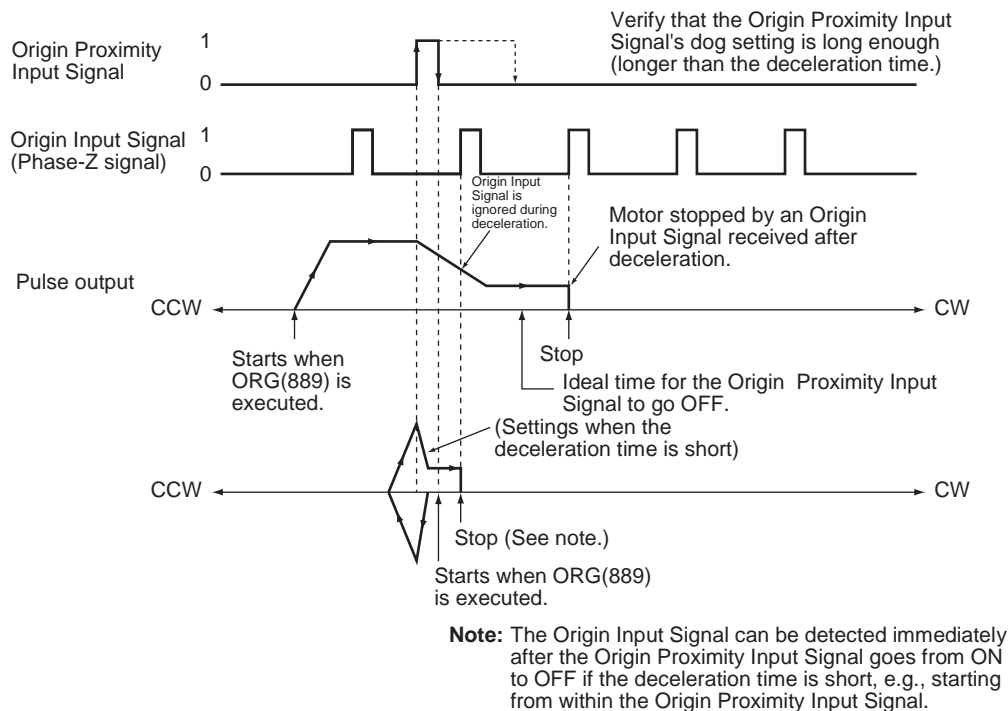
Connect the phase-Z signal from the Servo Driver to the Origin Input Signal. When the Origin Input Signal is received, the pulse output will be stopped and the Error Counter Reset Signal will be output for about 20 to 30 ms.



When the Origin Proximity Input Signal is received, the motor will begin decelerating from the origin search high speed to the origin search proximity speed. In this operating mode, the motor will stop at the Origin Input Signal after deceleration is completed.

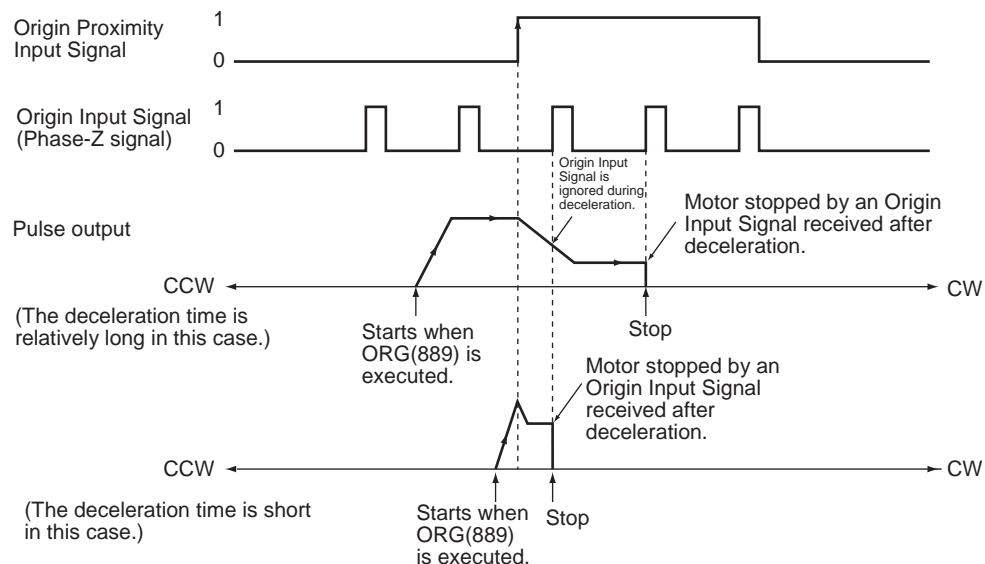
### **Operating Mode 1 with Origin Proximity Input Signal Reverse (Origin Detection Method Setting = 0)**

When the deceleration time is short, the Origin Input Signal can be detected immediately after the Origin Proximity Input Signal goes from ON to OFF. Set a Origin Proximity Input Signal dog setting that is long enough (longer than the deceleration time.)



### Operating Mode 1 without Origin Proximity Input Signal Reverse (Origin Detection Method Setting = 1)

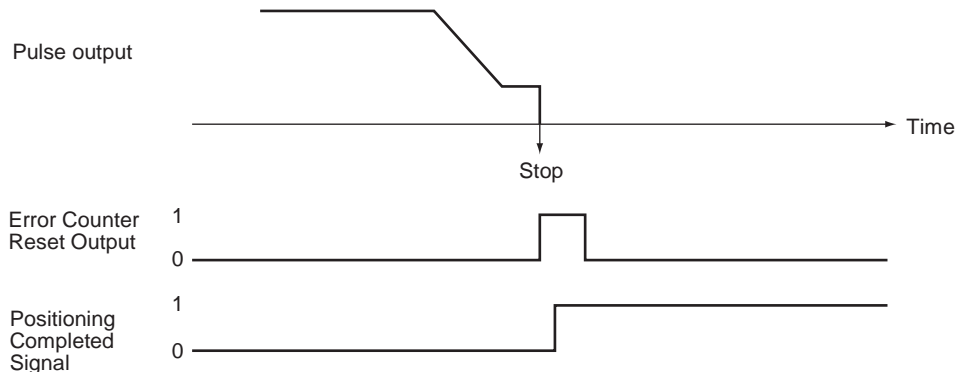
Depending on the length of the deceleration time, the stopping position may change when the Origin Input Signal is detected during deceleration.



### Operating Mode 2 (with Error Counter Reset Output, with Positioning Completed Input)

This operating mode is the same as mode 1, except the Positioning Completed Signal (INP) from the Servo Driver is used. Connect the Positioning Completed Signal from the Servo Driver to a normal input (origin search 0 to 3 input).

If origin compensation is not being applied, the Positioning Completed Signal is checked after the Error Counter Reset Output. If origin compensation is being applied, the Positioning Completed Signal is checked after the compensation operation is completed.



### Origin Search Operation Setting

Select either of the following two reverse modes for the origin search operation pattern.

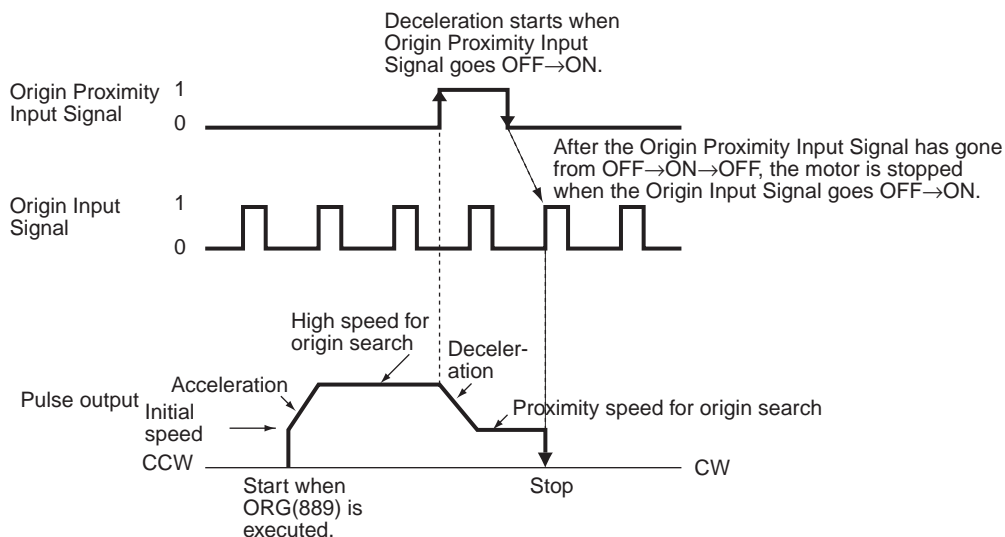
| Setting            | Description   |
|--------------------|---|
| 0: Reversal mode 1 | When the limit input signal is received in the origin search direction, reverse and continue operation.       |
| 1: Reversal mode 2 | When the limit input signal is received in the origin search direction, generate an error and stop operation. |

### Origin Detection Method

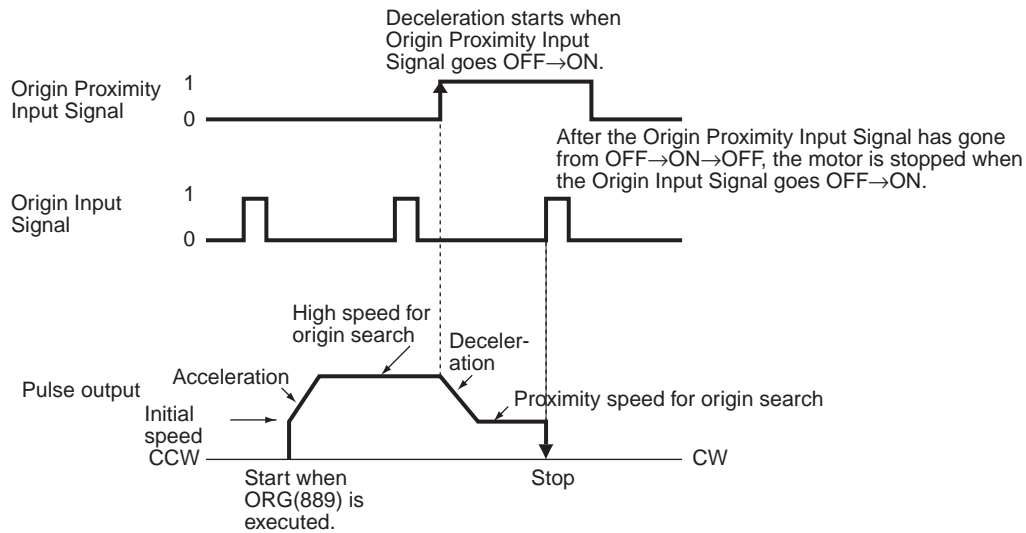
The origin detection method depends on the Origin Proximity Input Signal settings. Select one of the following three methods in each port's parameters.

| Setting   | Description  |
|---|--|
| 0: Origin Proximity Input Signal reversal required.     | Reads the first Origin Input Signal after the Origin Proximity Input Signal goes OFF→ON→OFF. |
| 1: Origin Proximity Input Signal reversal not required. | Reads the first Origin Input Signal after the Origin Proximity Input Signal goes OFF→ON.     |
| 2: Origin Proximity Input Signal not used.              | Just read the Origin Input Signal without using the Origin Proximity Input Signal.           |

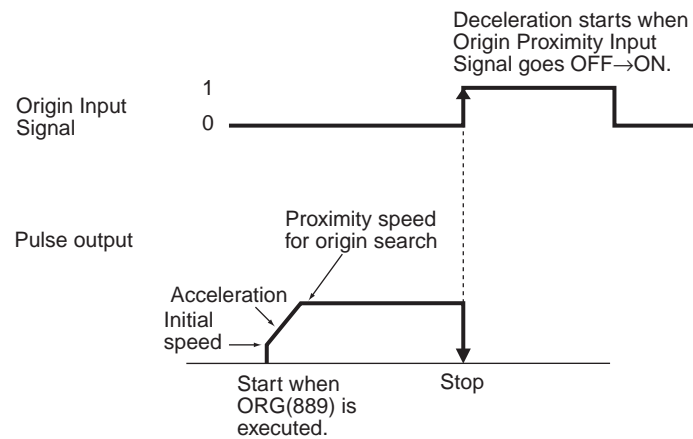
### Origin Detection Method 0: Origin Proximity Input Signal Reversal Required



### Origin Detection Method 1: Origin Proximity Input Signal Reversal Not Required



### Origin Detection Method 2: Origin Proximity Input Signal Reversal Not Used



#### Origin Search Operating Mode and Origin Detection Method Settings

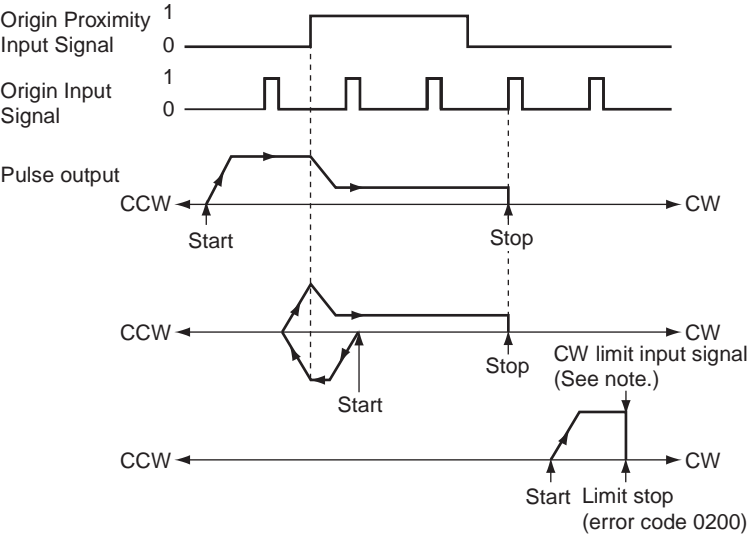
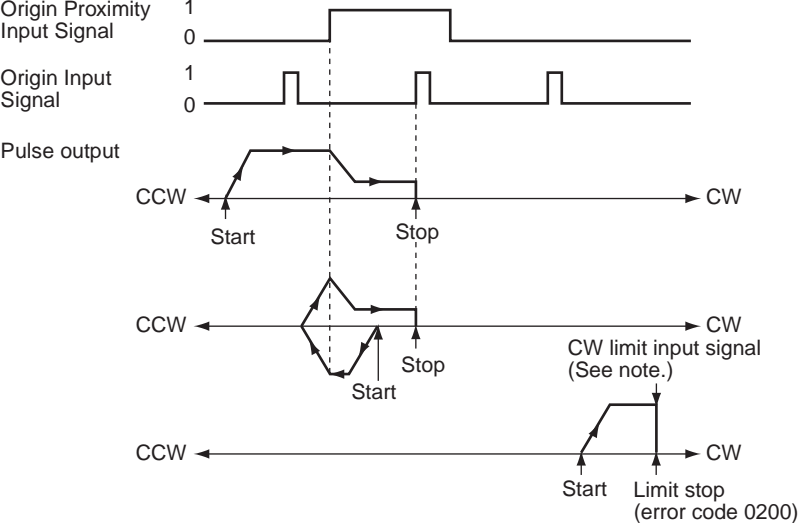
The following examples explain how the operation patterns are affected by the origin search operation and origin detection method settings.

These examples have a CW origin search direction. (The search direction and limit input signal direction would be different for an origin search in the CCW direction.)

**Using Reversal Mode 1**

| Origin search operation<br>Origin detection method      | 0: Reversal mode 1   |
|---|--|
| 0: Origin Proximity Input Signal reversal required.     | <p>Origin Proximity Input Signal 1 0</p> <p>Origin Input Signal 1 0</p> <p>High speed for origin search</p> <p>Pulse output</p> <p>CCW Start Stop CW</p> <p>CCW Stop Start CW</p> <p>CCW Stop Start CW</p> <p>CW limit input signal (See note.)</p> <p><b>Note</b> When the limit input signal is received, the motor stops without deceleration, reverses direction, and accelerates.</p> |
| 1: Origin Proximity Input Signal reversal not required. | <p>Origin Proximity Input Signal 1 0</p> <p>Origin Input Signal 1 0</p> <p>Pulse output</p> <p>CCW Start Stop CW</p> <p>CCW Stop Start CW</p> <p>CCW Stop Start CW</p> <p>CW limit input signal (See note.)</p> <p><b>Note</b> When the limit input signal is received, the motor stops without deceleration, reverses direction, and accelerates.</p>                                     |
| 2: Origin Proximity Input Signal not used.              | <p>Origin Input Signal 1 0</p> <p>Pulse output</p> <p>CCW Start Stop CW</p> <p>CCW Stop Start CW</p> <p>CCW Stop Start CW</p> <p>CW limit input signal (See note.)</p> <p><b>Note</b> When the direction of operation is reversed, it is reversed immediately without deceleration or acceleration.</p>  |

## Using Reversal Mode 2

| <b>Origin search operation</b><br><br><b>Origin detection method</b> | <b>1: Reversal mode 2</b>   |
|--|---|
| <b>0: Origin Proximity Input Signal reversal required.</b>           |  <p><b>Note</b> When the limit input signal is received, the motor stops without deceleration.</p>  |
| <b>1: Origin Proximity Input Signal reversal not required.</b>       |  <p><b>Note</b> When the limit input signal is received, the motor stops without deceleration.</p> |



| Origin search operation                    | 1: Reversal mode 2  |
|--|---|
| Origin detection method                    |   |
| 2: Origin Proximity Input Signal not used. | <p><b>Note</b> When the limit input signal is received, the motor stops without deceleration.</p> |

### Specifying the Origin Search Direction (CW or CCW Direction)

Sets the direction to move when detecting the Origin Input Signal.

Typically, the origin search is performed so that the Origin Input Signal's rising edge is detected when moving in the origin search direction.

| Setting | Description   |
|---------|---------------|
| 0       | CW direction  |
| 1       | CCW direction |

### Origin Search Speed

These are the motor speed settings used in the origin search.

#### Note

The origin search will not be performed in these cases:  
 Origin search high speed  $\leq$  Origin search proximity speed  
 Origin search proximity speed  $\leq$  Origin search initial speed

#### Origin Search/Return Initial Speed

Sets the motor's starting speed when the origin search is executed. Specify the speed in the number of pulses per second (pps).

#### Origin Search High Speed

Sets the motor's target speed when the origin search is executed. Specify the speed in the number of pulses per second (pps).

#### Origin Search Proximity Speed

Sets the motor's speed after the Origin Proximity Input Signal is detected. Specify the speed in the number of pulses per second (pps).

#### Origin Search Acceleration Rate

Sets the motor's acceleration rate when the origin search is executed. Specify the amount to increase the speed (Hz) per 4-ms interval.

#### Origin Search Deceleration Rate

Sets the motor's acceleration rate when the origin search function is decelerating. Specify the amount to decrease the speed (Hz) per 4-ms interval.

### Origin Compensation

After the origin has been determined, the origin compensation can be set to compensate for a shift in the Proximity Sensor's ON position, motor replacement, or other change.

Once the origin has been detected in an origin search, the number of pulses specified in the origin compensation is output, the current position is reset to 0, and the pulse output's No-origin Flag is turned OFF.

Setting range: 8000 0000 to 7FFF FFFF hex (–2,147,483,648 to 2,147,483,647) pulses

### I/O Settings

#### Limit Input Signal Type (NC/NO)

Specifies the type of input signal (normally closed or normally open) being used for the limit inputs.

0: NC

1: NO

#### Origin Proximity Input Signal Type (NC/NO)

Specifies the type of input signal (normally closed or normally open) being used for the Origin Proximity Input Signal.

0: NC

1: NO

#### Origin Input Signal Type (NC/NO)

Specifies the type of input signal (normally closed or normally open) being used for the Origin Input Signal.

0: NC

1: NO

### Positioning Monitor Time

When the operating mode is set to mode 2, this setting specifies how long to wait (in ms) for the Positioning Completed Signal after the positioning operation has been completed, i.e., the pulse output has been completed. A Positioning Timeout Error (error code 0300) will be generated if the motor driver's Positioning Completed Signal does not come ON within the specified time.

Setting range: 0000 to 270F hex (0 to 9,999 ms)

The actual monitoring time will be the Positioning Monitor Time rounded up to the nearest 10-ms unit + 10 ms max.

If the Positioning Monitor Time is set to 0, the function will be disabled and the Unit will continue waiting for the Positioning Completed Signal to come ON. (A Positioning Timeout Error will not be generated.)

### Executing an Origin Search

Execute ORG(889) in the ladder program to perform an origin search with the specified parameters.

|   |          |   |
|---|----------|---|
| — | ORG(889) | P: Port specifier                                       |
|   | P        | Pulse output 0: #0000                                   |
|   |          | Pulse output 1: #0001                                   |
|   | C        | C: Control data; Origin search and CW/CCW method: #0000 |
|   |          | Origin search and pulse + direction method: #0001       |

### Restrictions

The motor can be moved even if the origin position has not been determined with the origin search function, but positioning operations will be limited as follows:

| Function      | Operation       |
|---------------|-----------------|
| Origin return | Cannot be used. |

| Function                                      | Operation   |
|---|---|
| Positioning with absolute pulse specification | Cannot be used.   |
| Positioning with relative pulse specification | Outputs the specified number of pulses after setting the current position to 0. |

An origin search will not be started unless the origin search proximity speed is less than the origin search high speed and unless the origin search/return initial speed is less than the origin search proximity speed.

### Origin Search Error Processing

The CP1L-EL/EM CPU Unit's pulse output function performs a basic error check before starting to output pulses (when the instruction is executed) and will not output pulses if the settings are incorrect. There are other errors that can occur with the origin search function during pulse output, which may stop the pulse output.

If an error occurs that stops pulse output, the pulse output's Output Stopped Error Flag will be turned ON and the Pulse Output Stop Error Code will be written to Error Code word. Use these flags and error codes to identify the cause of the error.

The Pulse Output Stop Errors will not affect the CPU Unit's operating status. (The Pulse Output Stop Errors do not cause a fatal or non-fatal error in the CPU Unit.)

### Related Auxiliary Area Flags

| Function  |  | Pulse output number |         |
|---|--|---------------------|---------|
|   |  | 0                   | 1       |
| Output Stopped Error Flags<br>ON when an error occurred while outputting pulses in the origin search function.                                | 0: No error<br>1: Stop error occurred. | A280.07             | A281.07 |
| Stop Error Codes<br>When a Pulse Output Stop Error occurs, the error code is stored in that pulse outputs corresponding Stop Error Code word. |  | A444                | A445    |

### Pulse Output Stop Error Codes

| Error name                       | Error code | Likely cause   | Corrective action   | Operation after error                      |
|----------------------------------|------------|--|---|--|
| CW Limit Stop Input Signal       | 0100       | Stopped due to a CW limit signal input.  | Move in the CCW direction.  | Immediate stop,<br>No effect on other port |
| CCW Limit Stop Input Signal      | 0101       | Stopped due to a CCW limit signal input.   | Move in the CW direction.   |  |
| No Origin Proximity Input Signal | 0200       | The parameters indicate that the Origin Proximity Input Signal is being used, but a Origin Proximity Input Signal was not received during the origin search. | Check the wiring of the Origin Proximity Input Signal as well as the PLC Setup's Origin Proximity Input Signal Type setting (NC or NO) and execute the origin search again. Turn the power supply OFF and then ON if the signal type setting was changed. | No effect on other port                    |
| No Origin Input Signal           | 0201       | The Origin Input Signal was not received during the origin search.   | Check the wiring of the Origin Input Signal as well as the PLC Setup's Origin Input Signal Type setting (NC or NO) and execute the origin search again. Turn the power supply OFF and then ON if the signal type setting was changed.                     |  |

| Error name   | Error code | Likely cause   | Corrective action  | Operation after error                                |
|--|------------|--|--|--|
| Origin Input Signal Error                          | 0202       | During an origin search in operating mode 0, the Origin Input Signal was received during the deceleration started after the Origin Proximity Input Signal was received.  | Take one or both of the following steps so that the Origin Input Signal is received after deceleration is completed.<br><ul style="list-style-type: none"> <li>•Increase the distance between the Origin Proximity Input Signal sensor and Origin Input Signal sensor.</li> <li>•Decrease the difference between the origin search's high speed and proximity speed settings.</li> </ul> | Decelerates to a stop,<br>No effect on other port    |
| Limit Inputs in Both Directions                    | 0203       | The origin search cannot be performed because the limit signals for both directions are being input simultaneously.  | Check the wiring of the limit signals in both directions as well as the PLC Setup's Limit Signal Type setting (NC or NO) and execute the origin search again. Turn the power supply OFF and then ON if the signal type setting was changed.  | Operation will not start.<br>No effect on other port |
| Simultaneous Origin Proximity and Limit Inputs     | 0204       | The Origin Proximity Input Signal and the Limit Input Signal in the search direction are being input simultaneously during an origin search.   | Check the wiring of the Origin Proximity Input Signal and the Limit Input Signal. Also check the PLC Setup's Origin Proximity Input Signal Type and Limit Signal Type settings (NC or NO) and then execute the origin search again. Turn the power supply OFF and then ON if a signal type setting was changed.  | Immediate stop,<br>No effect on other port           |
| Limit Input Signal Already Being Input             | 0205       | <ul style="list-style-type: none"> <li>•When an origin search in one direction is being performed, the Limit Input Signal is already being input in the origin search direction.</li> <li>•When a non-regional origin search is being performed, the Origin Input Signal and the Limit Input Signal in the opposite direction (from the search direction) are being input simultaneously.</li> </ul>   | Check the wiring of the Limit Input Signal and the PLC Setup's I/O settings. Also check the PLC Setup's Limit Signal Type setting (NC or NO) and then execute the origin search again. Turn the power supply OFF and then ON if the signal type setting was changed.   | Immediate stop,<br>No effect on other port           |
| Origin Proximity Input Signal Origin Reverse Error | 0206       | <ul style="list-style-type: none"> <li>•When an origin search with reversal at the limit is being performed, the Limit Input Signal in the search direction was input while the Origin Proximity Input Signal was reversing.</li> <li>•When an origin search with reversal at the limit is being performed and the Origin Proximity Input Signal is not being used, the Limit Input Signal in the search direction was input while the Origin Input Signal was reversing.</li> </ul> | Check the installation positions of the Origin Proximity Input Signal, Origin Input Signal, and Limit Input Signal as well as the PLC Setup's I/O settings. Also check the PLC Setup's Signal Type settings (NC or NO) for each input signal and then execute the origin search again. Turn the power supply OFF and then ON if a signal type setting was changed.                       | Immediate stop,<br>No effect on other port           |
| Positioning Timeout Error                          | 0300       | The Servo Driver's Positioning Completed Signal does not come ON within the Positioning Monitor Time specified in the PLC Setup.   | Adjust the Positioning Monitor Time setting or Servo system gain setting. Check the Positioning Completed Signal wiring, correct it if necessary, and then execute the origin search again.  | Decelerates to a stop,<br>No effect on other port    |

## Origin Search Examples

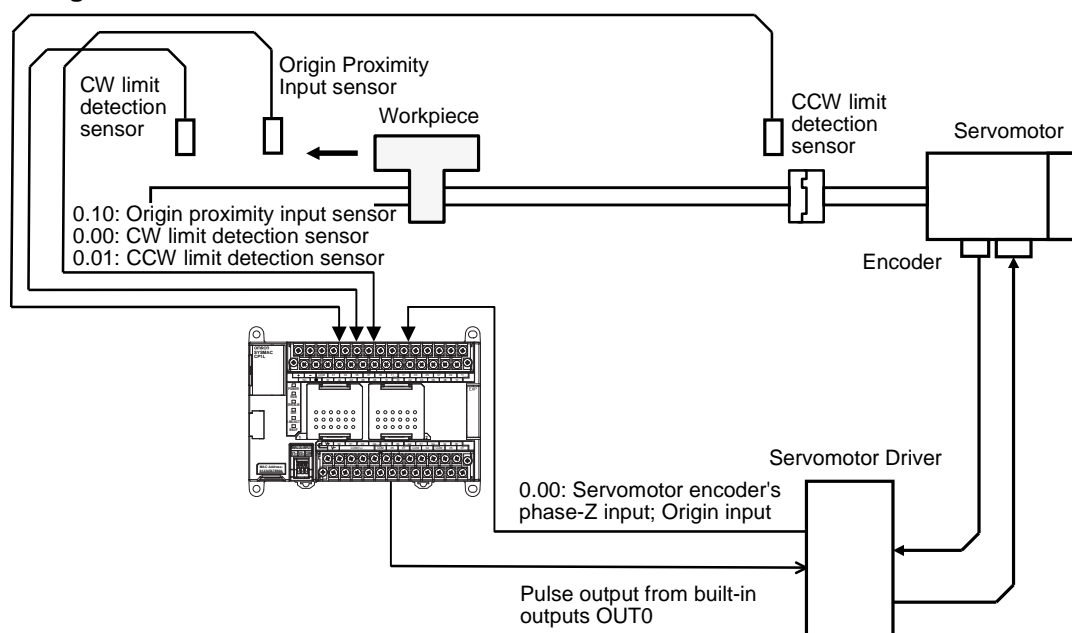
### Operation

Connect a Servo Driver and execute an origin search based on the Servomotor's built-in encoder phase-Z signal and a Origin Proximity Input Signal.

### Conditions

- Operating mode: 1  
(Uses the Servomotor encoder's phase-Z signal as the Origin Input Signal.)
- Origin search operation setting: 0  
(Sets reverse mode 1. Reverses direction when the limit input signal is input in the origin search direction.)
- Origin detection method: 0  
(Reads the Origin Input Signal after the Origin Input Signal goes OFF→ON→OFF.)
- Origin search direction: 0 (CW direction)

### System Configuration



### Instructions Used

ORG(889)

I/O Allocations  
(Example: CP1L-EM40/30  
DT□-D, CP1L-EL20D□-D  
Units)

### ■ Inputs

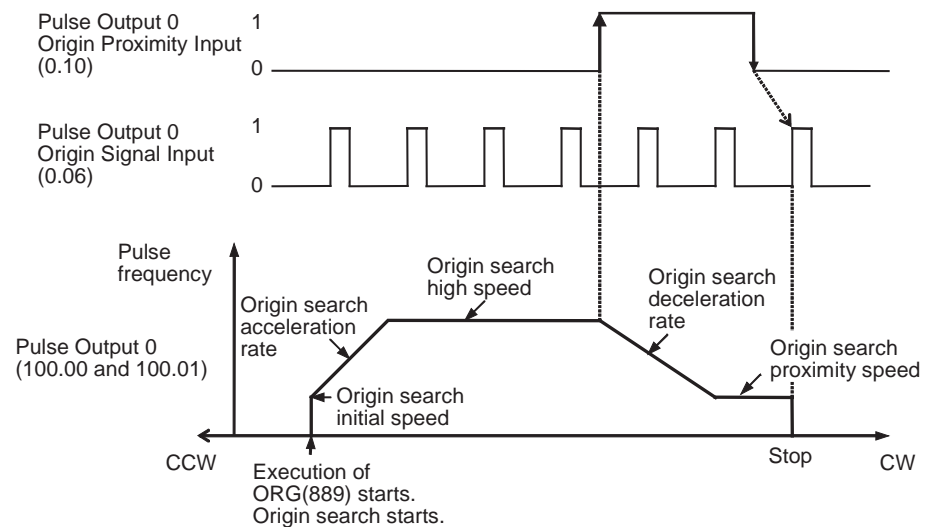
| Input terminal |     | Name   |
|----------------|-----|--|
| Word           | Bit |  |
| CIO 0          | 00  | CW limit detection sensor                    |
|                | 01  | CCW limit detection sensor                   |
|                | 06  | Pulse Output 0 Origin Input Signal           |
|                | 10  | Pulse Output 0 Origin Proximity Input Signal |

| Word | Bit | Name                                  |
|------|-----|---------------------------------------|
| A540 | 08  | Pulse Output 0 CW Limit Input Signal  |
|      | 09  | Pulse Output 0 CCW Limit Input Signal |

### ■ Outputs

| Output terminal |     | Name                      |
|-----------------|-----|---------------------------|
| Word            | Bit |                           |
| CIO 100         | 00  | Pulse Output 0 CW output  |
|                 | 01  | Pulse Output 0 CCW output |

## Operation

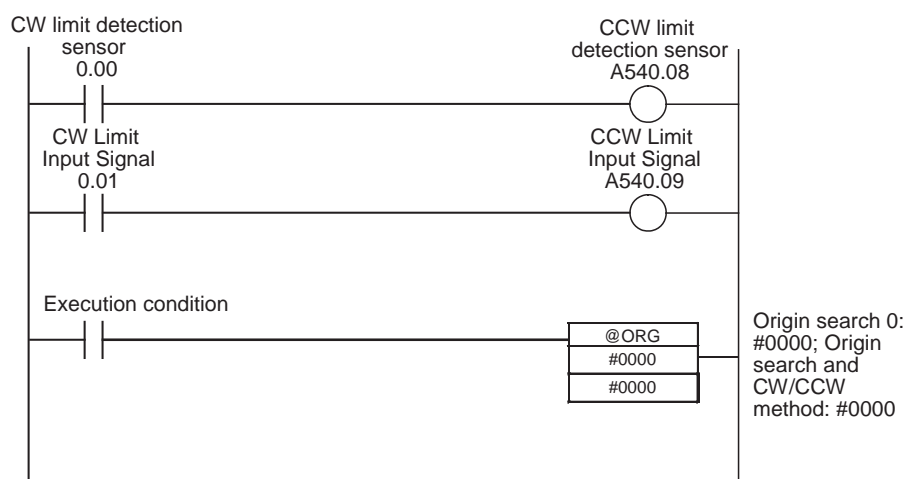


## PLC Setup

| Function   | Setting (example)                |
|--|----------------------------------|
| Pulse Output 0 Origin Search Function Enable/Disable | 1 hex: Enabled                   |
| Pulse Output 0 Origin Search Operating Mode          | 1 hex: Mode 1                    |
| Pulse Output 0 Origin Search Operation Setting       | 0 hex: Reverse mode 1            |
| Pulse Output 0 Origin Detection Method               | 0 hex: Origin detection method 0 |
| Pulse Output 0 Origin Search Direction Setting       | 0 hex: CW direction              |
| Pulse Output 0 Origin Search/Return Initial Speed    | 0064 hex (100 pps)               |
|  | 0000 hex                         |
| Pulse Output 0 Origin Search High Speed              | 07D0 hex (2,000 pps)             |
|  | 0000 hex                         |

| Function  | Setting (example)     |
|---|-----------------------|
| Pulse Output 0 Origin Search Proximity Speed      | 03E8 hex (1,000 pps)  |
|   | 0000 hex              |
| Pulse Output 0 Origin Compensation                | 0000 hex              |
|   | 0000 hex              |
| Pulse Output 0 Origin Search Acceleration Rate    | 0032 hex (50 Hz/4 ms) |
| Pulse Output 0 Origin Search Deceleration Rate    | 0032 hex (50 Hz/4 ms) |
| Pulse Output 0 Limit Input Signal Type            | 1: NO                 |
| Pulse Output 0 Origin Proximity Input Signal Type | 1: NO                 |
| Pulse Output 0 Origin Input Signal Type           | 1: NO                 |

## Ladder Program

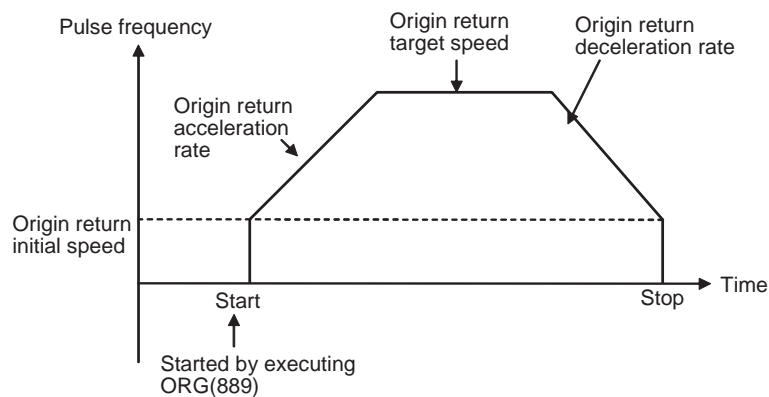


## 7-2-6 Origin Return

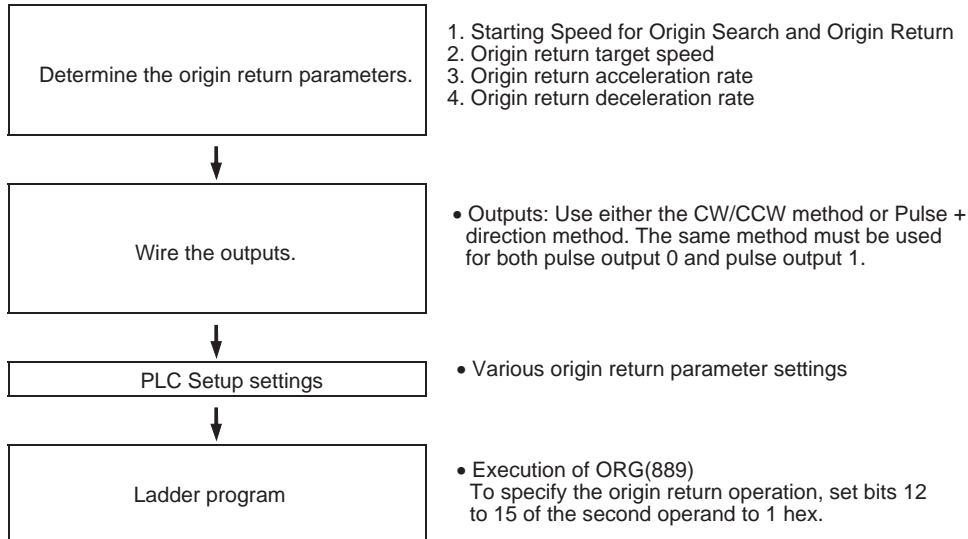
### Overview

Moves the motor to the origin position from any other position. The origin return operation is controlled by ORG(889).

The origin return operation returns the motor to the origin by starting at the specified speed, accelerating to the target speed, moving at the target speed, and then decelerating to a stop at the origin position.



## Procedure



## PLC Setup

The various origin return parameters are set in the PLC Setup.

### Origin Return Parameters

| Name                               | Settings                                      | Remarks            |
|------------------------------------|---|--------------------|
| Origin search/return initial speed | 00000000 to 000186A0 hex<br>(0 Hz to 100 kHz) | Start of operation |
| Origin return target speed         | 00000001 to 000186A0 hex<br>(1 Hz to 100 kHz) |                    |
| Origin return acceleration rate    | 0001 to FFFF hex<br>(1 to 65,535 Hz/4 ms)     |                    |
| Origin return deceleration rate    | 0001 to FFFF hex<br>(1 to 65,535 Hz/4 ms)     |                    |

## Explanation of the Origin Return Parameters

### Origin Search/Return Initial Speed

Sets the motor's starting speed when the origin return is executed. Specify the speed in the number of pulses per second (pps).

### Origin Return Target Speed

Sets the motor's target speed when the origin return is executed. Specify the speed in the number of pulses per second (pps).

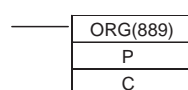
### Origin Return Acceleration Rate

Sets the motor's acceleration rate when the origin return operation starts. Specify the amount to increase the speed (Hz) per 4-ms interval.

### Origin Return Deceleration Rate

Sets the motor's acceleration rate when the origin return function is decelerating. Specify the amount to decrease the speed (Hz) per 4-ms interval.

## Executing an Origin Return



P: Port specifier (Pulse output 0: #0000, Pulse output 1: #0001)  
 Pulse output 0: #0000  
 Pulse output 1: #0001  
 C: Control data  
 (Origin return and CW/CCW method: #1000, Origin search and pulse + direction method: #1100)

**Note** An instruction execution error will occur if the origin is not determined (relative coordinate system) when ORG(889) is executed to perform an origin return operation.

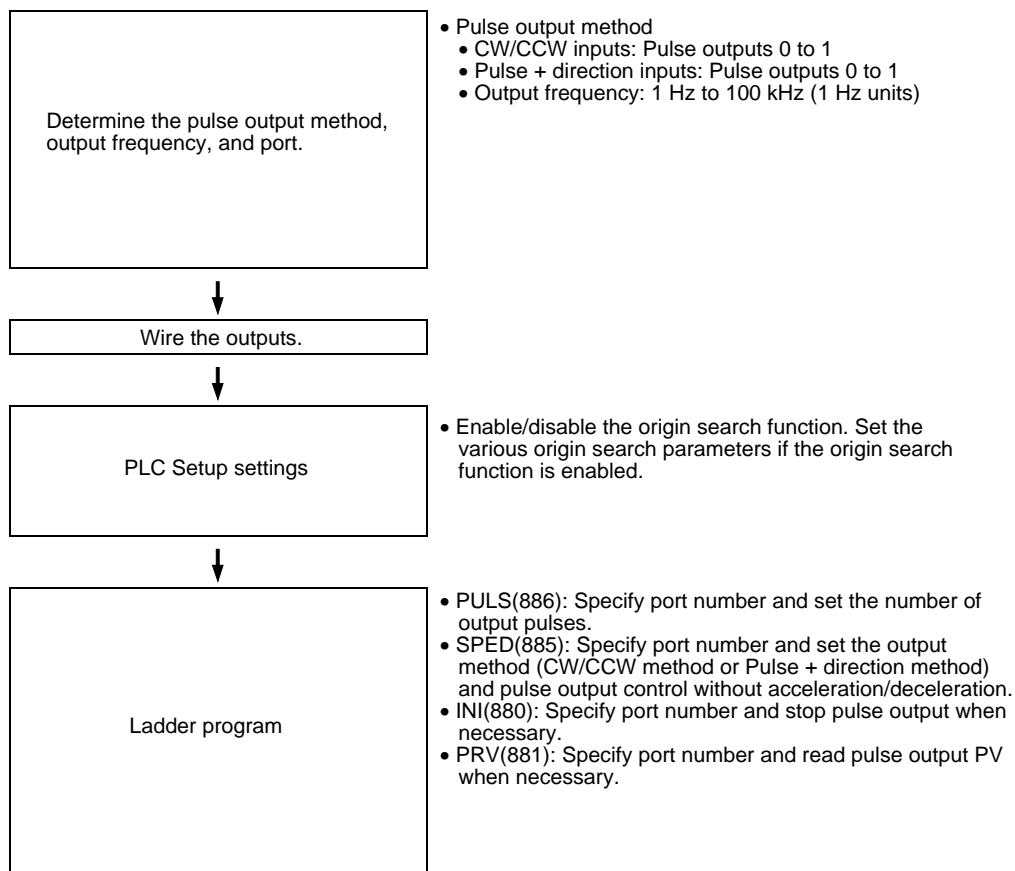


## 7-2-7 Pulse Output Procedures

### Single-phase Pulse Output without Acceleration/Deceleration

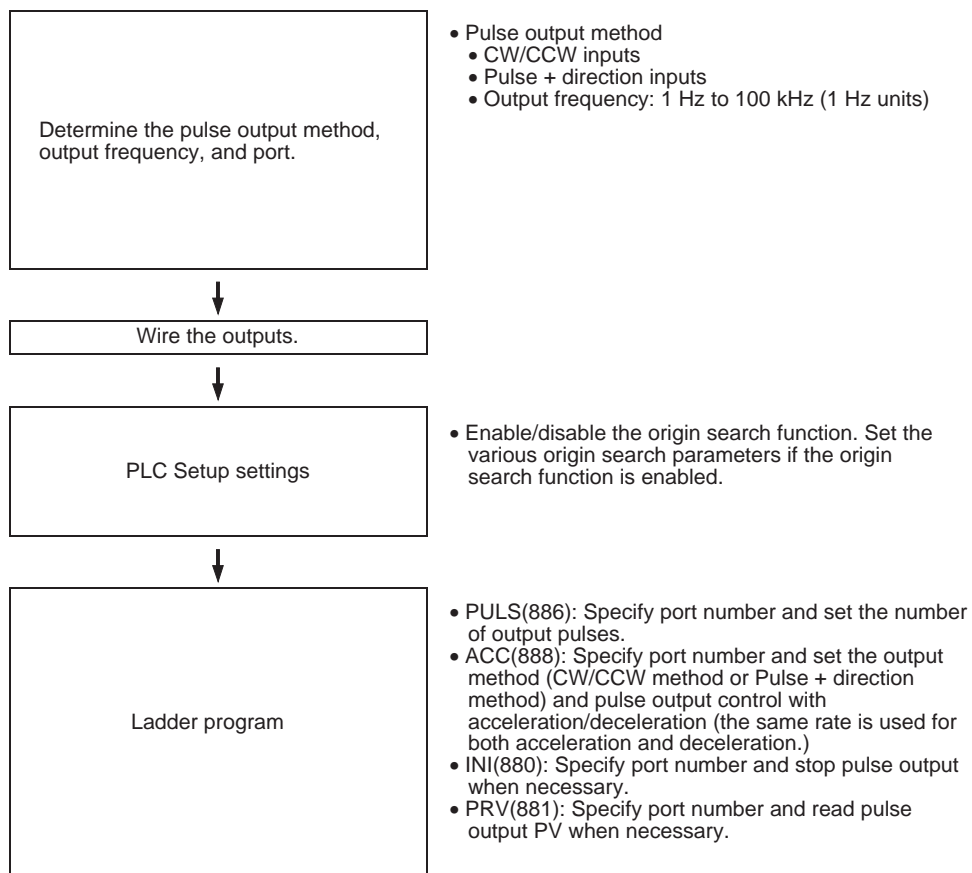
The number of output pulses setting cannot be changed during positioning.

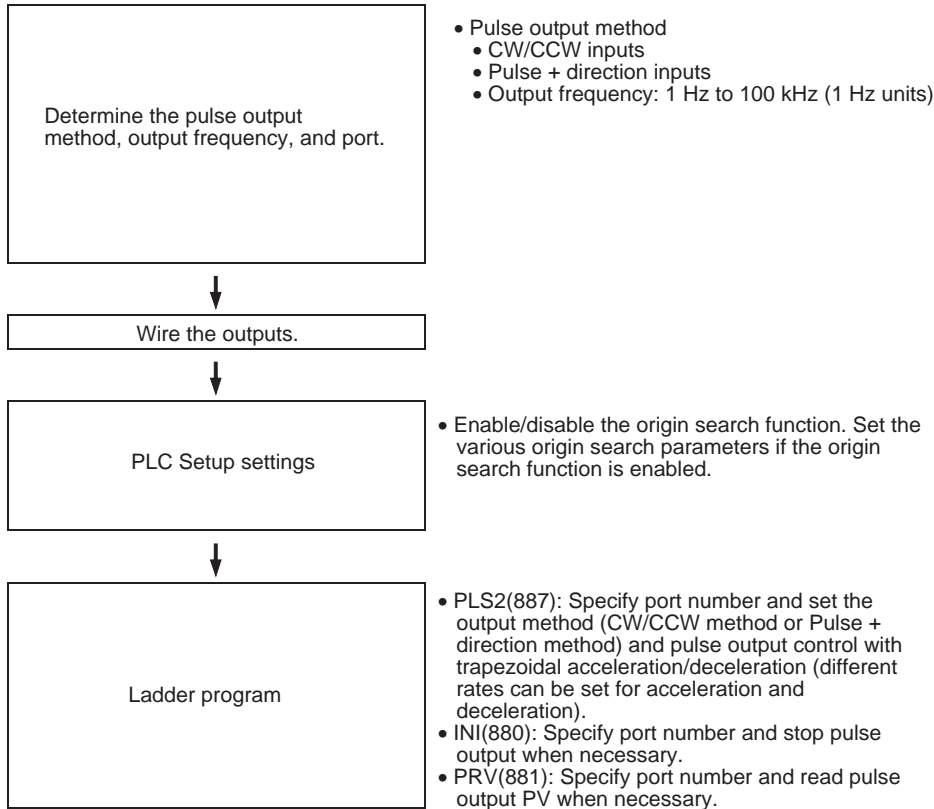
#### ■ PULS(886) and SPED(885)



## Single-phase Pulse Output with Acceleration/Deceleration

## ■ PULS(886) and ACC(888)



**Pulse Output with Trapezoidal Acceleration/Deceleration (Using PLS2(887))****7-2-8 Instructions Used for Pulse Outputs**

The pulse output functions can be used by executing the pulse control instructions in the ladder program. For some instructions, the PLC Setup must be set in advance. The following instructions can be combined for positioning and speed control.

**Supported Pulse Instructions**

Use the following 8 instructions to control the pulse outputs.

The following table shows the kinds of pulse outputs controlled by each instruction.

| Instruction                                 | Function   | Positioning (independent mode)                  |   |  | Speed control (continuous mode)                 |  | Origin search |
|---|--|---|---|--|---|--|---------------|
|   |  | Pulse output without acceleration/ deceleration | Pulse output with acceleration/ deceleration        |  | Pulse output without acceleration/ deceleration | Pulse output with acceleration/ deceleration |               |
|   |  |   | Trapezoidal, equal acceleration/ deceleration rates | Trapezoidal, separate acceleration/ deceleration rates |   |  |               |
| PULS(886)<br>SET PULSES                     | Sets the number of pulses to be output.  | Used  | ---   | ---  | ---   | ---  | ---           |
| SPED(885)<br>SPEED OUTPUT                   | Performs pulse output control without acceleration or deceleration.<br><br>(When positioning, the number of pulses must be set in advance with PULS(886).) | Used  | ---   | ---  | Used  | ---  | ---           |
| ACC(888)<br>ACCELERATION CONTROL            | Performs pulse output control with acceleration and deceleration.<br><br>(When positioning, the number of pulses must be set in advance with PULS(886).)   | ---   | Used  | ---  | ---   | Used   | ---           |
| PLS2(887)<br>PULSE OUTPUT                   | Performs pulse output control with independent acceleration and deceleration rates.<br><br>(Also sets the number of pulses.)                               | ---   | ---   | Used   | ---   | ---  | ---           |
| ORG(889)<br>ORIGIN SEARCH                   | Actually moves the motor with pulse outputs and determines the machine origin based on the Origin Proximity Input and Origin Input signals                 | ---   | ---   | ---  | ---   | ---  | Used          |
| INI(880)<br>MODE CONTROL                    | Stops the pulse output. Changes the pulse output PV. (This operation determines the origin location.)  | Used  | Used  | Used   | Used  | Used   | ---           |
| PRV(881)<br>HIGH-SPEED COUNTER PV READ      | Reads the pulse output PV.   | Used  | Used  | Used   | Used  | Used   | ---           |
| PWM(891)<br>PULSE WITH VARIABLE DUTY FACTOR | Performs pulse output control with variable duty factor pulse output.  | ---   | ---   | ---  | ---   | ---  | ---           |

**SET PULSES: PULS(886)**

PULS(886) is used to set the pulse output amount (number of output pulses) for pulse outputs that are started later in the program using SPED(885) or ACC(888) in independent mode.

|           |                     |
|-----------|---------------------|
| PULS(886) |                     |
| P         | P: Port specifier   |
| T         | T: Pulse type       |
| N         | N: Number of pulses |

| Operand |                             | Contents   |
|---------|-----------------------------|--|
| P       | Port specifier              | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1   |
| T       | Pulse type                  | 0000 hex: Relative pulse output<br>0001 hex: Absolute pulse output   |
| N       | First number of pulses word | N and N+1 contain the number of pulses setting. (N contains the rightmost 4 digits and N+1 contains the leftmost 4 digits.)<br>Relative pulse output:<br>0000 0000 to 7FFF FFFF hex (0 to 2,147,483,647)<br>Absolute pulse output:<br>8000 0000 to 7FFF FFFF hex (-2,147,483,648 to 2,147,483,647) |

**SPEED OUTPUT: SPED(885)**

SPED(885) can be used to perform pulse output without acceleration or deceleration. Either independent mode positioning or continuous mode speed control is possible. For independent mode positioning, the number of pulses is set using PULS(886).

SPED(885) can also be executed during pulse output to change the output frequency, creating stepwise changes in the speed.

|           |                               |
|-----------|-------------------------------|
| SPED(885) |                               |
| P         | P: Port specifier             |
| T         | T: Output mode                |
| F         | F: First pulse frequency word |

| Operand |                            |               | Contents  |
|---------|----------------------------|---------------|---|
| P       | Port specifier             |               | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1  |
| T       | Output mode                | Bits 0 to 3   | Mode<br>0 hex: Continuous<br>1 hex: Independent   |
|         |                            | Bits 4 to 7   | Direction<br>0 hex: CW<br>1 hex: CCW  |
|         |                            | Bits 8 to 11  | Pulse output method (See note.)<br>0 hex: CW/CCW<br>1 hex: Pulse + direction  |
|         |                            | Bits 12 to 15 | Not used. (Always 0 hex.)   |
| F       | First pulse frequency word |               | F and F+1 contain the pulse frequency setting, in units of 1 Hz. (F contains the rightmost 4 digits and F+1 contains the leftmost 4 digits.)<br>0000 0000 to 000186A0 hex (0 Hz to 100 kHz) |

**ACCELERATION  
CONTROL: ACC(888)**

Use ACC(888) to set the target frequency and acceleration and deceleration rate and output pulses with acceleration and deceleration. (Acceleration rate is the same as the deceleration rate.)

Either independent mode positioning or constant mode speed control is possible when used in combination with PULS(886). ACC(888) can also be executed during pulse output to change the target frequency or acceleration/deceleration rate, enabling smooth (sloped) speed changes.

|          |  |
|----------|--|
| ACC(888) |  |
| P        | <b>P:</b> Port specifier               |
| M        | <b>M:</b> Output mode                  |
| S        | <b>S:</b> First word of settings table |

| Operand |                           |               | Contents   |
|---------|---------------------------|---------------|--|
| P       | Port specifier            |               | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1   |
| M       | Output mode               | Bits 0 to 3   | Mode<br>0 hex: Continuous<br>1 hex: Independent  |
|         |                           | Bits 4 to 7   | Direction<br>0 hex: CW<br>1 hex: CCW   |
|         |                           | Bits 8 to 11  | Pulse output method (See note.)<br>0 hex: CW/CCW<br>1 hex: Pulse + direction   |
|         |                           | Bits 12 to 15 | Not used. (Always 0 hex.)  |
| S       | First settings table word | S             | Acceleration/deceleration rate:<br>0001 to FFFF hex (1 to 65,535 Hz)<br>Specify the increase or decrease in the frequency per pulse control period (4 ms).                                     |
|         |                           | S+1 and S+2   | S and S+1 contain the target frequency setting, in units of 1 Hz. (S+1 contains the rightmost 4 digits and S+2 contains the leftmost 4 digits.)<br>0000 0000 to 000186A0 hex (0 Hz to 100 kHz) |

**PULSE OUTPUT:  
PLS2(887)**

Use PLS2(887) to set the startup frequency, acceleration rate, and deceleration rate, and output a specified number of pulses. Only independent mode positioning is supported.

PLS2(887) can also be executed during pulse output to change the number of output pulses, target frequency, acceleration rate, or deceleration rate.

|           |  |
|-----------|--|
| PLS2(887) |  |
| P         | <b>P:</b> Port specifier                   |
| M         | <b>M:</b> Output mode                      |
| S         | <b>S:</b> First word of settings table     |
| F         | <b>F:</b> First word of starting frequency |

| Operand |                               |               | Contents   |
|---------|-------------------------------|---------------|--|
| P       | Port specifier                |               | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1   |
| M       | Output mode                   | Bits 0 to 3   | Mode<br>0000 hex: Relative pulse output<br>0001 hex: Absolute pulse output   |
|         |                               | Bits 4 to 7   | Direction<br>0 hex: CW<br>1 hex: CCW   |
|         |                               | Bits 8 to 11  | Pulse output method (See note.)<br>0 hex: CW/CCW<br>1 hex: Pulse + direction   |
|         |                               | Bits 12 to 15 | Not used. (Always 0 hex.)  |
| S       | First settings table word     | S             | Acceleration rate:<br>0001 to FFFF hex (1 to 65,535 Hz)<br>Specify the increase or decrease in the frequency per pulse control period (4 ms).  |
|         |                               | S+1           | Deceleration rate:<br>0001 to FFFF hex (1 to 65,535 Hz)<br>Specify the increase or decrease in the frequency per pulse control period (4 ms).  |
|         |                               | S+2 and S+3   | S+2 and S+3 contain the target frequency setting, in units of 1 Hz. (S+2 contains the rightmost 4 digits and S+3 contains the leftmost 4 digits.)<br>00000001 to 000186A0 hex (0 Hz to 100 kHz)  |
|         |                               | S+4 and S+5   | S+4 and S+5 contain the number of pulses setting. (S+4 contains the rightmost 4 digits and S+5 contains the leftmost 4 digits.)<br>Relative pulse output:<br>0000 0000 to 7FFF FFFF hex (0 to 2,147,483,647)<br>Absolute pulse output:<br>8000 0000 to 7FFF FFFF hex (-2,147,483,648 to 2,147,483,647) |
| F       | First starting frequency word |               | F and F+1 contain the starting frequency setting, in units of 1 Hz. (F contains the rightmost 4 digits and F+1 contains the leftmost 4 digits.)<br>0000 0000 to 000186A0 hex (0 Hz to 100 kHz)   |

### ORIGIN SEARCH: ORG(889)

ORG(889) performs an origin search or origin return operation. The required PLC Setup parameters must be set before performing an origin search or origin return operation.

#### Origin Search

Positions the system to the origin based on the origin proximity input and origin input signals.

#### Origin Return

Returns the system from its present position to the pre-established origin.

|   |          |                   |
|---|----------|-------------------|
| — | ORG(889) |                   |
|   | P        | P: Port specifier |
|   | C        | C: Control data   |

| Operand |                |               | Contents   |
|---------|----------------|---------------|--|
| P       | Port specifier |               | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1                         |
| C       | Control data   | Bits 0 to 3   | Not used. (Always 0 hex.)  |
|         |                | Bits 4 to 7   | Not used. (Always 0 hex.)  |
|         |                | Bits 8 to 11  | Pulse output method (See note.)<br>0 hex: CW/CCW<br>1 hex: Pulse + direction |
|         |                | Bits 12 to 15 | Mode<br>0 hex: Origin search<br>1 hex: Origin return                         |

**MODE CONTROL: INI(880)**

In addition to the various interrupt and high-speed counter functions, INI(880) can be used to change the pulse output PV or stop the pulse output.

**Note** This section explains the functions related to pulse outputs only. For details on the INI(880) instruction's high-speed counter or interrupt functions, refer to *8-1 Interrupt Functions* or *7-1 High-speed Counters*.

|          |                                 |
|----------|---------------------------------|
| INI(880) |                                 |
| P        | <b>P:</b> Port specifier        |
| C        | <b>C:</b> Control data          |
| NV       | <b>NV:</b> First word of new PV |

| Operand |                      |  | Contents  |
|---------|----------------------|--|---|
| P       | Port specifier       |  | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1<br>1000 hex: PWM output 0<br>1001 hex: PWM output 1  |
| C       | Control data         |  | 0002 hex: Change the PV.<br>0003 hex: Stop pulse output.  |
| NV      | First word of new PV |  | NV and NV+1 contain the new PV when changing the PV. (N contains the rightmost 4 digits and N+1 contains the leftmost 4 digits.)<br>0000 0000 to FFFFFFFF hex |

**HIGH-SPEED COUNTER  
PV READ: PRV(881)**

In addition to its interrupt and high-speed counter functions, PRV(881) can be used to read the pulse output PV or pulse output status information.

The status of the following flags is read as status information:

- Pulse Output Status Flag
- PV Underflow/Overflow Flag
- Pulse Output Amount Set Flag
- Pulse Output Completed Flag
- Pulse Output Flag
- No-origin Flag
- At Origin Flag
- Pulse Output Stopped Error Flag

|          |                                  |
|----------|----------------------------------|
| PRV(881) |                                  |
| P        | <b>P:</b> Port specifier         |
| C        | <b>C:</b> Control data           |
| D        | <b>D:</b> First destination word |



**Note** This section explains the functions related to pulse outputs only. For details on the PRV(881) instruction's high-speed counter or interrupt functions, refer to 8-1 *Interrupt Functions* or 7-1 *High-speed Counters*.

| Operand |                        |                                 | Contents  |  |
|---------|------------------------|---------------------------------|---|--|
| P       | Port specifier         |                                 | 0000 hex: Pulse output 0<br>0001 hex: Pulse output 1<br>1000 hex: PWM output 0<br>1001 hex: PWM output 1  |  |
| C       | Control data           |                                 | 0000 hex: Read the PV.<br>0001 hex: Read the status.<br>0003 hex: Read the pulse output frequency.  |  |
| D       | First destination word | Reading PV (D and D+1)          | After the pulse output PV is read, the 8-digit hexadecimal data is stored in D and D+1. (D contains the rightmost 4 digits and D+1 contains the leftmost 4 digits.) |  |
|         |                        | Reading pulse output status (D) | Bit 0   | Pulse Output Status Flag<br>0: Constant speed<br>1: Accelerating/decelerating          |
|         |                        |                                 | Bit 1   | PV Underflow/Overflow Flag<br>0: Normal<br>1: Error                                    |
|         |                        |                                 | Bit 2   | Pulse Output Amount Set Flag<br>0: Not set<br>1: Set                                   |
|         |                        |                                 | Bit 3   | Pulse Output Completed Flag<br>0: Output not completed<br>1: Output completed          |
|         |                        |                                 | Bit 4   | Pulse Output Flag<br>0: Stopped<br>1: Outputting pulses                                |
|         |                        |                                 | Bit 5   | No-origin Flag<br>0: Origin established<br>1: Origin not established                   |
|         |                        |                                 | Bit 6   | At Origin Flag<br>0: Not stopped at origin<br>1: Stopped at origin                     |
|         |                        |                                 | Bit 7   | Pulse Output Stopped Error Flag<br>0: No error<br>1: Pulse output stopped due to error |
|         |                        |                                 | Bits 8 to 15  | Not used.  |
|         |                        | Reading PWM output status (D)   | Bit 0   | PWM Output Flag<br>0: Stopped<br>1: Outputting pulses                                  |
|         |                        |                                 | Bits 1 to 15  | Not used.  |

#### PULSE WITH VARIABLE DUTY FACTOR: PWM(891)

PWM(891) is used to output pulses with the specified duty factor.

|     |                          |
|-----|--------------------------|
| PWM |                          |
| P   | <b>P:</b> Port specifier |
| F   | <b>F:</b> Frequency      |
| D   | <b>D:</b> Duty factor    |

| Operand |                | Contents   |
|---------|----------------|--|
| P       | Port specifier | 0000 hex: Pulse output 0 (duty factor set in 1% units, frequency 0.1 Hz units)<br>0001 hex: Pulse output 1 (duty factor set in 1% units, frequency 0.1 Hz units)<br>1000 hex: Pulse output 0 (duty factor set in 0.1% units, frequency 0.1 Hz units)<br>1001 hex: Pulse output 1 (duty factor set in 0.1% units, frequency 0.1 Hz units)<br>0100 hex: Pulse output 0 (duty factor set in 1% unit, frequency 1 Hz units)<br>0101 hex: Pulse output 1 (duty factor set in 1% unit, frequency 1 Hz units)<br>1100 hex: Pulse output 0 (duty factor set in 0.1% unit, frequency 1 Hz units)<br>1101 hex: Pulse output 1 (duty factor set in 0.1% unit, frequency 1 Hz units) |
| T       | Frequency      | 0001 to FFFF hex (0.1 to 6553.5 Hz, in 0.1 Hz units)<br>0001 to 8020 hex (1 to 32,800 Hz, in 1 Hz units)   |
| S       | Duty factor    | Specify the duty factor of the pulse output, i.e., the percentage of time that the output is ON.<br>0000 to 03E8 hex: 0.0% to 100.0% (in 0.1 units)<br>0000 to 0064 hex: 0.0% to 100% (in 1% units)  |

### **Combinations of Pulse Control Instructions**

The following tables show when a second pulse control instruction can be started if a pulse control operation is already being executed.

Generally, a second independent-mode positioning instruction can be started if an independent-mode positioning instruction is being executed, and a second continuous-mode speed control instruction can be started if a continuous-mode speed control instruction is being executed. Operation cannot be switched between the independent and continuous modes, although PLS2(887) can be started while ACC(888) (continuous mode) is being executed.

It is possible to start another operation during acceleration/deceleration and start another positioning instruction during positioning.

| Instruction being executed |                              | Starting instruction<br>(○: Can be executed., x: Instruction Error occurs and Error Flag goes ON) |                            |                           |                           |                          |            |
|----------------------------|------------------------------|---|----------------------------|---------------------------|---------------------------|--------------------------|------------|
|                            |                              | INI(880)  | SPED(885)<br>(Independent) | SPED(885)<br>(Continuous) | ACC(888)<br>(Independent) | ACC(888)<br>(Continuous) | PLS2(887)  |
| SPED(885) (Independent)    |                              | ○   | ○ (note 1)                 | x                         | ○ (note 3)                | x                        | x          |
| SPED(885) (Continuous)     |                              | ○   | x                          | ○ (note 2)                | x                         | ○ (note 5)               | x          |
| ACC(888)<br>(Independent)  | Steady speed                 | ○   | x                          | x                         | ○ (note 4)                | x                        | ○ (note 6) |
|                            | Accelerating or decelerating | ○   | x                          | x                         | ○ (note 4)                | x                        | ○ (note 6) |
| ACC(888)<br>(Continuous)   | Steady speed                 | ○   | x                          | x                         | x                         | ○ (note 5)               | ○ (note 7) |
|                            | Accelerating or decelerating | ○   | x                          | x                         | x                         | ○ (note 5)               | ○ (note 7) |
| PLS2(887)                  | Steady speed                 | ○   | x                          | x                         | ○ (note 4)                | x                        | ○ (note 8) |
|                            | Accelerating or decelerating | ○   | x                          | x                         | ○ (note 4)                | x                        | ○ (note 8) |
| ORG(889)                   | Steady speed                 | ○   | x                          | x                         | x                         | x                        | x          |
|                            | Accelerating or decelerating | ○   | x                          | x                         | x                         | x                        | x          |
| PWM                        |                              | ○   | x                          | x                         | x                         | x                        | x          |

**Note** (1) SPED(885) (Independent) to SPED(885) (Independent)

- The number of pulses cannot be changed.
  - The frequency can be changed.
  - The output mode and direction cannot be switched.
- (2) SPED(885) (Continuous) to SPED(885) (Continuous)
- The frequency can be changed.
  - The output mode and direction cannot be switched.
- (3) SPED(885) (Independent) to ACC(888) (Independent)
- The number of pulses cannot be changed.
  - The frequency can be changed.
  - The acceleration/deceleration rate can be changed.
  - The output mode and direction cannot be switched.
- (4) ACC(888) (Independent) to ACC(888) (Independent)  
or PLS2(887) to ACC(888) (Independent)
- The number of pulses cannot be changed.
  - The frequency can be changed.
  - The acceleration/deceleration rate can be changed. (The rate can even be changed during acceleration or deceleration.)
  - The output mode and direction cannot be switched.
- (5) SPED(885) (Continuous) to ACC(888) (Continuous)  
or ACC(888) (Continuous) to ACC(888) (Continuous)
- The frequency can be changed. (The target frequency can even be changed during acceleration or deceleration.)
  - The acceleration/deceleration rate can be changed. (The rate can even be changed during acceleration or deceleration.)
  - The output mode and direction cannot be switched.
- (6) ACC(888) (Independent) to PLS2(887)
- The number of pulses can be changed. (The setting can even be changed during acceleration or deceleration.)
  - The frequency can be changed. (The target frequency can even be changed during acceleration or deceleration.)
  - The acceleration/deceleration rate can be changed. (The rate can even be changed during acceleration or deceleration.)
  - The output mode and direction cannot be switched.
- (7) ACC(888) (Continuous) to PLS2(887)
- The frequency can be changed. (The target frequency can even be changed during acceleration or deceleration.)
  - The acceleration/deceleration rate can be changed. (The rate can even be changed during acceleration or deceleration.)
  - The output mode and direction cannot be switched.
- (8) PLS2(887) to PLS2(887)
- The number of pulses can be changed. (The setting can even be changed during acceleration or deceleration.)
  - The frequency can be changed. (The target frequency can even be changed during acceleration or deceleration.)
  - The acceleration/deceleration rate can be changed. (The rate can even be changed during acceleration or deceleration.)
  - The output mode and direction cannot be switched.

## 7-2-9 Variable Duty Factor Pulse Outputs (PWM(891) Outputs)

### Overview

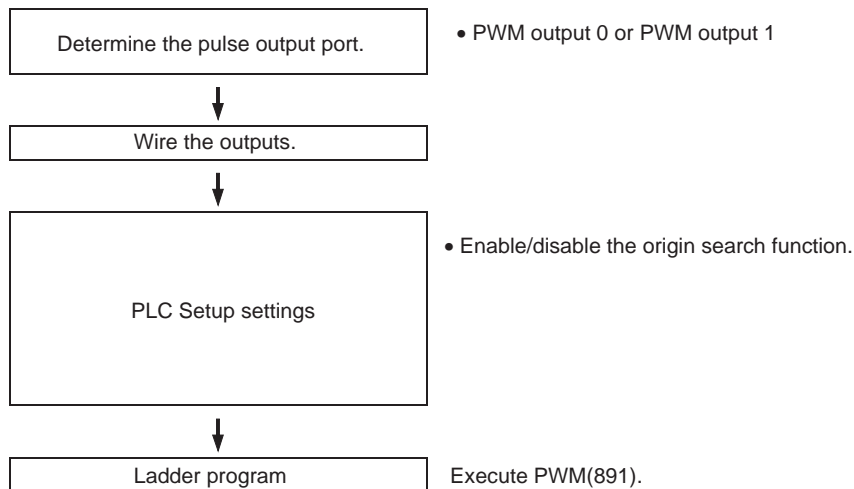
PWM (Pulse Width Modulation) pulse outputs can be output with a specified duty factor. The duty factor is the ratio of the pulse's ON time and OFF time in one pulse cycle. Use the PWM(891) instruction to generate variable duty factor pulses from a built-in output.

The duty factor can be changed while pulses are being output.

### Bit Allocations

| Word    | Bit | Function     |
|---------|-----|--------------|
| CIO 100 | 01  | PWM output 0 |
|         | 03  | PWM output 1 |

### Procedure



### Specifications

| Item        | Specifications  |
|-------------|---|
| Duty factor | 0.0% to 100.0% in 0.1% increments<br>(Duty factor accuracy is +1%/–0% at 10 kHz, +5%/–0% at 10 to 32.8 kHz .) |
| Frequency   | 0.1 Hz to 6,553.5 Hz<br>Set in 0.1 Hz units. (See note.)  |
| Output mode | Continuous mode   |
| Instruction | PWM(891)  |

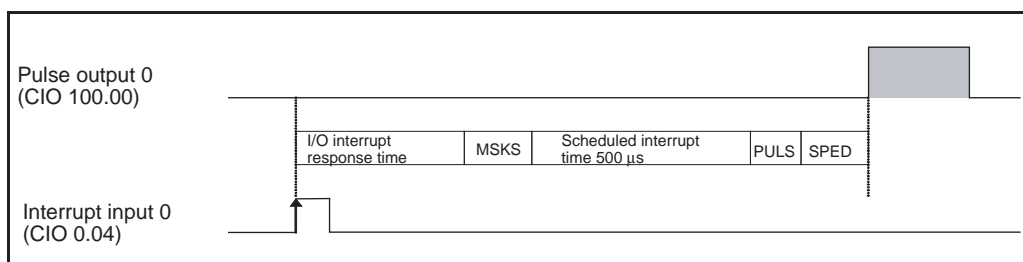
**Note** The frequency can be set up to 6553.5 Hz in the PWM(891) instruction, but the duty factor accuracy declines significantly at high frequencies because of limitations in the output circuit at high frequencies.

## 7-2-10 Example Pulse Output Applications

### Outputting Pulses after a Preset Delay

This example program waits for a preset time (0.5 ms) after the interrupt input (CIO 0.04) goes ON and then outputs 100,000 pulses at 100 kHz from pulse output 0.

Input interrupt task 0 (interrupt task number 140) starts a scheduled interrupt with a scheduled time of 0.5 ms. The scheduled interrupt task executes the pulse output instructions and stops the scheduled interrupt.



#### Instructions Used

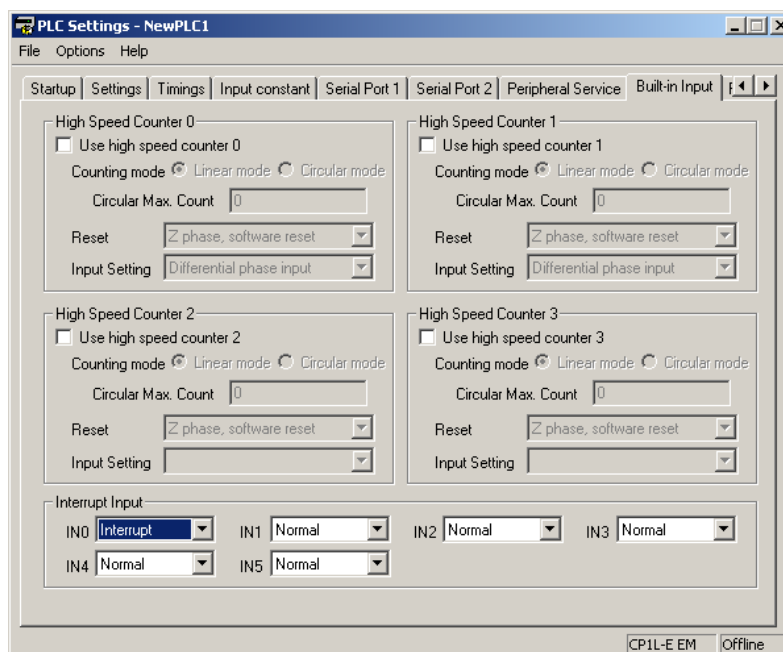
|           |  |
|-----------|--|
| MSKS(690) | Enables the I/O interrupt. Starts the scheduled interrupt. |
| PULS(886) | Sets the number of output pulses.                          |
| SPED(885) | Starts the pulse output.                                   |

#### Preparation

#### ■ PLC Setup

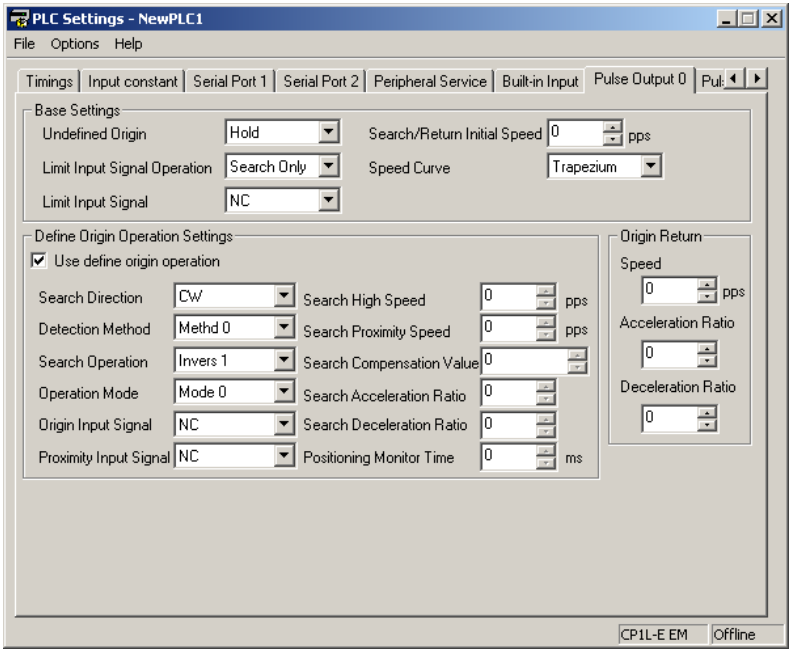
##### Built-in Input Settings

| PLC Setup setting details                       |
|---|
| Use built-in input 0.04 as the interrupt input. |



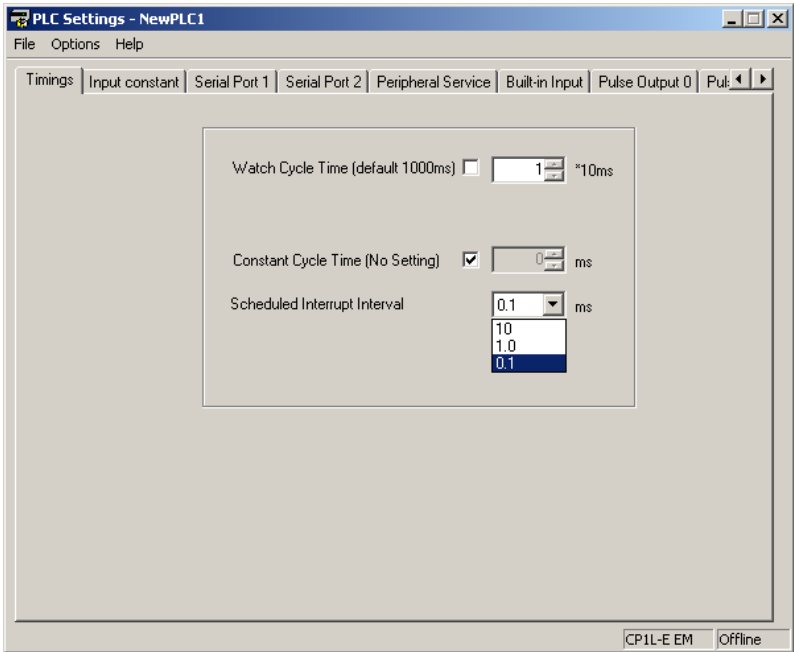
Pulse Output 0 Settings

| PLC Setup setting details                             |
|---|
| Do not use high-speed counter 0.                      |
| Do not use the pulse output 0 origin search function. |



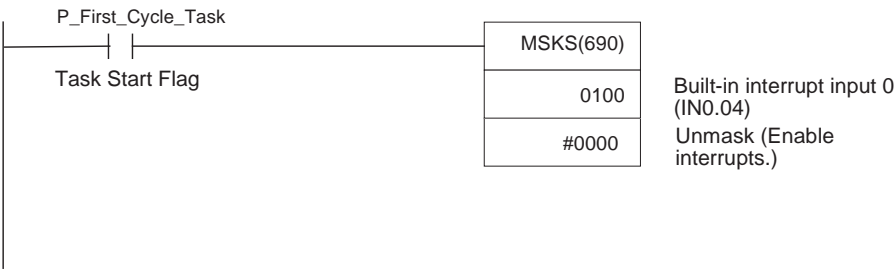
Scheduled Interrupt Time Unit Setting

| PLC Setup setting details                         | Data     |
|---|----------|
| Set the scheduled interrupt time units to 0.1 ms. | 0002 hex |

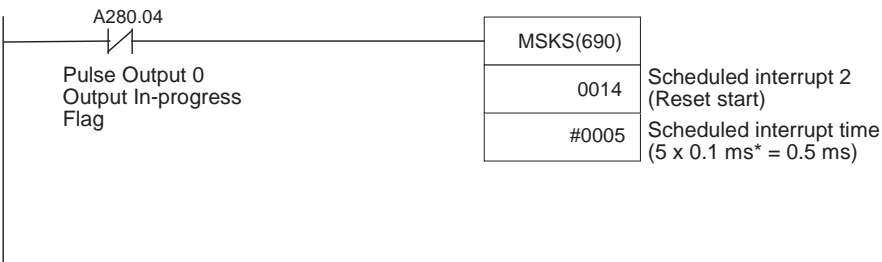


Ladder Program

Cyclic Task (Task 0)

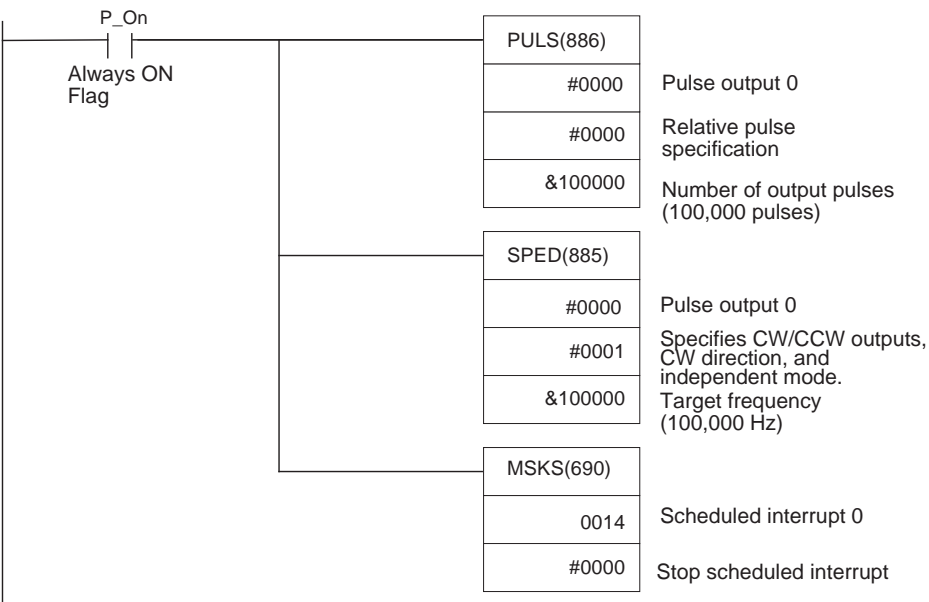


Built-in Input 0 Interrupt Task (Interrupt Task 140)



\* Select 0.1 ms for the setting units in the PLC Setup.

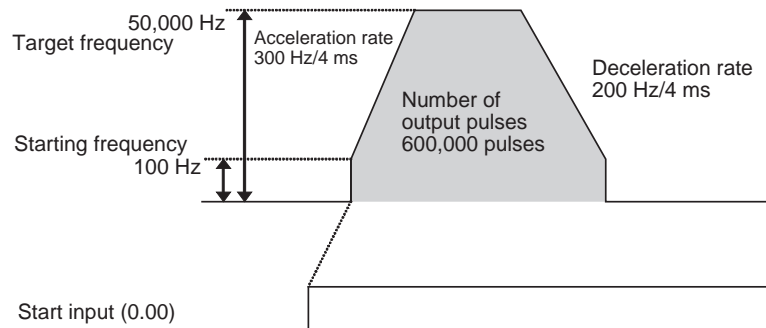
Scheduled Interrupt Task 0 (Interrupt Task 2)



## Positioning (Trapezoidal Control)

### Specifications and Operation

When the start input (0.00) goes ON, this example program outputs 600,000 pulses from pulse output 0 and turns the motor.



### Instructions Used

PLS2(887)

### Preparation

#### ■ PLC Setup

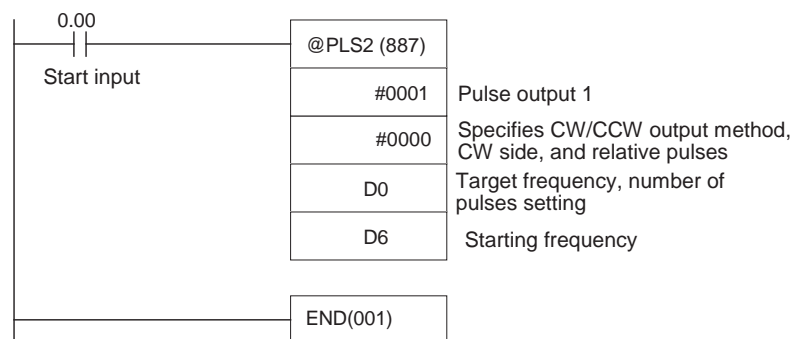
There are no settings that need to be made in the PLC Setup.

### DM Area Settings

#### PLS2(887) Settings (D00000 to D00007)

| Setting details                         | Address | Data |
|---|---------|------|
| Acceleration rate: 300 Hz/4 ms          | D0      | 012C |
| Deceleration rate: 200 Hz/4 ms          | D1      | 00C8 |
| Target frequency: 50,000 Hz             | D2      | C350 |
|   | D3      | 0000 |
| Number of output pulses: 600,000 pulses | D4      | 27C0 |
|   | D5      | 0009 |
| Starting frequency: 100 Hz              | D6      | 0064 |
|   | D7      | 0000 |

### Ladder Program



### Remarks

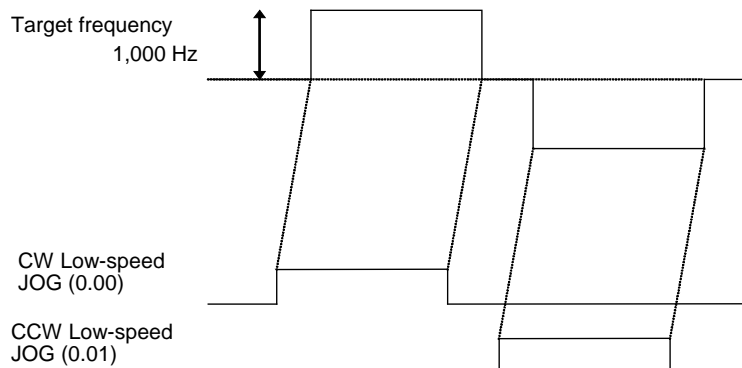
- Absolute pulses can be specified when the origin position has been determined.
- If a target frequency that cannot be reached has been set, the target frequency will be reduced automatically, i.e., triangular control will be performed. In some cases where the acceleration rate is substantially greater than the deceleration rate, the operation won't be true triangular control. The motor will be operated at a constant speed for a short time between the acceleration and deceleration.



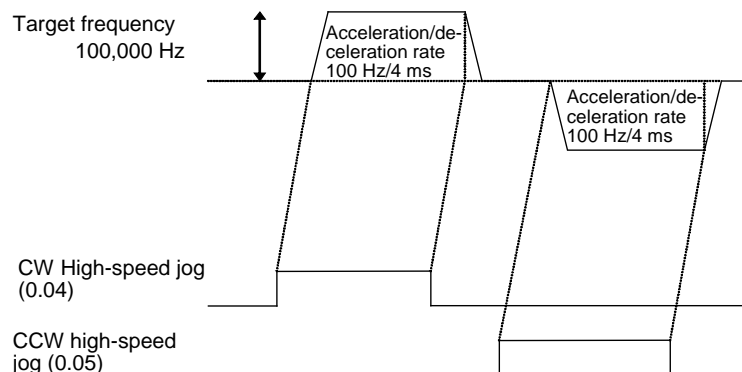
## Jog Operation

### Specifications and Operation

- Low-speed jog operation (CW) will be executed from pulse output 1 while input 0.00 is ON.
- Low-speed jog operation (CCW) will be executed from pulse output 1 while input 0.01 is ON.



- High-speed jog operation (CW) will be executed from pulse output 1 while input 0.04 is ON.
- High-speed jog operation (CCW) will be executed from pulse output 1 while input 0.05 is ON.



### Instructions Used

- SPED(885) Starts and stops (immediate stop) the low-speed jog operations.
- ACC(888) Starts and stops (decelerate to a stop) the high-speed jog operations.

### Preparation

#### ■ PLC Setup

There are no settings that need to be made in the PLC Setup.

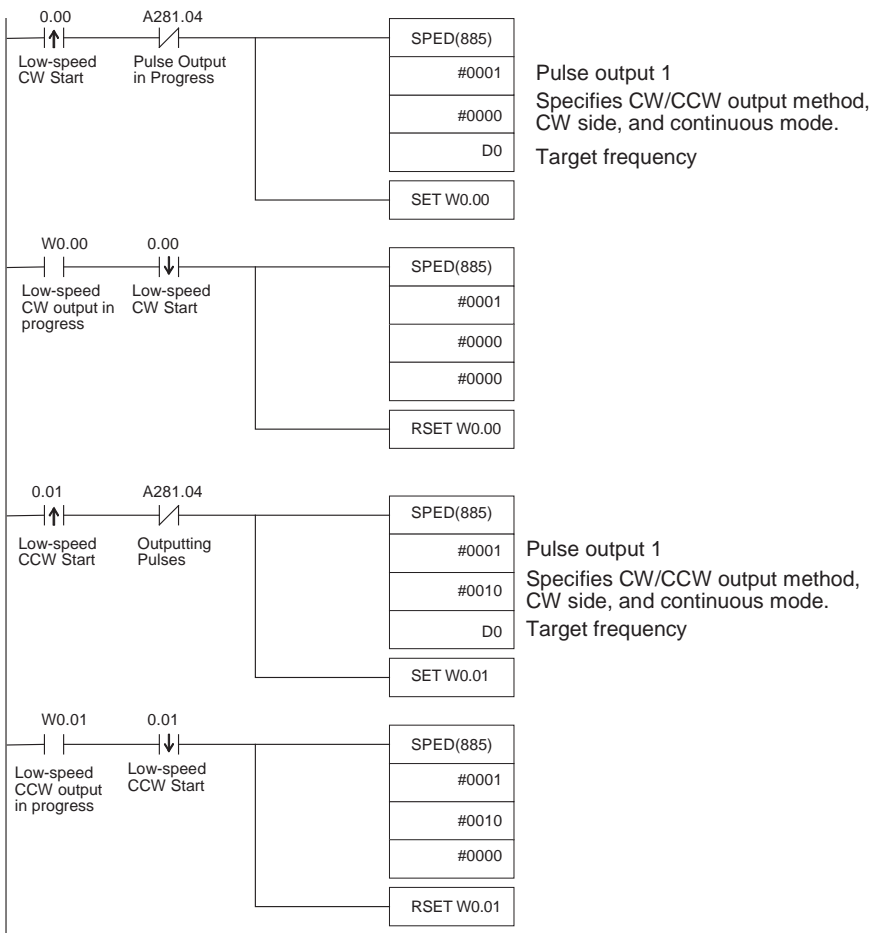
### DM Area Settings

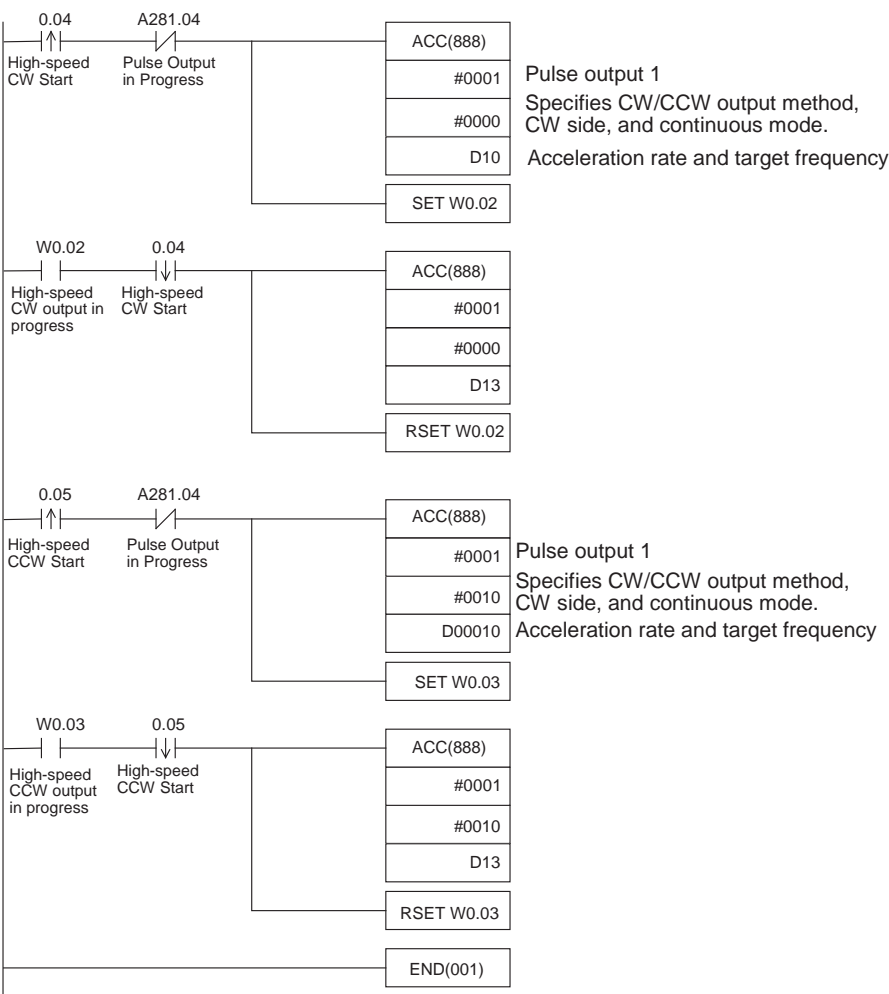
#### Settings to Control Speed while Jogging (D0 to D1 and D10 to D15)

| Setting details                        | Address | Data |
|--|---------|------|
| Target frequency (low speed): 1,000 Hz | D0      | 03E8 |
|  | D1      | 0000 |
| Acceleration rate: 100 Hz/4 ms         | D10     | 0064 |

| Setting details                            | Address | Data |
|--|---------|------|
| Target frequency (high speed): 100,000 Hz  | D011    | 86A0 |
|  | D12     | 0001 |
| Deceleration rate: 100 Hz/4 ms (Not used.) | D13     | 0064 |
| Target frequency (stop): 0 Hz              | D14     | 0000 |
|  | D15     | 0000 |

Ladder Program





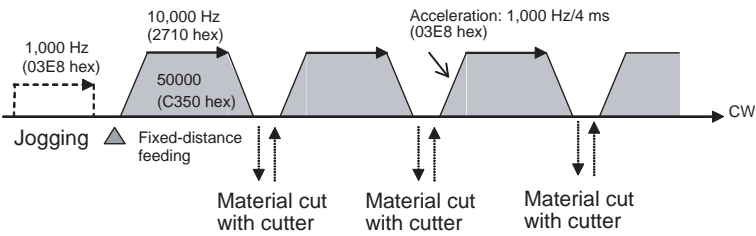
**Remarks** PLS2(887) can be used to set a starting frequency or unequal acceleration and deceleration rates, but there are limitations on the operating range because the end point must be specified in PLS2(887).

**Cutting Long Material Using Fixed Feeding**

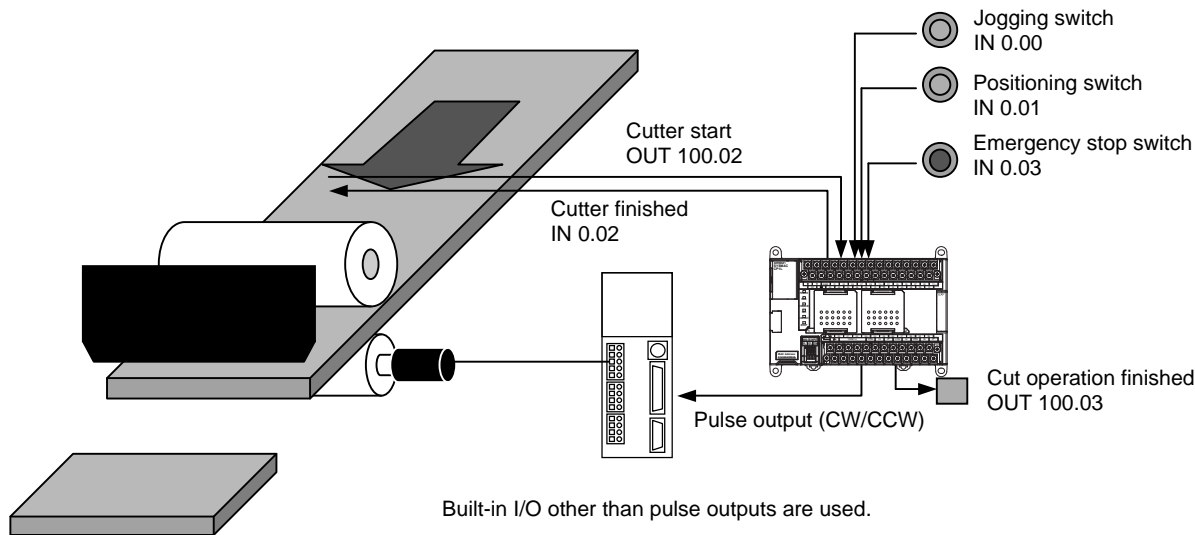
**Specifications and Operation**

■ **Outline**

In this example, first jogging is used to position the material and then fixed-distance positioning is used to feed the material.



■ **System Configuration**



■ **Operation**

- 1,2,3...
1. The workpiece is set at the starting position using the Jogging Switch Input (IN 0.00).
  2. The workpiece is feed the specified distance (relative) using the Positioning Switch Input (IN 0.01).
  3. When feeding has been completed, the cutter is activated using the Cutter Start Output (OUT 100.02).
  4. Feeding is started again when the Cutter Finished Input (IN 0.02) turns ON.
  5. The feeding/cutting operation is repeated for the number of times specified for the counter (C0, 100 times).
  6. When the operation has been completed, the Cutting Operation Finished Output (OUT 100.03). is turned ON.

The feeding operation can be canceled and operation stopped at any point using the Emergency Switch Input (IN 0.03).

**Instructions Used**

SPED(885)  
PLS2(887)

**Preparation**

■ **PLC Setup**

There are no settings that need to be made in the PLC Setup.

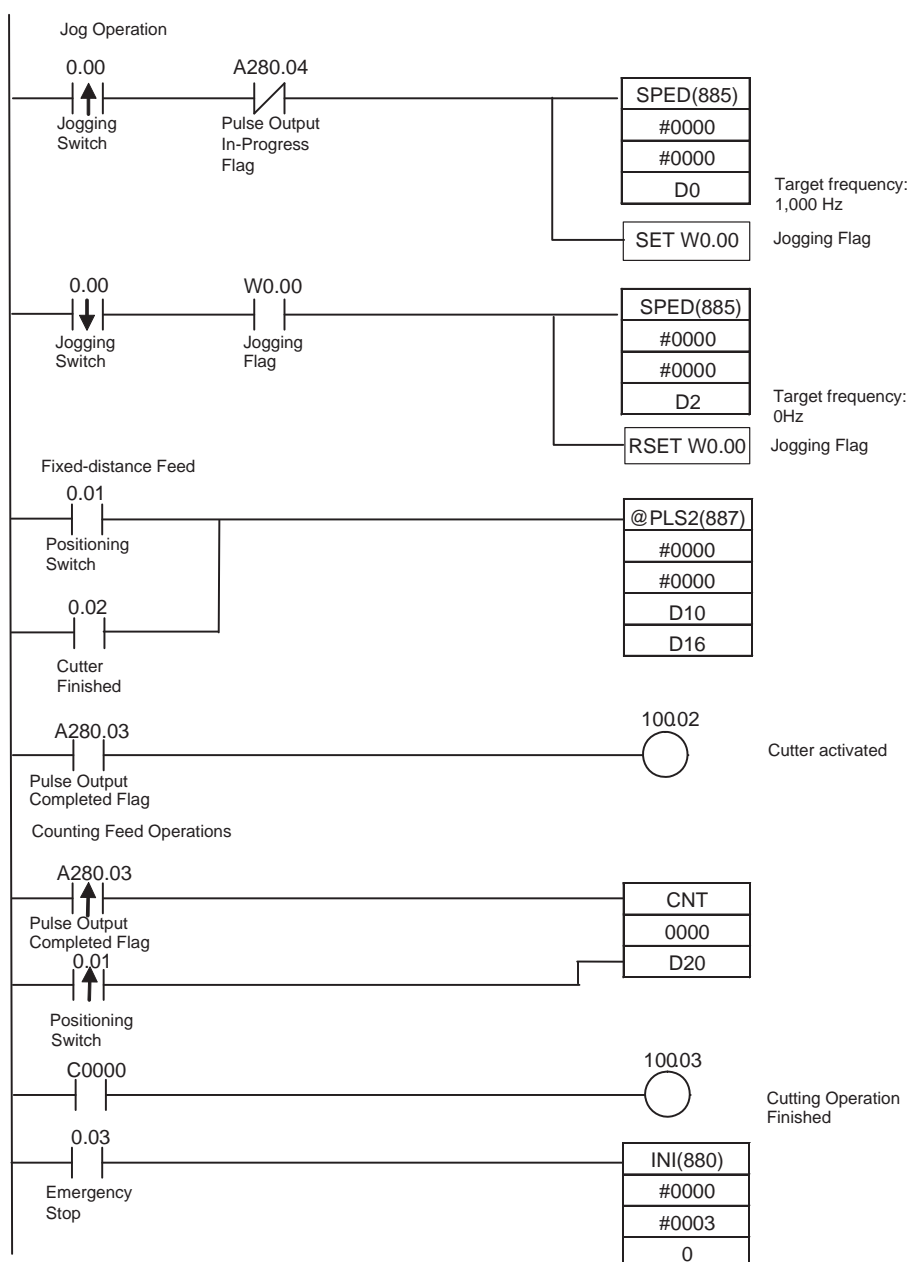
■ **DM Area Settings**

**Speed Settings for Jogging (D0 to D3)**

| Setting details            | Address | Data |
|----------------------------|---------|------|
| Target frequency: 1,000 Hz | D0      | 03E8 |
|                            | D1      | 0000 |
| Target frequency: 0 Hz     | D2      | 0000 |
|                            | D3      | 0000 |

**Settings for PLS2(887) for Fixed-distance Feeding (D10 to D20)**

| Setting details                        | Address | Data |
|--|---------|------|
| Acceleration rate: 1,000 Hz/4 ms       | D10     | 03E8 |
| Deceleration rate: 1,000 Hz/4 ms       | D11     | 03E8 |
| Target frequency: 10,000 Hz            | D12     | 2710 |
|  | D13     | 0000 |
| Number of output pulses: 50,000 pulses | D14     | C350 |
|  | D15     | 0000 |
| Starting frequency: 0000 Hz            | D16     | 0000 |
|  | D17     | 0000 |
| Counter setting: 100 times             | D20     | 0100 |

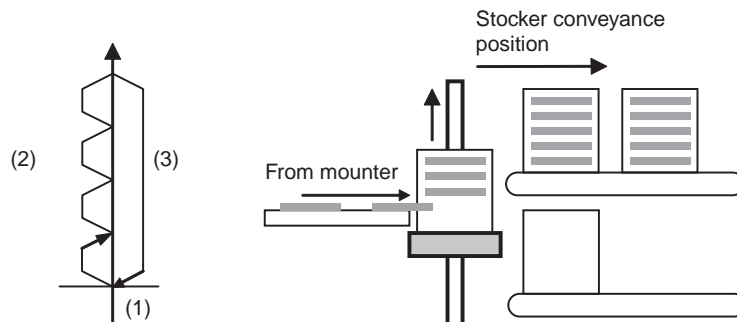
**Ladder Program**

## Remarks

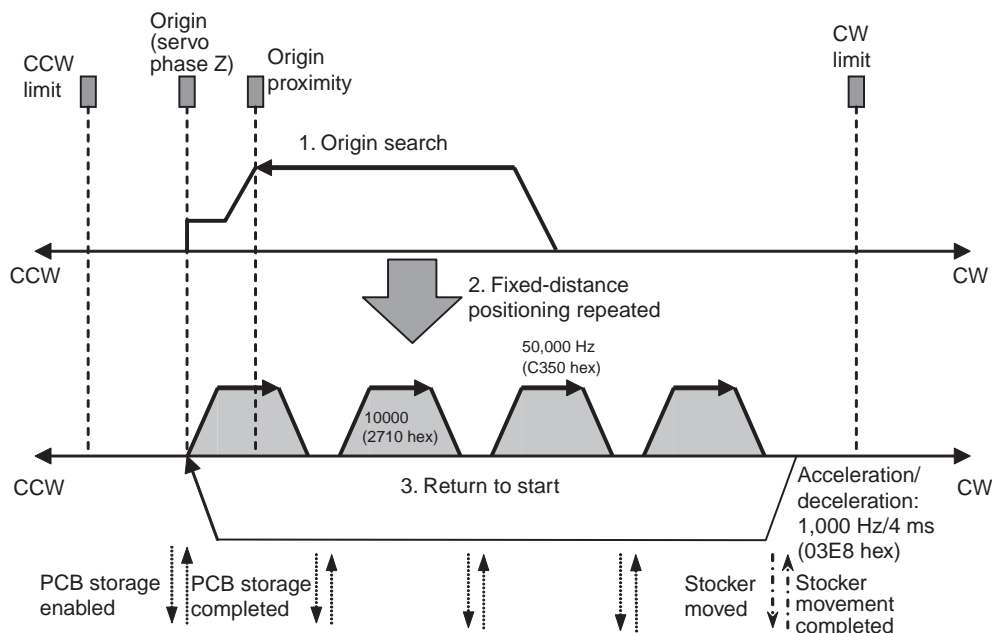
- 1,2,3... 1. PLS22(887) used a relative pulse setting. This enables operation even if the origin is not defined. The present position in A276 (lower 4 digits) and A277 (upper 4 digits) is set to 0 before pulse output and then contains the specified number of pulses.
2. ACC(888) can be used instead of SPED(885) for the jog operation. If ACC(888) is used, acceleration/deceleration can be included in the jog operation.

**Vertically Conveying PCBs (Multiple Progressive Positioning)****Specifications and Operation****■ Outline**

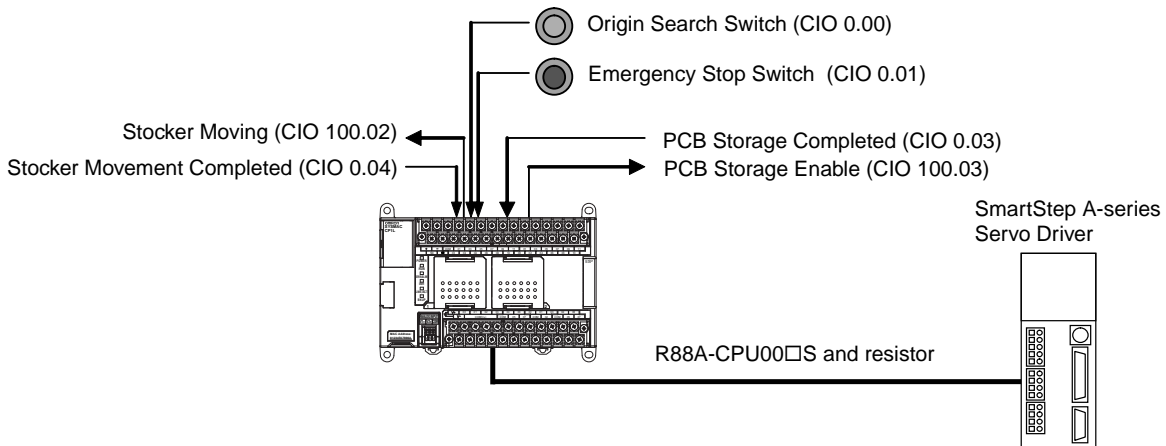
- 1,2,3... 1. PCBs with components mounted are stored in a stocker.
2. When a stocker becomes full, it is moved to the conveyance point.

**Positioning Operation for Vertical Conveyor****■ Operation Pattern**

- 1,2,3... 1. An origin search is performed.
2. Fixed-distance positioning is repeated.
3. The system is returned to the original position.

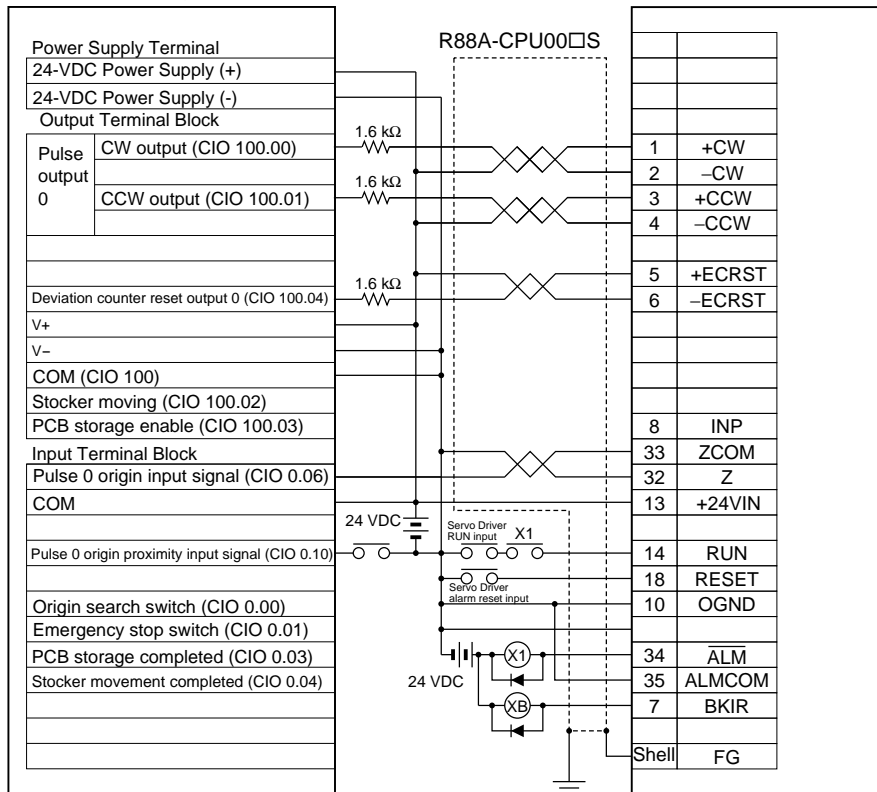


## Wiring Example Using SmartStep A-series Servo Driver



CP1L-EM40/30DT-D, CP1L-EL20DT-D

SMARTSTEP A-series Servo Driver



## Operation

- 1,2,3...**
1. An origin search is performed using the Origin Search Switch (CIO 0.00).
  2. When the origin search is finished, the PCB Storage Enabled Output (CIO 100.03) is turned ON.
  3. When a PCB has been stored, the stoker is raised (relative positioning) using the PCB Storage Completed Input (CIO 0.03).
  4. Storing PCBs is repeated until the stoker is full.
  5. The number of PCBs in the stoker is counted with counter C0 by counting the number of times the stoker is raised.

6. When the stocker is full, it is moved (CIO 100.02) and only the conveyor is lowered (absolute positioning) when stoker movement is completed (CIO 0.04).

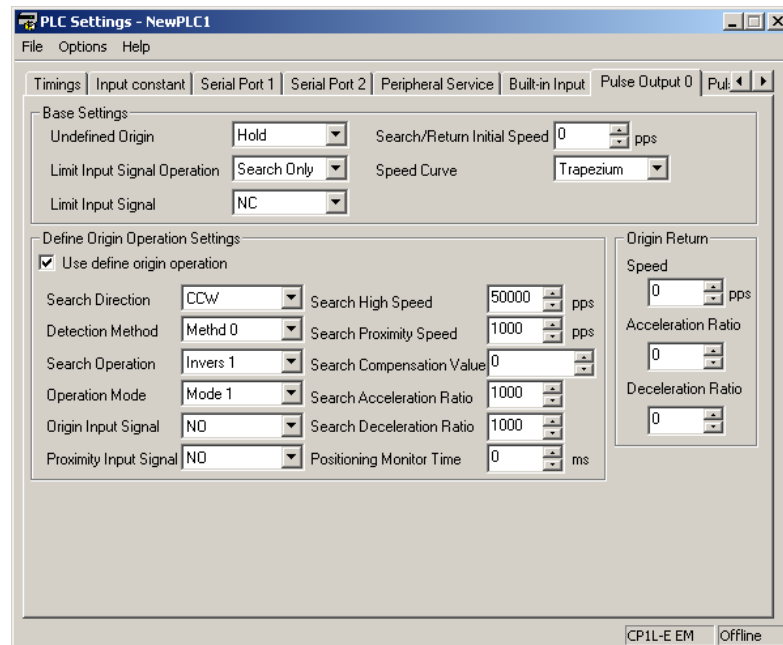
The operation can be canceled and pulse output stopped at any point using the Emergency Switch Input (CIO 0.01).

## Preparation

### ■ PLC Setup

| Setting details                                   |
|---|
| Enable origin search function for pulse output 0. |

**Note** The origin search enable setting is read when the power supply is turned ON.



## DM Area Settings

### Settings for PLS2(887) for Fixed-distance Positioning (D0 to D7)

| Setting details                        | Address | Data |
|--|---------|------|
| Acceleration rate: 1,000 Hz/4 ms       | D0      | 03E8 |
| Deceleration rate: 1,000 Hz/4 ms       | D1      | 03E8 |
| Target frequency: 50,000 Hz            | D2      | C350 |
|  | D3      | 0000 |
| Number of output pulses: 10,000 pulses | D4      | 2710 |
|  | D5      | 0000 |
| Starting frequency: 0 Hz               | D6      | 0000 |
|  | D7      | 0000 |

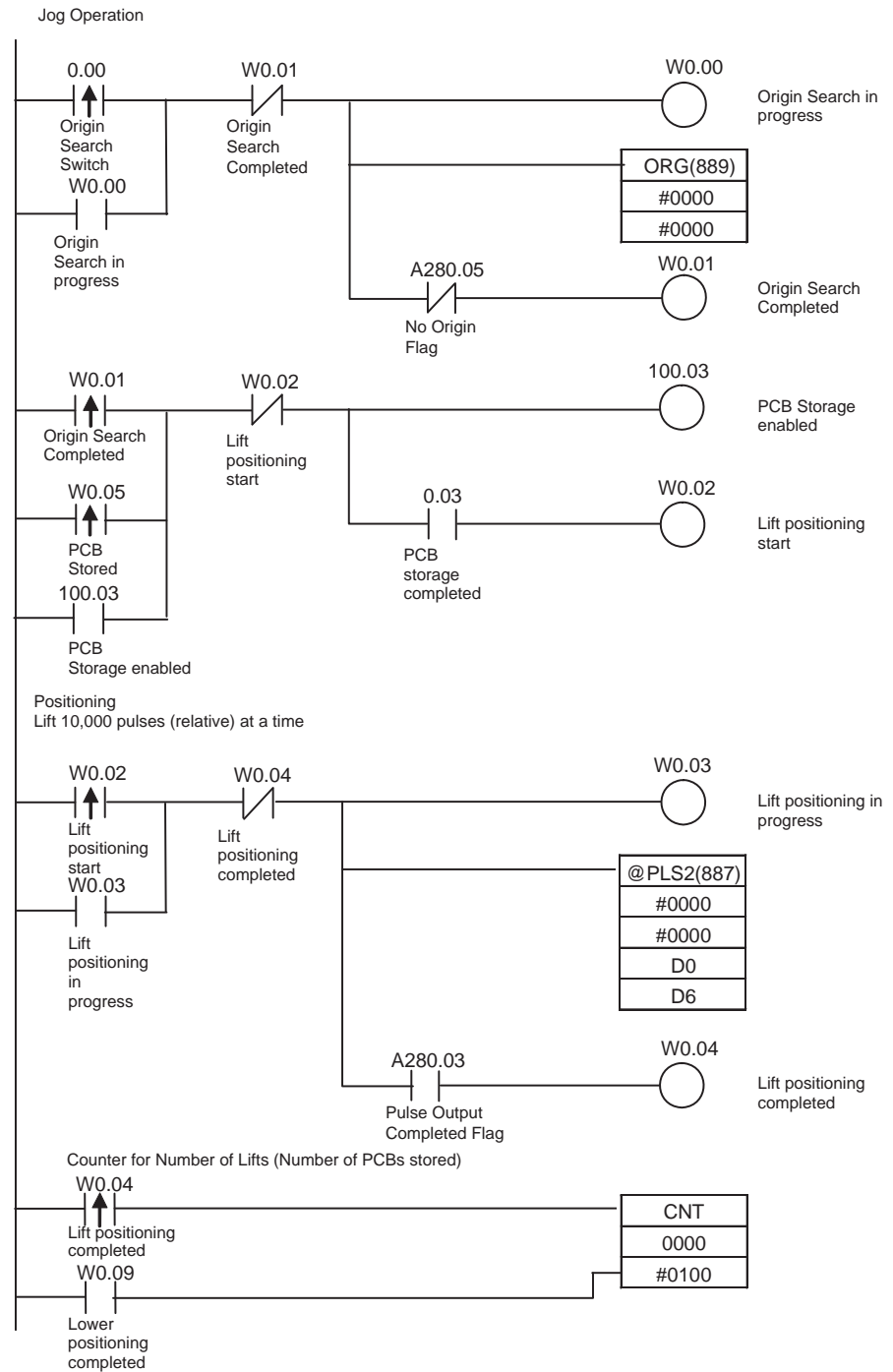


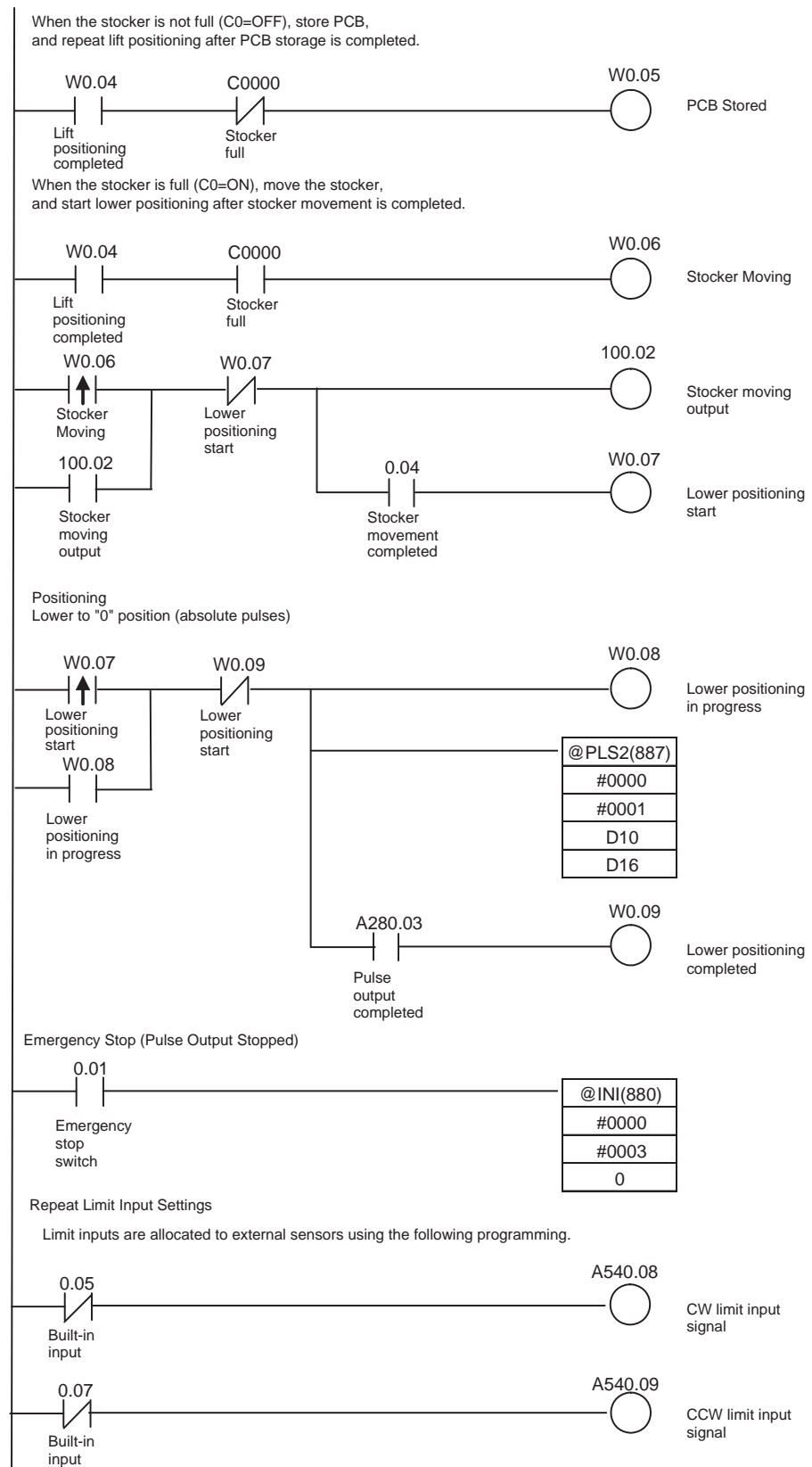
**Settings for PLS2(887) to Return to Start (D10 to D17)**

| Setting details                             | Address | Data |
|---|---------|------|
| Acceleration rate: 300 Hz/4 ms              | D10     | 012C |
| Deceleration rate: 200 Hz/4 ms              | D11     | 00C8 |
| Target frequency: 50,000 Hz                 | D12     | C350 |
|   | D13     | 0000 |
| Number of output pulses: 10,000 × 15 pulses | D14     | 49F0 |
|   | D15     | 0002 |
| Starting frequency: 100 Hz                  | D16     | 0000 |
|   | D17     | 0000 |

**Number of Repeats of Fixed-distance Positioning Operation (D20)**

| Setting details  | Address | Data |
|--|---------|------|
| Number of repeats of fixed-distance positioning operation<br>(number of PCBs in stocker) | D20     | 0015 |

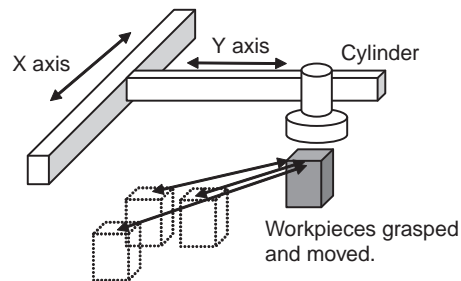
**Ladder Program**



## Palletize: Two-axis Multipoint Positioning

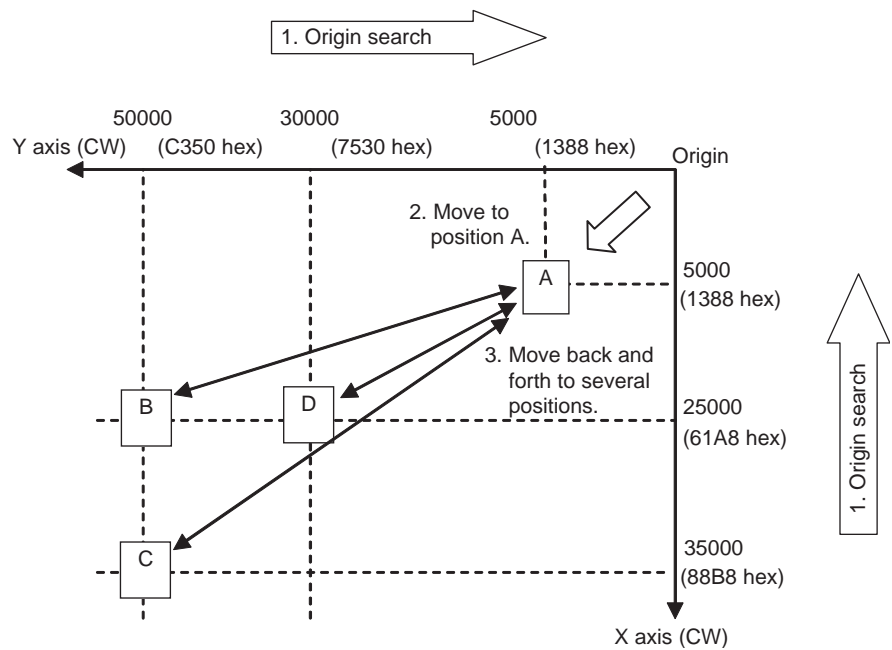
### Specifications and Operation

#### ■ Outline



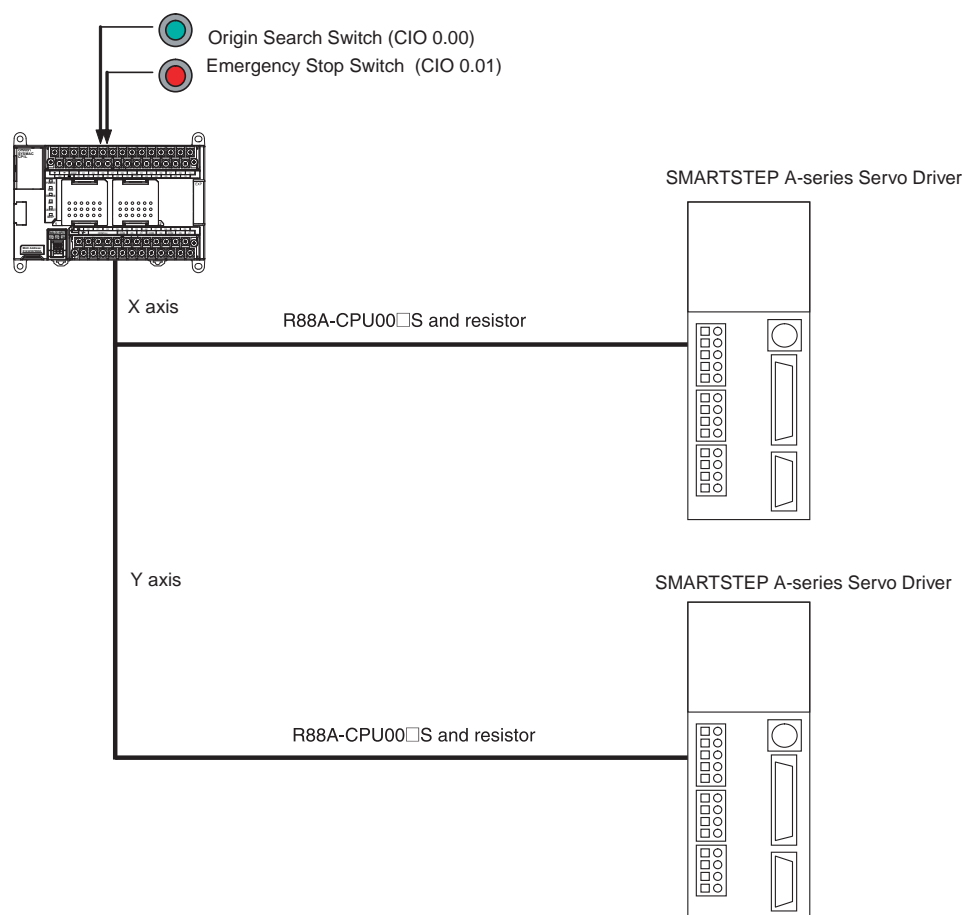
#### ■ Operation Pattern

- 1,2,3...
1. An origin search is performed.
  2. A workpiece is grasped and moved to position A.
  3. The workpiece is grasped at one position and moved back and forth to several assembly positions.



**Note** The X and Y axes are moved independently, i.e., interpolation is not performed.

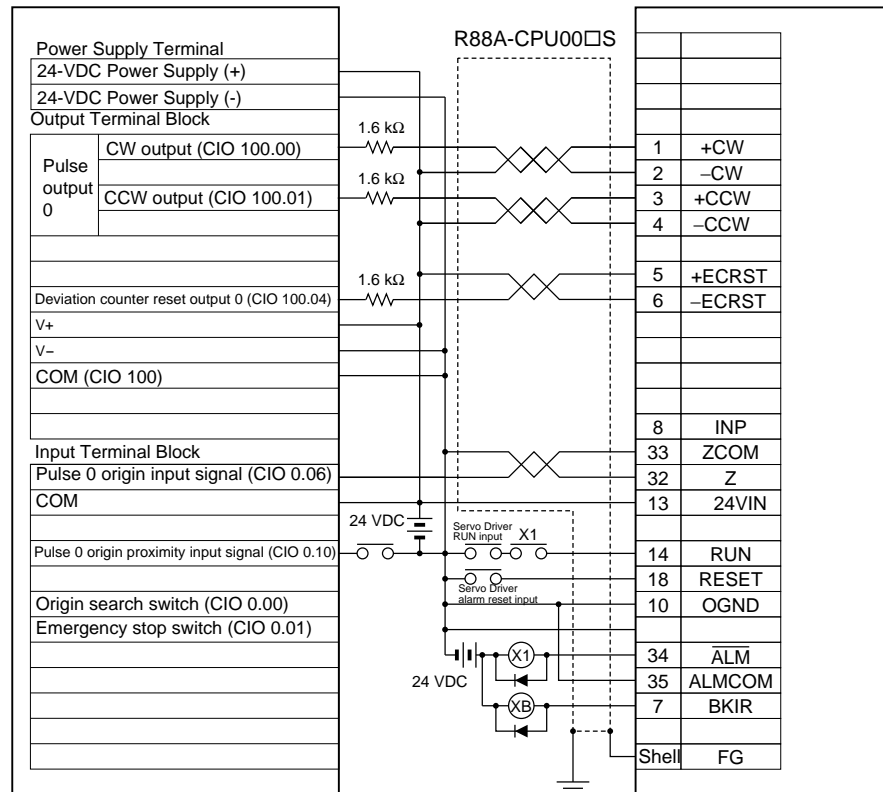
## Wiring Example Using SmartStep A-series Servo Driver



## X Axis

CP1L-EM40/30DT-D, CP1L-EL20DT-D

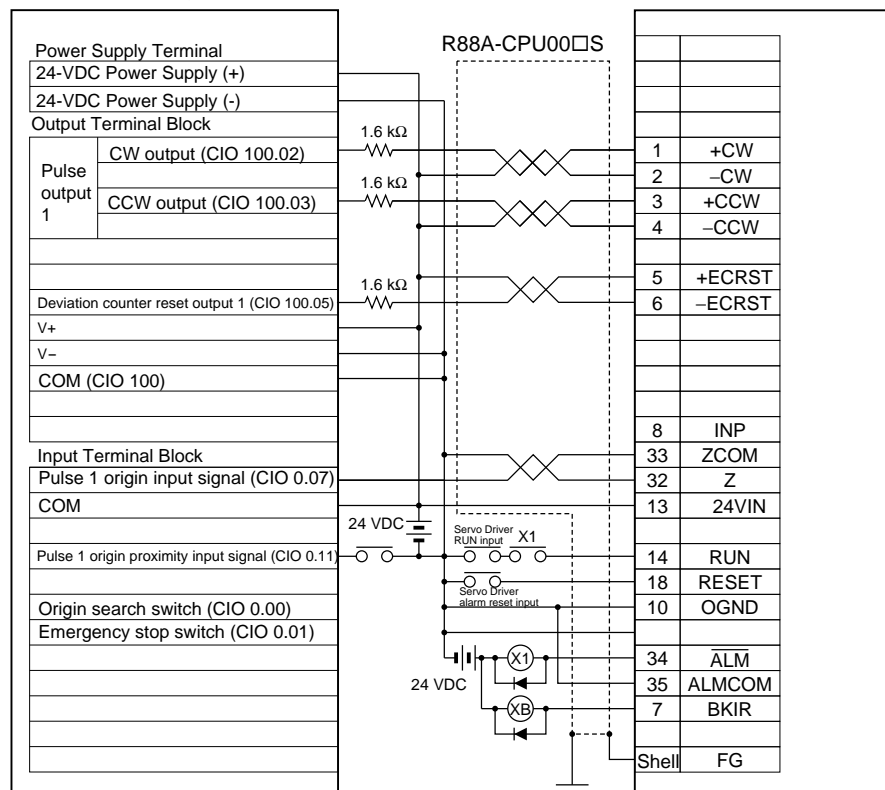
SMARTSTEP A-series Servo Driver



## Y Axis

CP1L-EM40/30DT-D, CP1L-EL20DT-D

SMARTSTEP A-series Servo Driver



## Operation

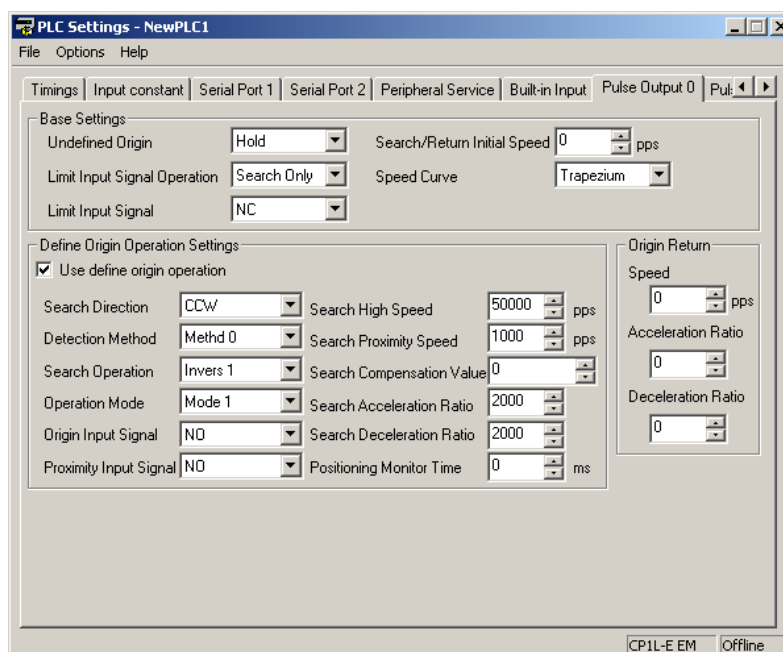
- 1,2,3...
1. An origin search is performed using the Origin Search Switch (CIO 0.00).
  2. When the origin search is finished, the following operations are performed continuously.  
Move to A.  
Move to B and return to A.  
Move to C and return to A.  
Move to D and return to A.
  3. An emergency stop can be performed using the Emergency Stop Input (CIO 0.01)

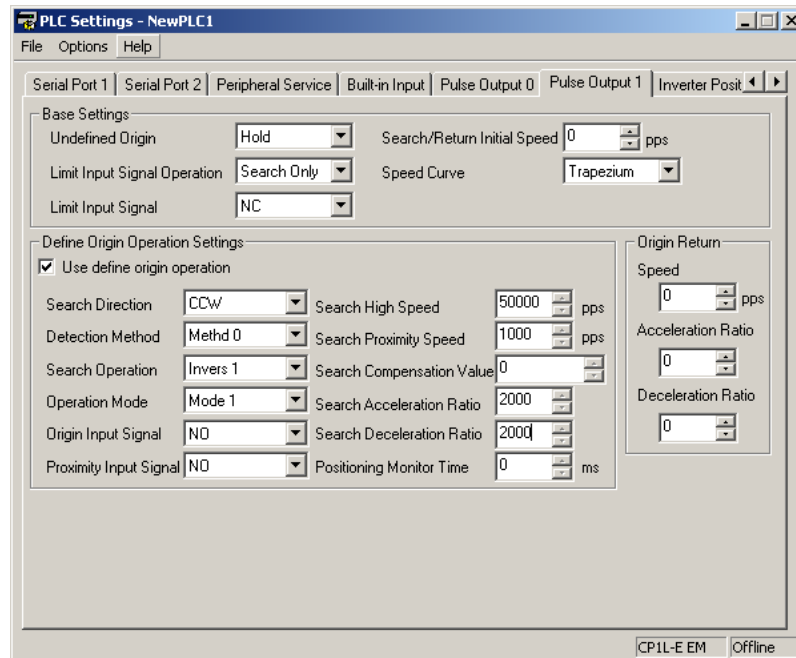
## Preparation

## ■ PLC Setup

| Setting details   |
|---|
| Enable origin search function for pulse output 0 and 1. |

**Note** The origin search enable setting is read when the power supply is turned ON.





### ■ DM Area Settings

#### Starting Frequency

| Setting details           | Address | Data |
|---------------------------|---------|------|
| X-axis starting frequency | D0      | 0000 |
| Y-axis starting frequency | D2      | 0000 |

#### PLS2(887) Settings to Move from Origin to Position A

| Setting details |                                       | Address | Data |
|-----------------|---------------------------------------|---------|------|
| X axis          | Acceleration rate: 2,000 Hz/4 ms      | D10     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms      | D11     | 07D0 |
|                 | Target frequency: 100,000 Hz          | D12     | 86A0 |
|                 |                                       | D13     | 0001 |
|                 | Number of output pulses: 5,000 pulses | D14     | 1388 |
|                 |                                       | D15     | 0000 |
| Y axis          | Acceleration rate: 2,000 Hz/4 ms      | D20     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms      | D21     | 07D0 |
|                 | Target frequency: 100,000 Hz          | D22     | 86A0 |
|                 |                                       | D23     | 0001 |
|                 | Number of output pulses: 5,000 pulses | D24     | 1388 |
|                 |                                       | D25     | 0000 |

#### PLS2(887) Settings to Move from Position A to Position B

| Setting details |  | Address | Data |
|-----------------|--|---------|------|
| X axis          | Acceleration rate: 2,000 Hz/4 ms       | D30     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms       | D31     | 07D0 |
|                 | Target frequency: 100,000 Hz           | D32     | 86A0 |
|                 |  | D33     | 0001 |
|                 | Number of output pulses: 25,000 pulses | D34     | 61A8 |
|                 |  | D35     | 0000 |



| Setting details |  | Address | Data |
|-----------------|--|---------|------|
| Y axis          | Acceleration rate: 2,000 Hz/4 ms       | D40     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms       | D41     | 07D0 |
|                 | Target frequency: 100,000 Hz           | D42     | 86A0 |
|                 |  | D43     | 0001 |
|                 | Number of output pulses: 50,000 pulses | D44     | C350 |
|                 |  | D45     | 0000 |

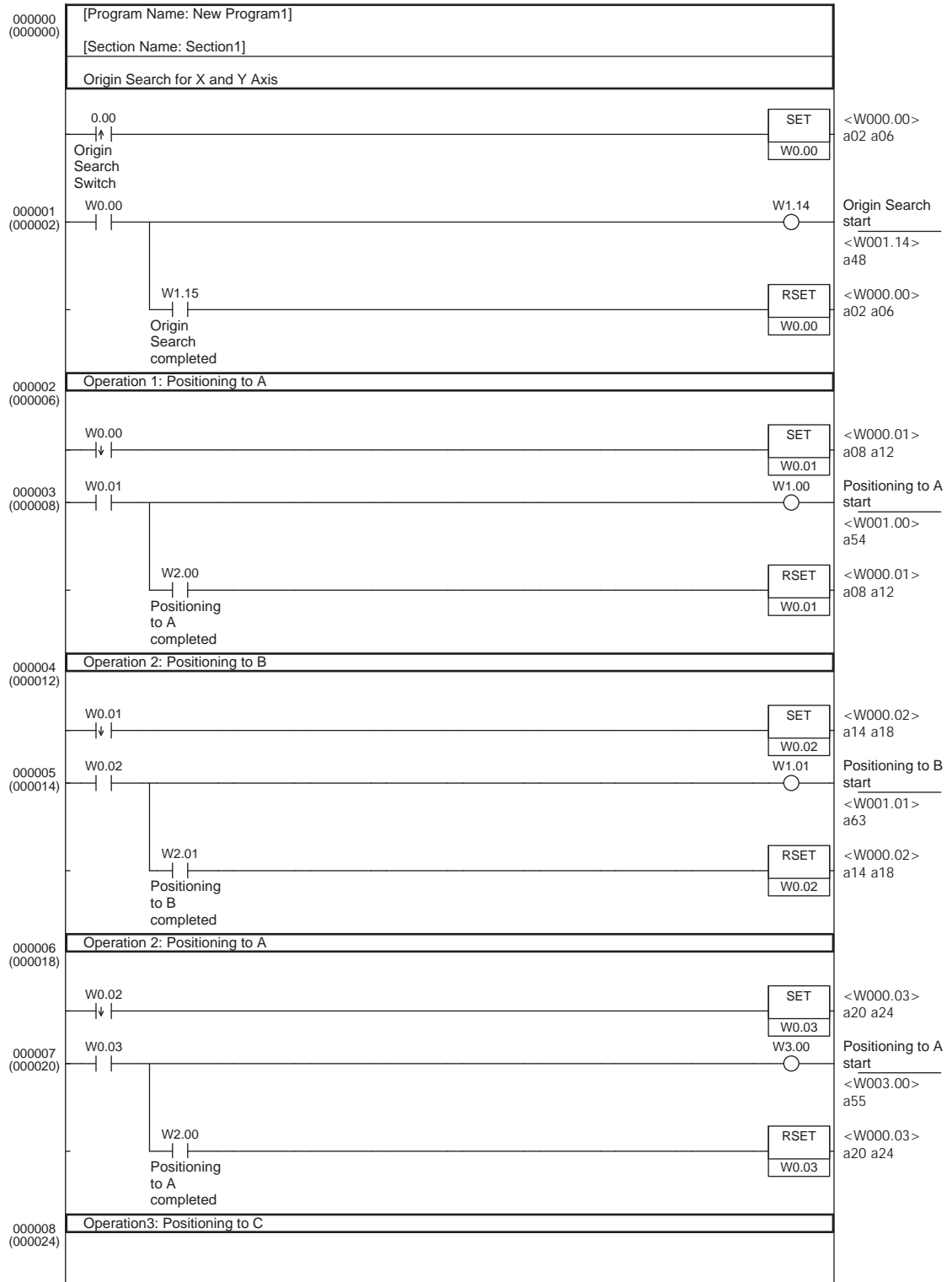
**PLS2(887) Settings to Move from Position A to Position C**

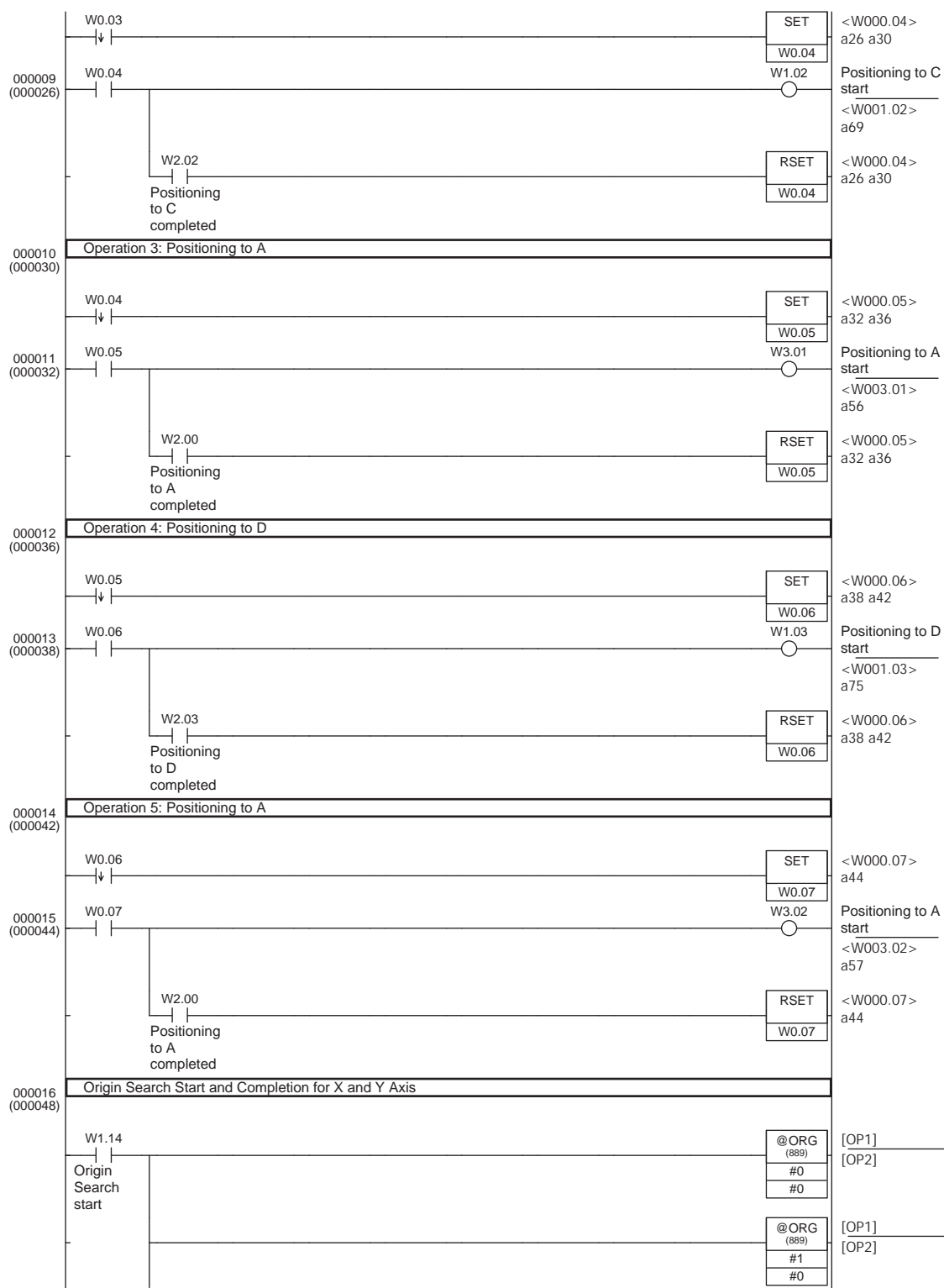
| Setting details |  | Address | Data |
|-----------------|--|---------|------|
| X axis          | Acceleration rate: 2,000 Hz/4 ms       | D50     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms       | D51     | 07D0 |
|                 | Target frequency: 100,000 Hz           | D52     | 86A0 |
|                 |  | D53     | 0001 |
|                 | Number of output pulses: 35,000 pulses | D54     | 88B8 |
|                 |  | D55     | 0000 |
| Y axis          | Acceleration rate: 2,000 Hz/4 ms       | D60     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms       | D61     | 07D0 |
|                 | Target frequency: 100,000 Hz           | D62     | 86A0 |
|                 |  | D63     | 0001 |
|                 | Number of output pulses: 50,000 pulses | D64     | C350 |
|                 |  | D65     | 0000 |

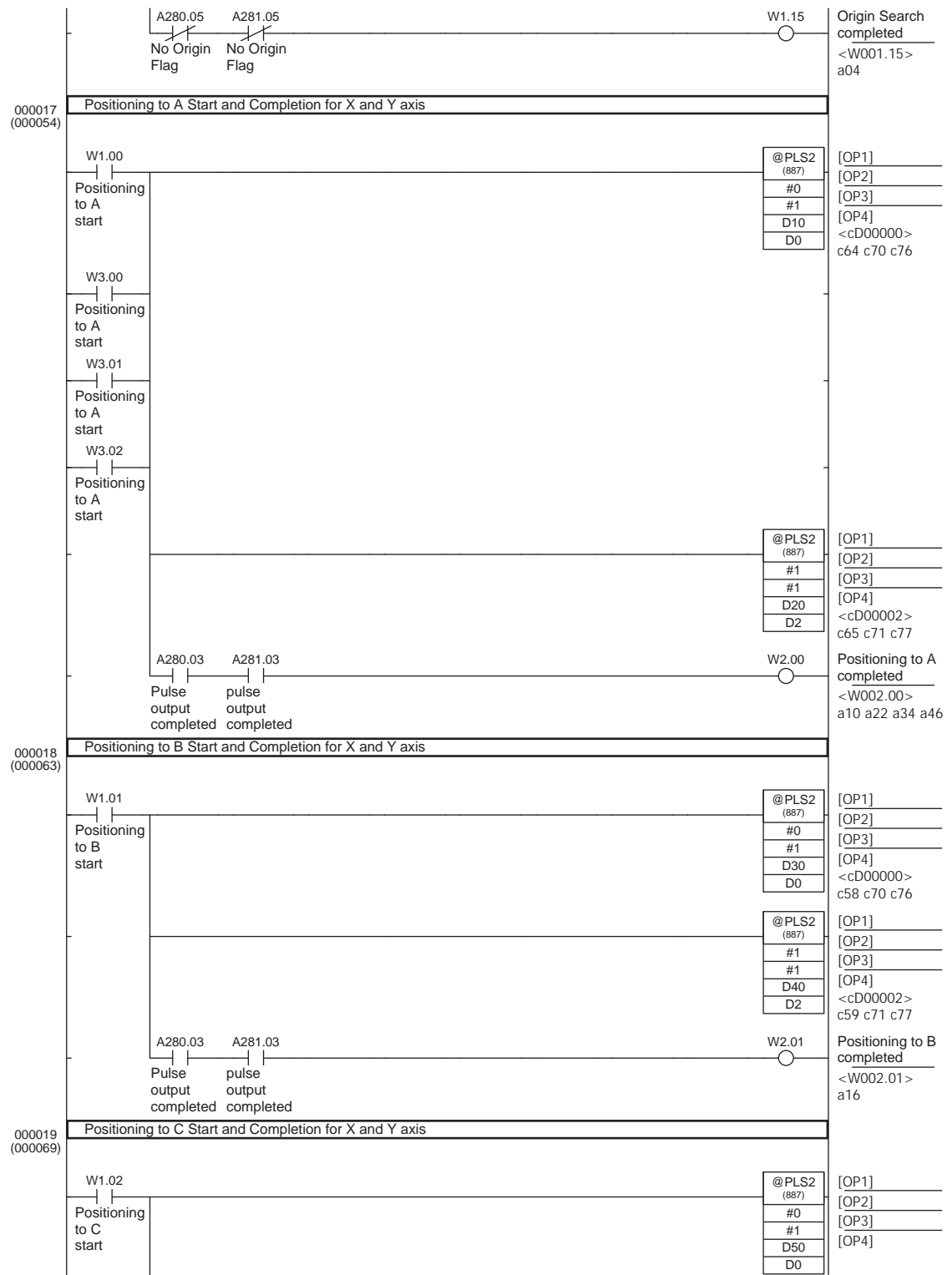
**PLS2(887) Settings to Move from Position A to Position D**

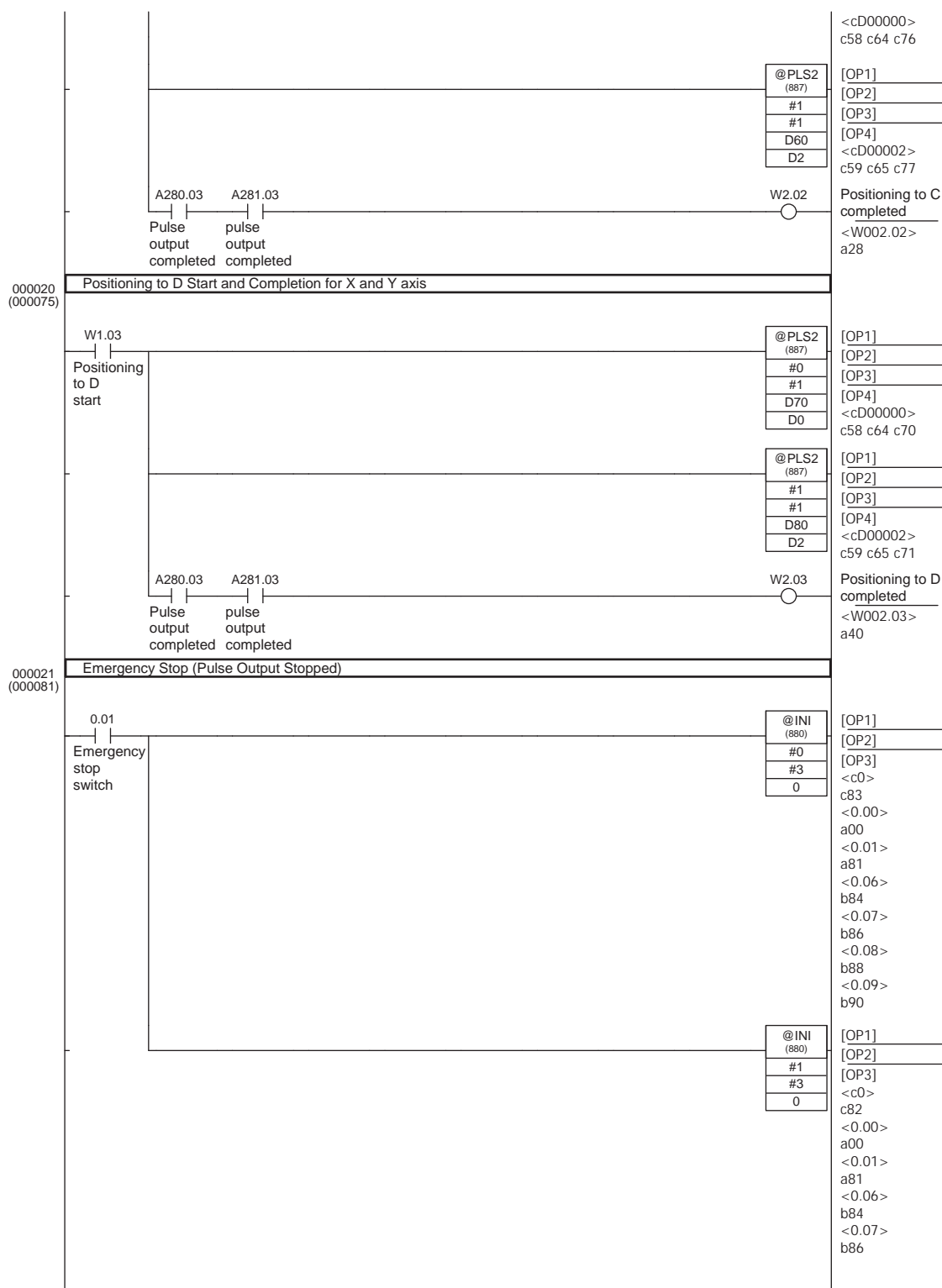
| Setting details |  | Address | Data |
|-----------------|--|---------|------|
| X axis          | Acceleration rate: 2,000 Hz/4 ms       | D70     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms       | D71     | 07D0 |
|                 | Target frequency: 100,000 Hz           | D72     | 86A0 |
|                 |  | D73     | 0001 |
|                 | Number of output pulses: 25,000 pulses | D74     | 61A8 |
|                 |  | D75     | 0000 |
| Y axis          | Acceleration rate: 2,000 Hz/4 ms       | D80     | 07D0 |
|                 | Deceleration rate: 2,000 Hz/4 ms       | D81     | 07D0 |
|                 | Target frequency: 100,000 Hz           | D82     | 86A0 |
|                 |  | D83     | 0001 |
|                 | Number of output pulses: 30,000 pulses | D84     | 7530 |
|                 |  | D85     | 0000 |

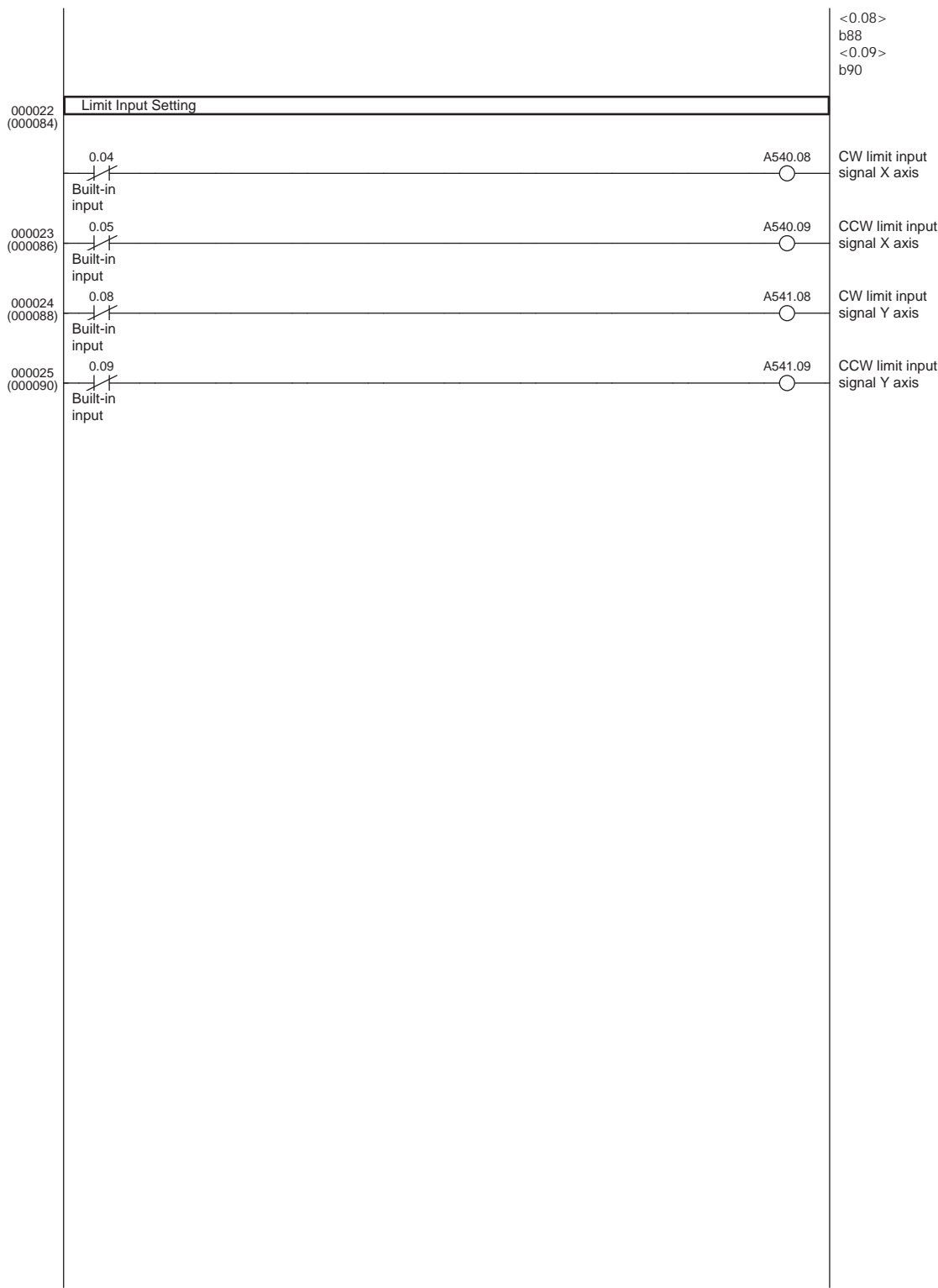
## Ladder Program







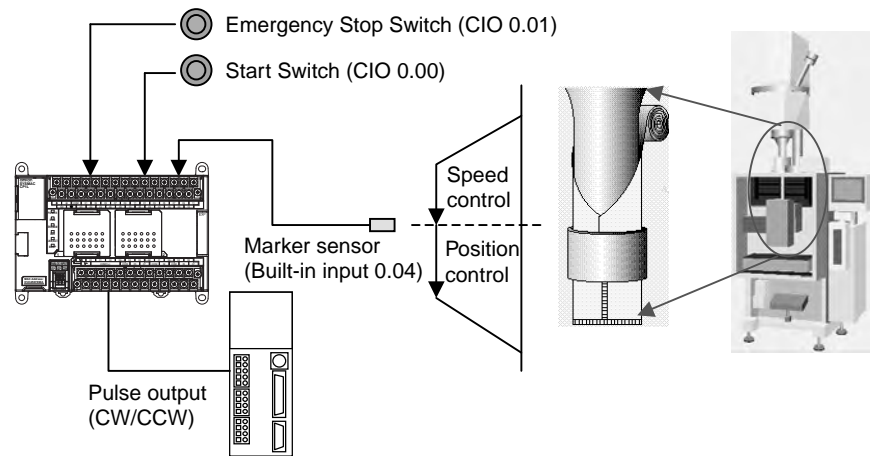




## Feeding Wrapping Material: Interrupt Feeding

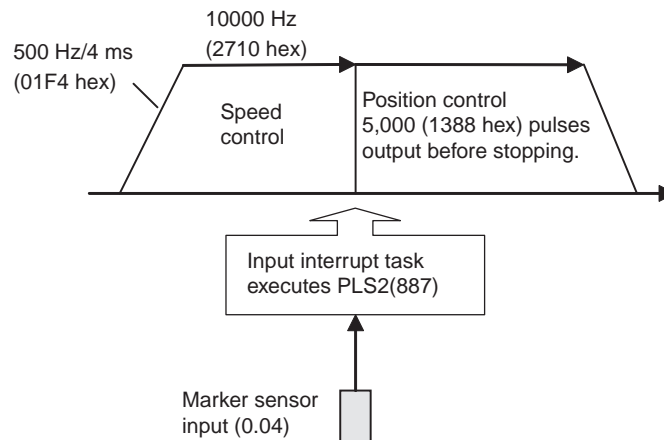
### Specifications and Operation

### Feeding Wrapping Material in a Vertical Pillow Wrapper



### ■ Operation Pattern

Speed control is used to feed wrapping material to the initial position. When the marker sensor input is received, fixed-distance positioning is performed before stopping.



### ■ Operation

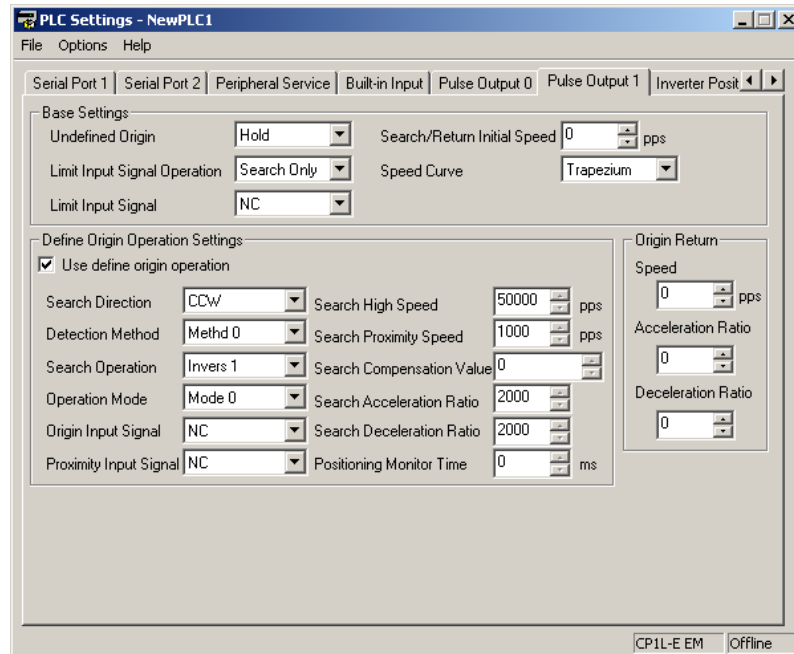
- 1,2,3... 1. Speed control is used to feed wrapping material to the initial position when the Start Switch (CIO 0.00) is activated.
2. When the Marker Sensor Input (0.04) is received, PLS2(887) is executed in interrupt task 140.
3. Fixed-distance positioning is executed with PLS2(887) before stopping.
4. An emergency stop is executed to stop pulse output with the Emergency Stop input (0.01).

## Preparation

■ **PLC Setup**

| Setting details  |
|--|
| Enable using built-in input IN0 as an interrupt input. |

**Note** The interrupt input setting is read when the power supply is turned ON.

■ **DM Area Settings****Speed Control Settings to Feed Wrapping Material to Initial Position**

| Setting details                  | Address | Data |
|----------------------------------|---------|------|
| Acceleration rate: 1,000 Hz/4 ms | D0      | 03E8 |
| Target frequency: 10,000 Hz      | D1      | 2710 |
|                                  | D2      | 0000 |

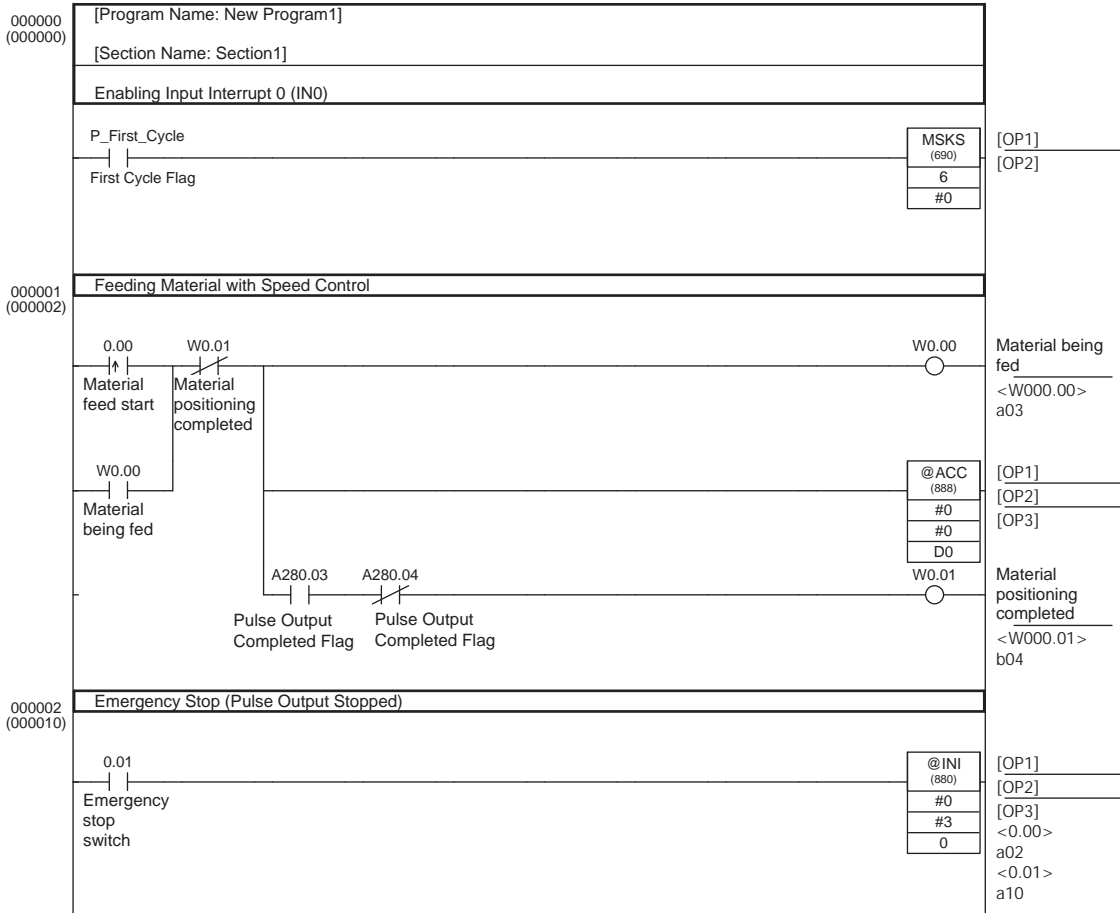
**Positioning Control Settings for Wrapping Material**

| Setting details                       | Address | Data |
|---------------------------------------|---------|------|
| Acceleration rate: 500 Hz/4 ms        | D10     | 01F4 |
| Deceleration rate: 500 Hz/4 ms        | D11     | 01F4 |
| Target frequency: 10,000 Hz           | D12     | 2710 |
|                                       | D13     | 0000 |
| Number of output pulses: 5,000 pulses | D14     | 1388 |
|                                       | D15     | 0000 |
| Starting frequency: 0 Hz              | D16     | 0000 |
|                                       | D17     | 0000 |

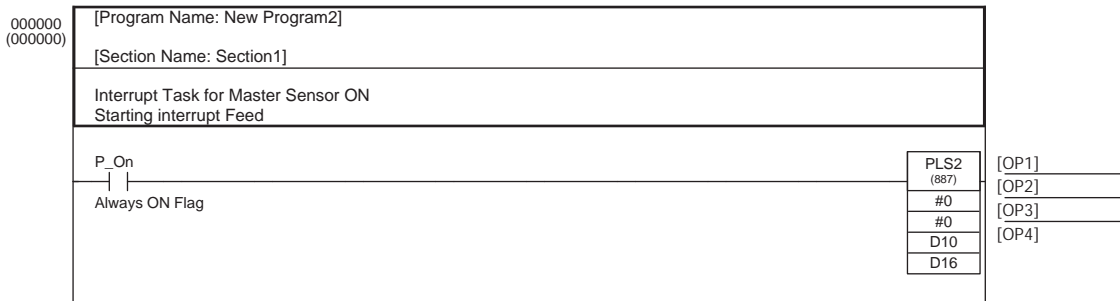


Ladder Program

Cyclic Task Program  
(Executed at Startup)



Program for Interrupt Task  
140



## 7-3 Inverter Positioning

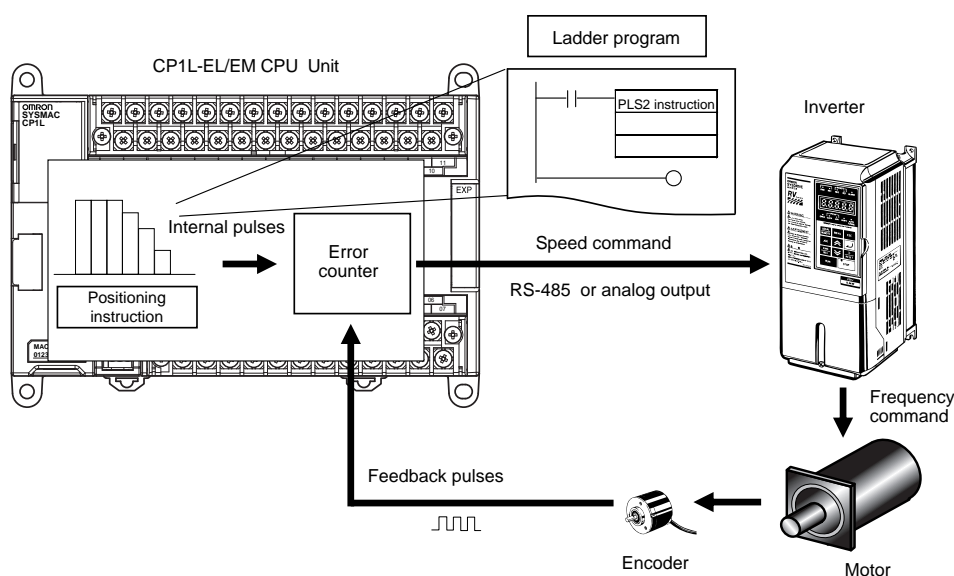
### 7-3-1 Features

Positioning can be achieved using an inverter. This enables a far more economical positioning system than with a servomotor.

#### Feedback Control with Error Counter

A position error counter built into the CP1L-EL/EM CPU Unit enables high-precision positioning with an Inverter using feedback control. The PULSE OUTPUT instruction is used in the ladder program in the CP1L-EL/EM CPU Unit to output internal pulses to a built-in error counter.

The error counter calculates the position error from the number of input internal pulses and the number of feedback pulses from the rotary encoder, and sends speed commands to the inverter so that the position error goes to zero.



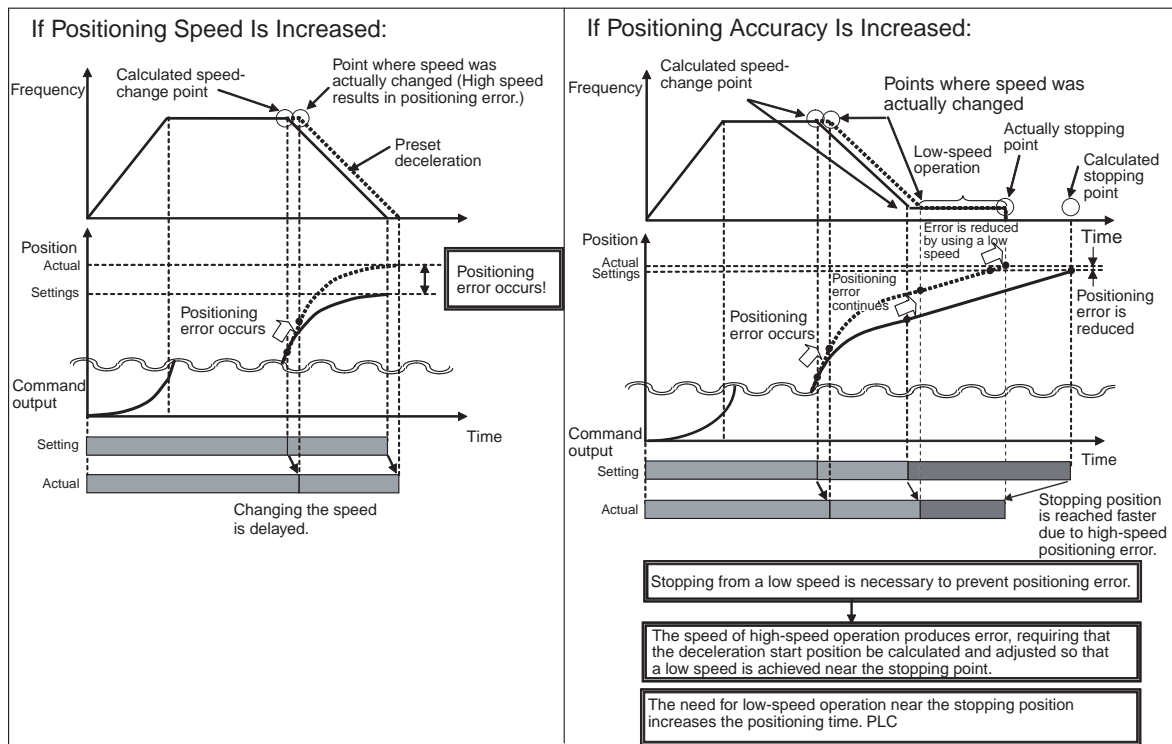
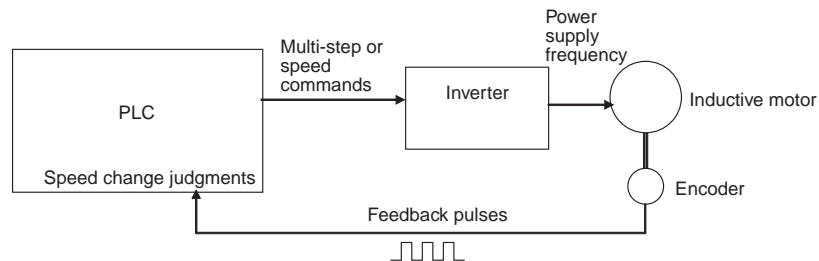
#### Reducing Positioning Time

With traditional inverter positioning, positioning patterns are created in which set positions are detected to trigger changes in the speed. Pulses are read from the encoder and compared to set values during positioning to enable determining when a position requiring a speed change has been reached. This results in positioning errors at speed-change points when stopping at high speed, reducing stopping precision. To ensure high-precision positioning, sufficient deceleration was required before stopping, but this increases the positioning time.

With the CP1L-EL/EM's inverter positioning function, feedback pulses are used so that the present position is always known, increasing positioning accuracy. And because preset positioning patterns are used for deceleration and stopping, positioning time is reduced.

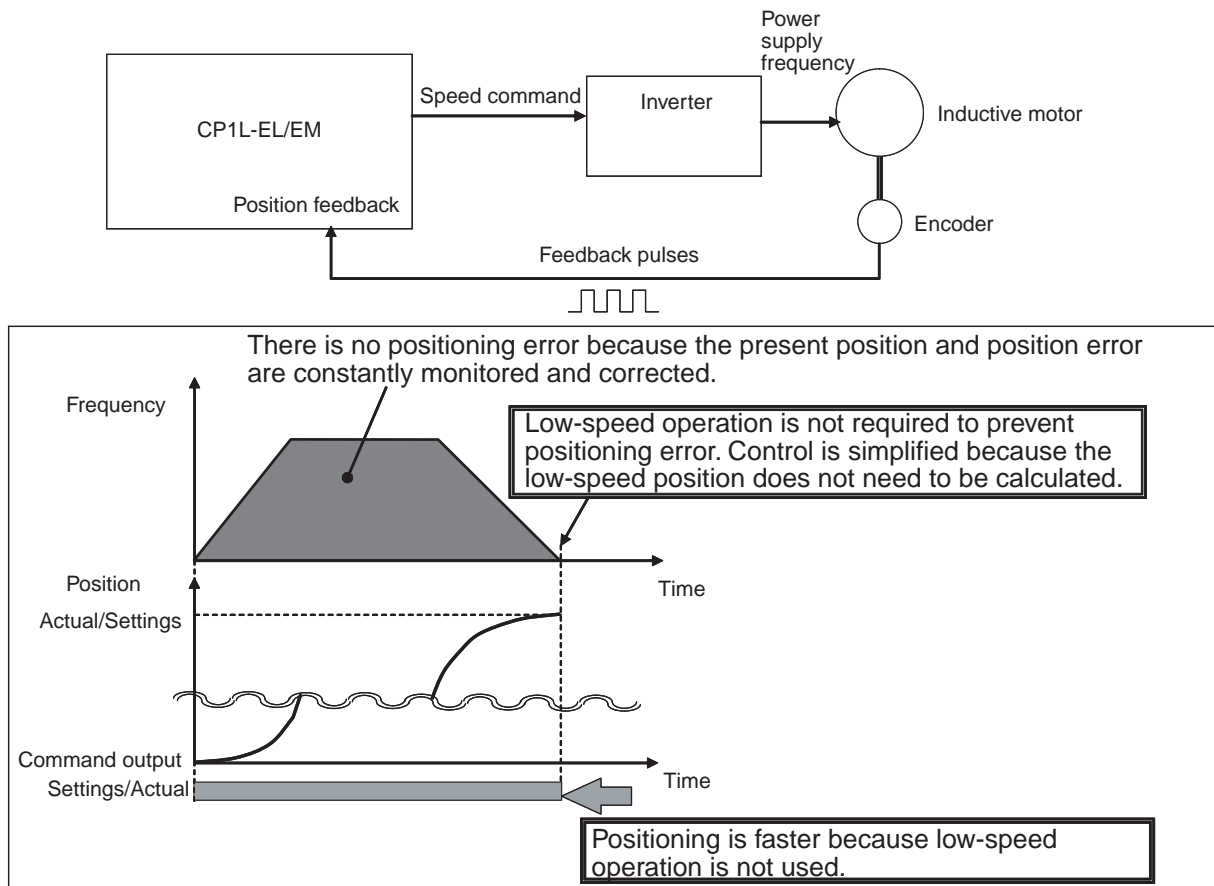
**Traditional Inverter Positioning**

The PLC counts the feedback pulses from the encoder using a high-speed counter. When a deceleration point is reached, the speed is changed to control the stop position. If the precision of the stop position must be increased, the stop position must also be detected to control positioning.



**Inverter Positioning with the CP1L-EL/EM**

With the CP1L-EL/EM's inverter positioning function, feedback is constantly read for the positioning data while controlling the position.

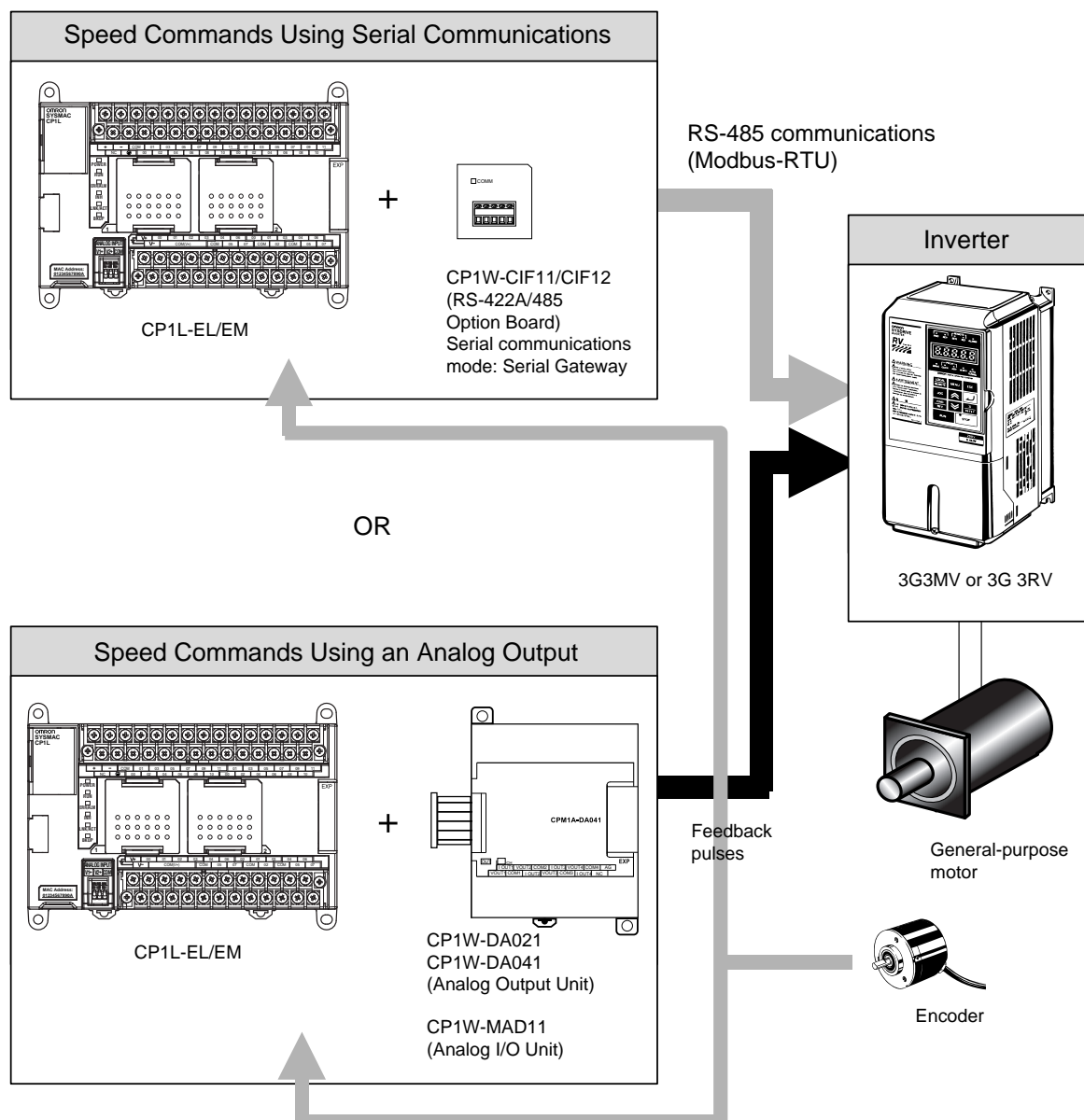
**Note**

- (1) The CP1L-EL/EM's inverter positioning function is designed to increase positioning speed and stopping precision by reading position information and using a feedback loop with an error counter to switch speeds. It does not increase the response, stopping precision, or speed change rate of the inverter and motor. These are characteristics of the inverter and motor. Refer to user documentation on your inverter and motor for details.
- (2) The corresponding pulse output number (0 or 1) cannot be used for the PULSE WITH VARIABLE DUTY FACTOR instruction (PWM) if inverter positioning 0 or 1 is used. The high-speed counter of the same number (0 or 1) is used to input the feedback pulse.

## 7-3-2 System Configuration

### Speed Commands Using Serial Communications or Analog Outputs

There are two ways to send speed commands to the inverter: serial communications and analog outputs.



**Note**

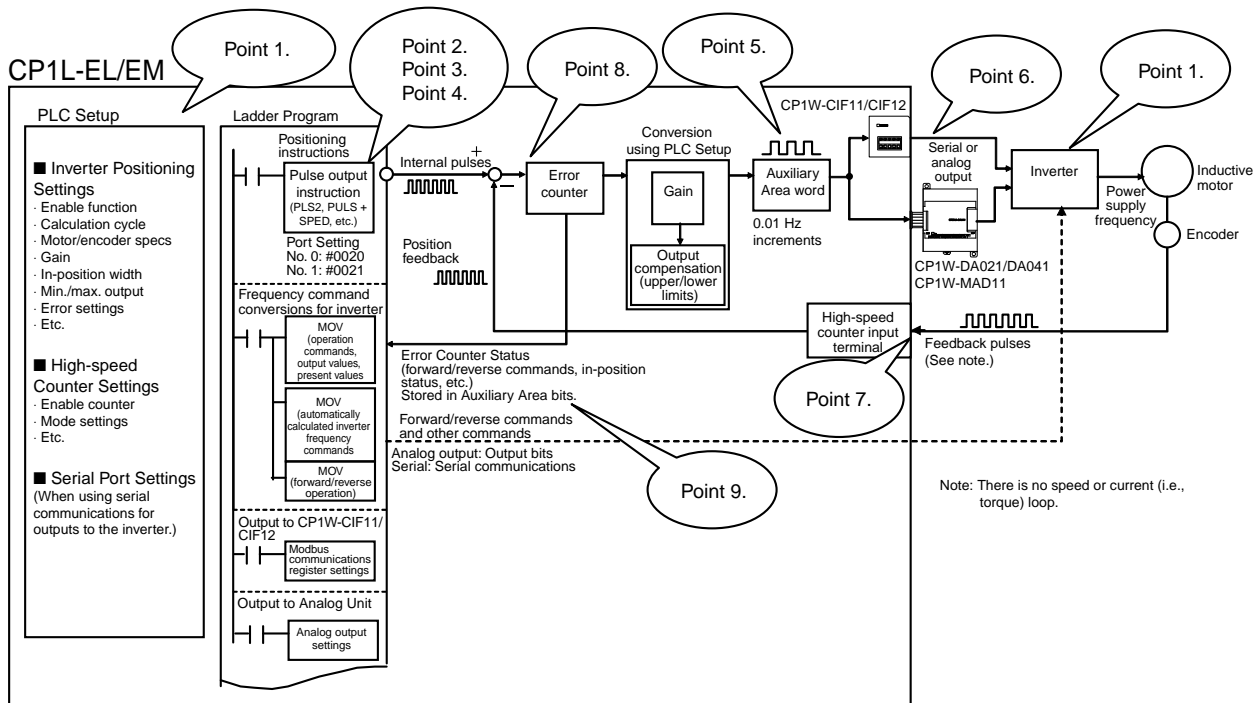
- (1) The inverter positioning function uses either serial communications or an analog output, and is thus possible with a CP1L-EL/EM CPU Unit with either transistor or relay outputs.
- (2) The inverter positioning function does not use external pulse outputs. Normal outputs are used for commands to the inverter (e.g., forward/reverse commands).

### ■ Precaution for Inverter Settings

- Set the stop time to 0 second.
- Use Modus-RTU communication when the send delay setting is above 10ms.  
However, if the send delay time is too long, the inverter response to the command from the PLC will be slow.

## 7-3-3 Functional Overview

### Operation



1. To use inverter positioning, the motor and encoder specifications, feedback gain, and other parameters must be set in the PLC Setup. The high-speed counter and inverter must also be set.
2. Pulse output instructions, such as PLS2 or PULS with SPED, are used to execute positioning. Although normally the pulse output instructions are used to output pulses from CP1L-EL/EM output contacts, when inverter positioning 0 or inverter positioning 1 is enabled in the PLC Setup, the internal position error counter (called simply the "error counter") is enabled and the pulse output instruction will output internal pulses to the error counter. Both error counters 0 and 1 can be used at the same time.
3. For the number of pulses (i.e., the amount of movement) set in the pulse output instruction, use the number of feedback pulses from the encoder. For the pulse frequency set in the pulse output instruction, use the motor power supply frequency converted to the feedback pulse frequency from the encoder. (Refer to 7-3-7 *Determining the Internal Pulse Output Frequency* for details.)
4. Specify an inverter positioning port for the pulse output instruction (port 0: 0020, port 1: 0021). The internal pulses will be output to the error counter for the specified port.

5. The number of pulses remaining in the error counter is converted to a power supply frequency command for the inverter according to a value set in the PLC Setup and output to a word in the Auxiliary Area in increments of 0.01 Hz.
6. The frequency command value output to the Auxiliary Area is output to the inverter from the ladder program according to the inverter command method (i.e., RS-485 communications or analog output). (Refer to 7-3-9 *Automatic Calculation of Inverter Frequency Command Value* for details.)
7. When a speed command is sent to the inverter, the motor will turn at the command speed and feedback pulses (i.e., the amount of movement) from the encoder will be returned to a high-speed counter of the CP1L-EL/EM. The CP1L-EL/EM will continue to send a speed command to the inverter until the error counter (i.e., the position error) goes to zero, i.e., until positioning has been completed.
8. When the error counter goes to zero, the speed command to the inverter will also go to zero. Even after the completion of internal pulse output (i.e., position command) from the pulse output instruction, the CP1L-EL/EM will maintain the error counter so that it remains at zero.
9. The status of the error counter (such as the command direction and in-position status) will be stored in the Auxiliary Area. This status can be read from the user program to enable controlling output of commands to the inverter.

For example, if a change in the load causes the motor shaft to turn, feedback pulses from the encoder will enter the error counter, the value in the error counter will be reduced, and the Reverse Command Flag in the Auxiliary Area will turn ON. By writing the ladder program to output a reverse operation command to the inverter for the Reverse Command Flag, a command in the opposite direction of motor shaft movement will be output from the CP1L-EL/EM to the inverter, causing the motor to return to its original position. This compensating operation to continuously maintain the current stop position is called a servo lock.

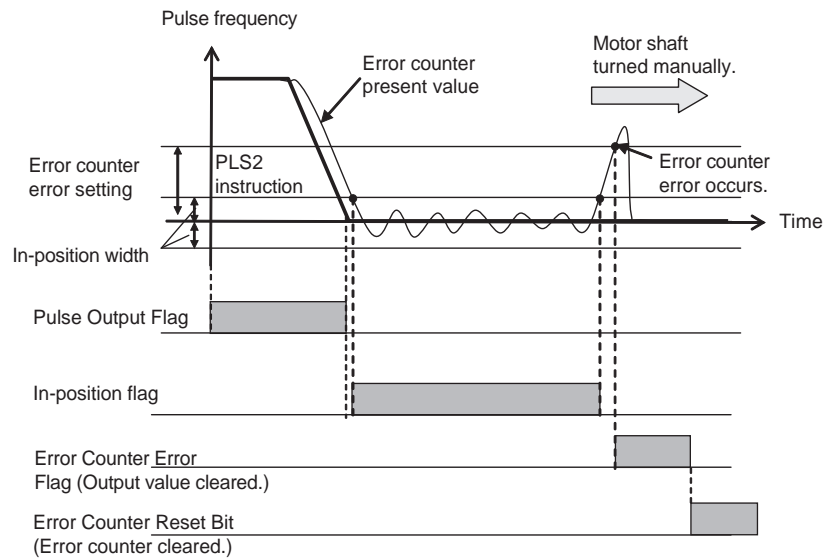
## **Other Functions**

### **Servo Locks with Vector Control Inverters**

The servo lock on an inverter can be used to stop positioning. By using the inverter's servo lock, the inverter positioning function and the output command to the inverter can be stopped from the user program without using feedback control even if the error counter value is not zero. This enables servo locks when using an inverter with vector control.

### **Clearing the Error Counter for Errors**

If the motor shaft is moved manually for error stops or when the inverter is stopped, feedback pulses will accumulate in the error counter. This can be very dangerous because it may cause the motor to suddenly return to the original position at high speed when operation is started again. To prevent such problems, an error counter error output can be produced when more than a set number of pulses accumulated in the error counter when positioning operations are stopped.



### Low-speed Operation Using Minimum Output Setting

An inductive motor driven with an inverter is different from a servomotor in that the torque at low speeds is so low that it may not be possible to turn the motor shaft at the minimum frequency. The CP1L-EL/EM provide a minimum output setting to ensure a minimum output to enable positioning at low speeds even when there are extremely few pulses in the error counter.

### Absolute Positioning

The amount of movement (i.e., amount of rotation) is input to the high-speed counter as feedback pulses. During inverter positioning, the present value of the high-speed counter can be used as an absolute position.

**Note** The absolute position will change if the present value of the high-speed counter is changed or the high-speed counter is reset.

## 7-3-4 Specifications

### Inverter Positioning Specifications

| Item   | Specification  |
|--|--|
| Applicable inverters                               | Inverter that receives frequency commands from an analog input or via Modbus-RTU communications. (Control method: V/f control, vector control, etc.) |
| Applicable motors                                  | Depends on the inverter (e.g., squirrel-cage inductive motor)  |
| Number of positioning ports and response frequency | Two ports at 100 kHz (within the speed command range of the pulse output instructions)   |
| Inverter command output method                     | Modbus-RTU communications commands or analog output (from ladder program)  |
| Present value coordinate system                    | With origin: Absolute coordinate system<br>Without origin: Relative coordinate system  |
| Present value range                                | 32 bits: 8000 000 to 7FFF FFFF hex (range of position command values and present values for pulse output instructions)                               |
| Output modes                                       | Continuous output (Number of pulses not specified.)<br>Independent mode (Number of pulses specified.)  |
| Acceleration/deceleration control                  | Trapezoidal or S-curve acceleration/deceleration   |



| Item                                    | Specification  |
|---|--|
| Specifications of number of pulses      | Relative positions: 0000 0000 to 7FFF FFFF hex (2,147,483,647 incrementing and decrementing)<br>Absolute positions: 8000 0000 to 7FFF FFFF hex (–2,147,483,648 to 2,147,483,647)<br>(Ranges of position command values and present values for pulse output instructions) |
| Origin searches                         | Motor driver and signal wire modes: 3 modes<br>Origin search modes: 2 modes<br>Origin detection methods: 3 methods   |
| Feedback pulse input ports              | High-speed counter 0 and high-speed counter 1 (fixed)<br>Maximum response frequency: 100 kHz   |
| Present value range for feedback pulses | 32 bits: 8000 000 to 7FFF FFFF hex   |
| Error counter range                     | 8000 to 7FFF hex (signed)  |
| Error counter calculation cycle         | 4 to 1,020 ms (x4)   |

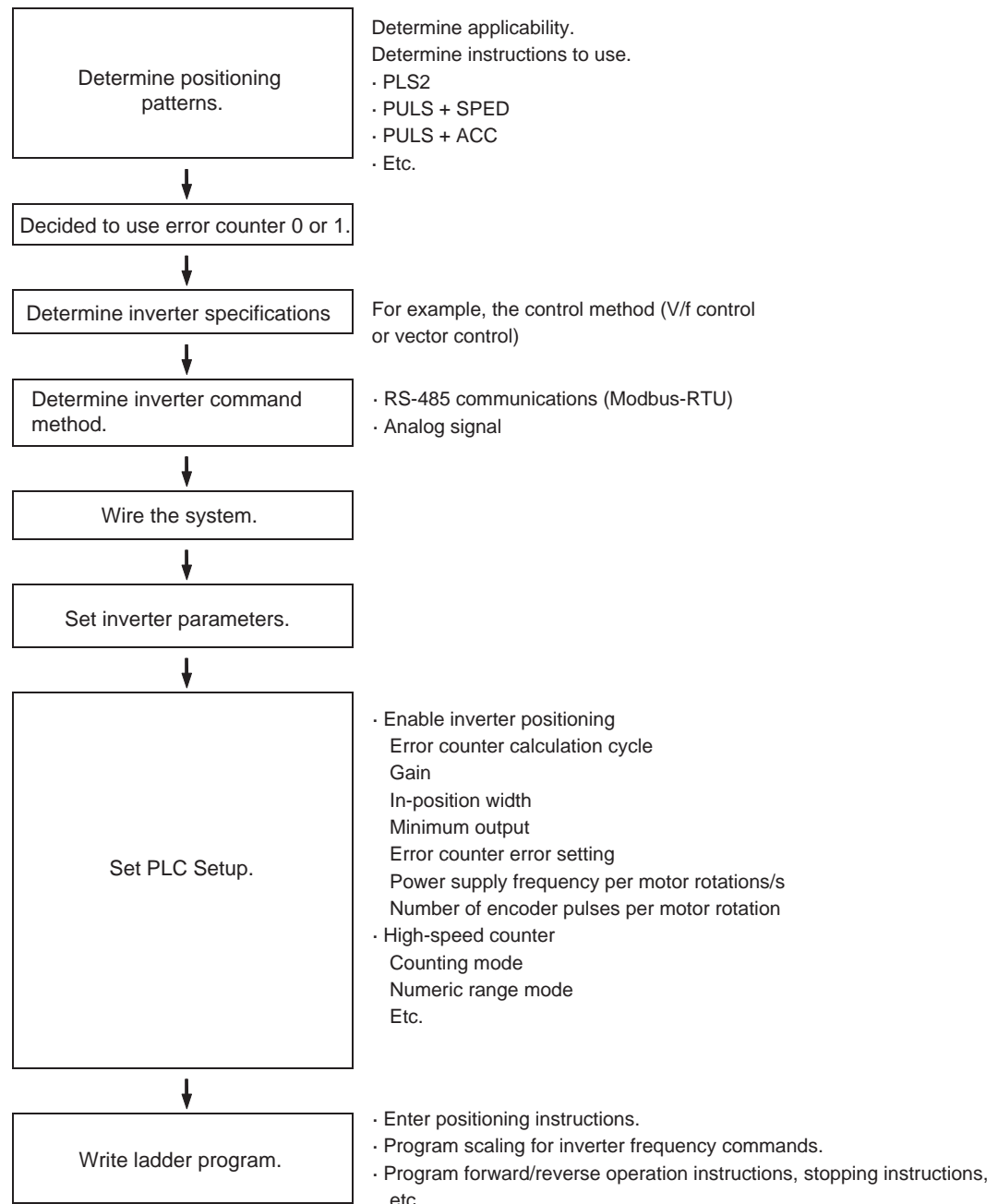
- Note**
- (1) If inverter positioning 0 is used, pulse output 0 and PWM0 cannot be used. If inverter positioning 1 is used, pulse output 1 and PWM1 cannot be used.
  - (2) If the continuous output mode is specified (i.e., if the number of pulses is not specified), be sure to use the high-speed counter (linear mode) so that it does not overflow.

#### High-speed Counter Specifications for Inverter Positioning

| Item                                      |                       | Specification   |
|---|-----------------------|---|
| Response frequency and number of counters |                       | Two 2-phase counters at 50 kHz and two single-phase counters at 100 kHz                   |
| Counting mode                             |                       | Differential-phase inputs (x4), up/down pulse inputs, or pulse plus direction inputs      |
| Numeric range mode                        |                       | Linear mode<br><b>Note</b> Always set linear mode when using inverter positioning.        |
| Numeric range                             |                       | 32 bits (–2,147,483,648 to 2,147,483,647)   |
| Reset method                              |                       | Phase Z signal (reset input) + software reset, or software reset                          |
| Interrupts (See note.)                    | Target value matching | Up to 48 target values and interrupt task numbers can be registered.                      |
|   | Zone comparison       | Up to 8 sets of upper values, lower values, and interrupt task numbers can be registered. |

- Note** Target value matching and zone comparisons can be used for high-speed counters with a feedback pulse input from an encoder even when using inverter positioning.

### 7-3-5 Application Procedure for Inverter Positioning



#### ■ Positioning Instruction Settings

- PULSE OUTPUT (PLS2)  
Port: Inverter positioning, Mode: Absolute pulse
- SET PULSES (PULS)  
Port: Inverter positioning, Mode: Absolute pulse + SPEED OUTPUT (SPED)  
Mode: Independent
- SET PULSES (PULS)  
Port: Inverter positioning, Mode: Absolute pulse + ACCELERATION CONTROL (ACC)  
Port: Inverter positioning, Mode: Independent

- **MODE CONTROL (INI)**  
Port: Inverter positioning, stopping inverter positioning
- **HIGH-SPEED COUNTER PV READ (PRV)**  
Port: Inverter positioning, Operation: Reading error counter, inverter positioning status, or error counter present value

#### ■ Automatic Calculation of Inverter Frequency Commands

- For either serial communications or an analog output, the power supply frequency per motor revolutions/s, the number of encoder pulses per motor revolution, and the error counter calculation cycle can be set in the PLC Setup to automatically calculate the inverter frequency command values and store it in A23/A33 in increments of 0.01 Hz.
- For serial communications, the ladder program is used to output the value in A23/A33 to the inverter using serial communications.
- For analog output, the value in A23/A33 can be scaled to analog output values and output from the Analog Unit to the inverter.

#### ■ Forward/Reverse Operation Commands, Stopping Commands, Etc.

- The Forward Command Flag (A26.01/A36.01) and Reverse Command Flag (A26.02/A36.02) can be used as input conditions for forward and reverse operation commands.
- The Operation Command Flag (A26.00/A36.00) and In-position Flag (A26.03/A36.03) can be used as input conditions to execute scaling to inverter frequency commands and to execute stop commands.

## 7-3-6 Instruction Specifications

The normal pulse output instructions are used (PLS2, PULS + SPED, or PULS + ACC). One of the inverter positioning ports is specified as the port for the instruction. Just like pulses are output externally for the normal pulse output instructions, error counter pulses are accumulated in the internal error counter when executing inverter positioning.

### Port Designation Operand Specifications

When executing pulse output instructions or status read instructions for inverter positioning, a port number for inverter positioning is specified for the port operand of the instruction. The following values are used.

0020 hex: Inverter positioning 0

0021 hex: Inverter positioning 1

When reading the present value of inverter positioning, use the following values to specified the port number for inverter positioning.

0030 hex: Inverter positioning 0 (signed)

0031 hex: Inverter positioning 1 (signed)

| Set value | Specified port             | Applicable instructions              |
|-----------|----------------------------|--------------------------------------|
| 0000      | Pulse output 0             | ---                                  |
| 0001      | Pulse output 1             | ---                                  |
| 0002      | Pulse output 2             | ---                                  |
| 0003      | Pulse output 3             | ---                                  |
| 0010      | High-speed counter input 0 | ---                                  |
| 0011      | High-speed counter input 1 | ---                                  |
| 0012      | High-speed counter input 2 | ---                                  |
| 0013      | High-speed counter input 3 | ---                                  |
| 0020      | Inverter positioning 0     | SPED, PULS, ACC, PLS2, INI, PRV, ORG |
| 0021      | Inverter positioning 1     | SPED, PULS, ACC, PLS2, INI, PRV, ORG |

| Set value | Specified port                   | Applicable instructions |
|-----------|----------------------------------|-------------------------|
| 0030      | Error counter 0 (signed)         | PRV                     |
| 0031      | Error counter 1 (signed)         | PRV                     |
| 0100      | Interrupt input 0 (counter mode) | ---                     |
| :         | :                                | :                       |
| 0107      | Interrupt input 7 (counter mode) | ---                     |
| 1000      | PWM output 0                     | ---                     |
| 1001      | PWM output 1                     | ---                     |

### **Applicable Instructions**

The following seven instructions can be used to execute inverter positioning. The relationship between the instructions and internal pulse outputs is as follows:

| Instruction                            | Overview   | Positioning (Independent Mode)                  |   |   | Origin searches |
|--|--|---|---|---|-----------------|
|  |  | Pulse output with no acceleration/ deceleration | Pulse output with acceleration/ deceleration        |   |                 |
|  |  |   | Trapezoid, same rate for acceleration/ deceleration | Trapezoid, different rates for acceleration/ deceleration |                 |
| PULS(886)<br>SET PULSES                | Sets the number of internal pulses to output.  | Applicable                                      | ---   | ---   | ---             |
| SPED(885)<br>SPEED OUTPUT              | Controls pulse output without acceleration or deceleration. (The number of internal pulses must be set in advance with PULS(886).)                           | Applicable                                      | ---   | ---   | ---             |
| ACC(888)<br>ACCELERATION CONTROL       | Controls pulse output with acceleration or deceleration using the same rate for both. (The number of internal pulses must be set in advance with PULS(886).) | ---   | Applicable  | ---   | ---             |
| PLS2(882)<br>PULSE OUTPUT              | Controls pulse output with acceleration or deceleration using a different rate for each (The number of internal pulses is also set.)                         | ---   | ---   | Applicable  | ---             |
| ORG(889)<br>ORIGIN SEARCH              | Actually moves the motor to establish the origin using origin proximity input, origin input, etc.  | ---   | ---   | ---   | Applicable      |
| INI(880)<br>MODE CONTROL               | Used to stop internal pulse output and inverter positioning. It can also be used to change the present value of pulse output (thus establishing the origin). | Applicable                                      | Applicable  | Applicable  | ---             |
| PRV(881)<br>HIGH-SPEED COUNTER PV READ | Reads the present value of the internal pulse output or error counter.   | Applicable                                      | Applicable  | Applicable  | ---             |

**SET PULSES: PULS(886)**

PULS(886) is used to set the pulse output amount (number of output pulses) for pulse outputs that are started later in the program using SPED(885) or ACC(888) in independent mode.

|           |                           |
|-----------|---------------------------|
| PULS(886) |                           |
| P         | ----- P: Port specifier   |
| T         | ----- T: Pulse type       |
| N         | ----- N: Number of pulses |

| Operand |                  | Description  |
|---------|------------------|--|
| P       | Port specifier   | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1   |
| T       | Pulse type       | 0000 hex: Relative<br>0001 hex: Absolute   |
| N       | Number of pulses | N (lower 4 digits)   |
|         |                  | N+1 (upper 4 digits)   |
|         |                  | <ul style="list-style-type: none"><li>Relative pulses: 0000 0000 to 7FFF FFFF hex (0 to 2,147,489,647)</li><li>Absolute pulses: 8000 0000 to 7FFF FFFF hex (–2,147,489,648 to 2,147,489,647)</li></ul> |

**SPEED OUTPUT: SPED(885)**

SPED(885) is used to start pulse output without acceleration or deceleration. It is used together with PULS(886). SPED(885) can also be executed during pulse output to change the output frequency.

|           |                                     |
|-----------|-------------------------------------|
| SPED(885) |                                     |
| P         | ----- P: Port specifier             |
| M         | ----- M: Output mode                |
| F         | ----- F: First pulse frequency word |

| Operand |                            |                      | Description  |
|---------|----------------------------|----------------------|--|
| P       | Port specifier             |                      | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1                     |
| M       | Output mode                | Bits 0 to 3          | Mode<br>0 hex: Continuous<br>1 hex: Independent  |
|         |                            | Bits 4 to 7          | Direction<br>0 hex: CW<br>1 hex: CCW   |
|         |                            | Bits 8 to 11         | Not used: Always set to 0 hex.   |
|         |                            | Bits 9 to 15         | Not used: Always set to 0 hex.   |
| F       | First pulse frequency word | F (lower 4 digits)   | Output Frequency in Hz<br>Pulse output 0 or 1: 0000 0000 to 0001 86A0 hex (0 to 100 kHz) |
|         |                            | F+1 (upper 4 digits) |  |

**ACCELERATION CONTROL: ACC(888)**

ACC(888) outputs pulses to the specified output port at the specified frequency using the specified acceleration and deceleration rate. (Acceleration rate is the same as the deceleration rate.) For positioning, ACC(888) is used in combination with PULS(886). ACC(888) can also be executed during pulse output to change the target frequency or acceleration/deceleration rate.

|          |                           |
|----------|---------------------------|
| ACC(888) |                           |
| P        | ----- P: Port specifier   |
| M        | ----- M: Output mode      |
| S        | ----- S: First word of se |

| Operand |                | Description  |
|---------|----------------|--|
| P       | Port specifier | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1 |

| Operand |                              |                      | Description  |
|---------|------------------------------|----------------------|--|
| M       | Output mode                  | Bits 0 to 3          | Mode<br>1 hex: Independent   |
|         |                              | Bits 4 to 7          | Direction<br>0 hex: CW<br>1 hex: CCW   |
|         |                              | Bits 8 to 11         | Not used: Always set to 0 hex.   |
|         |                              | Bits 9 to 15         | Not used: Always set to 0 hex.   |
| S       | First word of settings table | S                    | Acceleration/Deceleration Rate<br>1 to 65,535 Hz (0001 to FFFF hex)                      |
|         |                              | S+1 (lower 4 digits) | Target Frequency in Hz<br>Pulse output 0 to 3: 0000 0000 to 0001 86A0 hex (0 to 100 kHz) |
|         |                              | S+2 (upper 4 digits) |  |

### PULSE OUTPUT: PLS2(887)

PLS2(887) outputs a specified number of pulses to the specified port. Pulse output starts at a specified startup frequency, accelerates to the target frequency at a specified acceleration rate, decelerates at the specified deceleration rate, and stops at approximately the same frequency as the startup frequency. Only independent mode positioning is supported.

PLS2(887) can also be executed during pulse output to change the number of output pulses, target frequency, acceleration rate, or deceleration rate. PLS2(887) can thus be used for sloped speed changes with different acceleration and deceleration rates, target position changes, target and speed changes, or direction changes.

|           |   |
|-----------|---|
| PLS2(887) |   |
| P         | ----- P: Port specifier                   |
| M         | ----- M: Output mode                      |
| S         | ----- S: First word of settings table     |
| F         | ----- F: First word of starting frequency |

| Operand |                              |                       | Description   |
|---------|------------------------------|-----------------------|---|
| P       | Port specifier               |                       | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1  |
| M       | Output mode                  | Bits 0 to 3           | Mode<br>0 hex: Relative pulses<br>1 hex: Absolute pulses  |
|         |                              | Bits 4 to 7           | Direction<br>0 hex: CW<br>1 hex: CCW  |
|         |                              | Bits 8 to 11          | Not used: Always set to 0 hex.  |
|         |                              | Bits 9 to 15          | Not used: Always set to 0 hex.  |
| S       | First word of settings table | S1                    | Acceleration rate<br>0001 to FFFF hex (1 to 65,535 Hz)  |
|         |                              | S1+1                  | Deceleration rate<br>0001 to FFFF hex (1 to 65,535 Hz)  |
|         |                              | S1+2 (lower 4 digits) | Target Frequency in Hz<br>Pulse output 0 or 1: 0000 0000 to 0001 86A0 hex (0 to 100 kHz)  |
|         |                              | S1+3 (upper 4 digits) |   |
|         |                              | S1+4 (lower 4 digits) | Number of Pulses<br>• Relative pulses: 0000 0000 to 7FFF FFFF hex (0 to 2,147,489,647)<br>• Absolute pulses: 8000 0000 to 7FFF FFFF hex (-2,147,489,648 to 2,147,489,647) |
|         |                              | S1+5 (upper 4 digits) |   |

| Operand |                                  |                      | Description  |
|---------|----------------------------------|----------------------|--|
| F       | First word of starting frequency | F (lower 4 digits)   | Starting Frequency in Hz<br>Pulse output 0 or 1: 0000 0000 to 0001 86A0 hex (0 to 100 kHz) |
|         |                                  | F+1 (upper 4 digits) |  |

#### ORIGIN SEARCH: ORG(889)

ORG(889) performs an origin search or origin return operation.

- Origin Search:

Pulses are output to establish the origin based on origin proximity input and origin input signals.

- Origin Return:

The positioning system is returned to the origin.

The parameters for pulse output 0 or pulse output 1 must be set in advance in the PLC Setup to perform either an origin search or origin return operation.

|          |                         |
|----------|-------------------------|
| ORG(889) |                         |
| P        | ----- P: Port specifier |
| C        | ----- C: Control data   |

| Operand |                |              | Description  |
|---------|----------------|--------------|--|
| P       | Port specifier |              | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1 |
| C       | Control data   | Bits 0 to 3  | Not used: Always set to 0 hex  |
|         |                | Bits 4 to 7  | Not used: Always set to 0 hex  |
|         |                | Bits 8 to 11 | Not used: Always set to 0 hex  |
|         |                | Bits 9 to 15 | Mode<br>0 hex: Origin search<br>1 hex: Origin return                 |

#### MODE CONTROL: INI(880)

INI(880) changes the present value of inverter positioning or stops positioning.

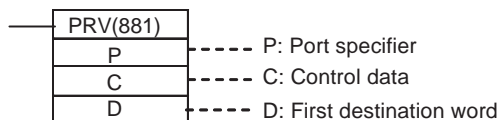
|          |                                  |
|----------|----------------------------------|
| INI(880) |                                  |
| P        | ----- P: Port specifier          |
| C        | ----- C: Control data            |
| NP       | ----- NV: First word with new PV |

| Operand |                        |                       | Description   |
|---------|------------------------|-----------------------|---|
| P       | Port specifier         |                       | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1  |
| C       | Control data           |                       | 0002 hex: Changes the PV of the internal pulse output.<br>0003 hex: Stops internal pulse output. Positioning will continue and the output value will not be cleared.<br>0004 hex: Stops inverter positioning. Internal pulse output will be stopped, positioning will be stopped, and the output value will be cleared. The next operation will not be accepted until the error counter is cleared. |
| NP      | First word with new PV | NP (lower 4 digits)   | New PV<br>0000 0000 to FFFF FFFF hex  |
|         |                        | NP+1 (upper 4 digits) |   |

### HIGH-SPEED COUNTER PV READ: PRV(881)

PRV(881) is used to read the present value and status of inverter positioning. The following status can be read.

- |                              |   |
|------------------------------|---|
| • Operation Command Flag     | • Internal Pulse Acceleration/Deceleration Flag |
| • Forward Command Flag       | • Error Counter Error Flag                      |
| • Reverse Command Flag       | • Error Counter Alarm Flag                      |
| • In-position Flag           | • Error Counter Sign Flag                       |
| • Internal Pulse Output Flag |   |



| Operand |                | Description  |
|---------|----------------|--|
| P       | Port specifier | 0020 hex: Inverter positioning 0<br>0021 hex: Inverter positioning 1<br>0030 hex: Error counter 0<br>0031 hex: Error counter 1 |
| C       | Control data   | 0000 hex: Read present value.<br>0001 hex: Read status.  |



| Operand |   |     | Description    |  |
|---------|---|-----|----------------|--|
| D       | First destination word for present value                              | D   | Lower 4 digits | When a present value is read, the following data is stored in D and D+1 as an 8-digit hexadecimal value.<br>P = #0020/#0021: The actual movement from the internal pulse origin.<br>P = #0030/#0031: The present value of the error counter. |
|         |   | D+1 | Upper 4 digits |  |
|         | Destination word for inverter positioning status (P = #0020 or #0021) | D   | Bit 0          | Operation Command Flag<br>ON: Operation command in progress<br>OFF: Stopped  |
|         |   |     | Bit 1          | Forward Command Flag<br>ON: Forward command in progress<br>OFF: Reverse command in progress or stopped   |
|         |   |     | Bit 2          | Reverse Command Flag<br>ON: Reverse command in progress<br>OFF: Forward command in progress or stopped   |
|         |   |     | Bit 3          | In-position Flag<br>ON: In position<br>OFF: Not in position  |
|         |   |     | Bit 4          | Error Counter Error Flag<br>ON: Error occurred in error counter<br>OFF: No error   |
|         |   |     | Bit 5          | Internal Pulse Output Flag<br>ON: Pulses being output<br>OFF: Pulse output stopped   |
|         |   |     | Bit 6          | Internal Pulse Acceleration/Deceleration Flag<br>ON: Acceleration/deceleration in progress for internal pulse output (i.e., frequency being changed)<br>OFF: Constant frequency for internal pulse output                                    |
|         |   |     | Bit 7          | Error Counter Alarm Flag<br>ON: Alarm occurred for error counter<br>OFF: No alarm  |
|         |   |     | Bit 15         | Error Counter Sign Flag<br>ON: Positive<br>OFF: Negative   |

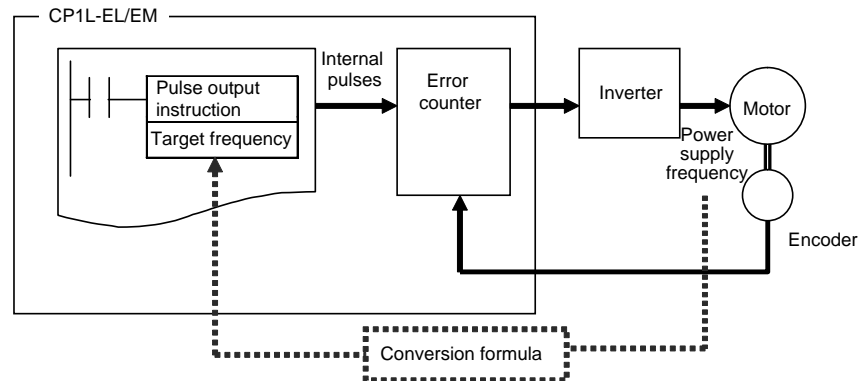
### 7-3-7 Determining the Internal Pulse Output Frequency

Use the following formula to calculate the internal pulse frequency (Hz) to output from the pulse output instruction (e.g., PLS2) based on the power supply frequency (Hz) to be output from the inverter to the motor.

$$\text{Frequency of internal pulse output (Hz)} = \frac{\text{Encoder resolution (pulses/revolution)} \times \text{High-speed counter multiplier} \times \text{Gear ratio between motor shaft and encoder shaft (See note 2.)}}{\text{Power supply frequency to motor for one revolution per second (See note 1.)}} \times \text{Power supply frequency to motor (Hz)}$$

**Note** (1) Calculate the power supply frequency for one revolution per second from the motor specifications. For example, with a 1,800-r/min (60-Hz) motor (30 r/s), the power supply frequency for one revolution per second would be calculated as follows: 60 [Hz] ÷ 30 [r/s] = 2 [Hz].

- (2) The encoder resolution times the counter multiplier times the gear ratio equals the number of pulses output by the encoder for one motor shaft revolution.



### Example of Calculating Conversion Factor

#### Conditions

- Frequency for 1 revolution/s for inductive motor: 2 Hz (motor specification)
- Rotary encoder resolution: 1,000 pulses/revolution (encoder specification)
- High-speed counter multiplier: x4 (PLC Setup)
- Gear ratio between motor and encoder shafts: 1/4 (machine specification)

#### Calculations

The factor goes into the formula as shown below.

|   |
|---|
| Frequency of internal pulse output (Hz) = $\frac{1000 \times 4 \times 1/4}{2}$ × Power supply frequency to motor (Hz) |
| = 500 × Power supply frequency to motor (Hz)  |

For example, to output a power supply frequency of 10 Hz to the motor:

**Frequency of internal pulse output = 500 × 10 Hz = 5,000 Hz = 5 kHz**

Therefore, set a pulse output frequency of 5 kHz in the pulse output instructions (e.g., PLS2).

## 7-3-8 PLC Setup

The following settings must be made in advance when using inverter positioning 0 or 1.

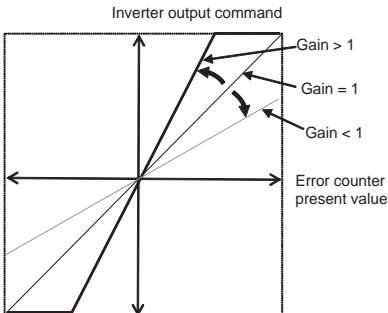
### Basic Settings

The following settings are required to use inverter positioning.

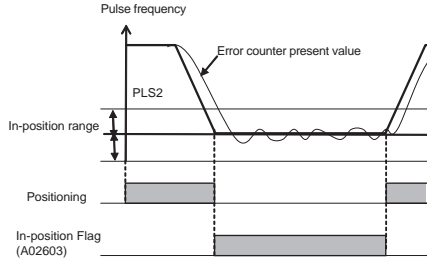
#### Inverter Positioning Function

| Setting                  | Description   | Set value      | Default    | Application | Refresh timing                   |
|--------------------------|---|----------------|------------|-------------|----------------------------------|
| Use inverter positioning | <p>Select this option to use inverter positioning. High-speed counter 0 will be allocated to inverter positioning 0 and high-speed counter 1 will be allocated to inverter positioning 1. The high-speed counter mode that is set will be used.</p> <p><b>Note</b> If inverter positioning 1 is used with a CPU Unit with 14 I/O Points, origin searches cannot be used. (Origin searches are possible even if inverter positioning 0 is used.)</p> | Use/Do not use | Do not use | ---         | When CPU Unit power is turned ON |

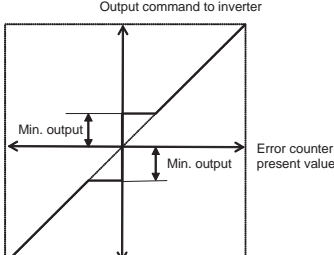
#### Gain

| Setting | Description  | Set value  | Default   | Application   | Refresh timing                   |
|---------|--|--|---|---|----------------------------------|
| Gain    | <p>The error counter present value times the gain setting will be used as the output command to the inverter.</p>  <p><b>Note</b> The setting is made in increments of 0.1. The gain will thus be 1/10 of the set value. For example, if 50 is set, the gain will be 5. It's best to initially try a gain of from 5 to 10 (settings of 50 to 100) and then adjust from there.</p> | <p>1 to 65,535 (0.1 increments)</p> <p>0 sets a value of 10 (0.1 increments)</p> | <p>0: 10 (0.1 increments)</p> <p>This will set a gain of 1.</p> | Adjusting the following characteristic of the motor | When CPU Unit power is turned ON |

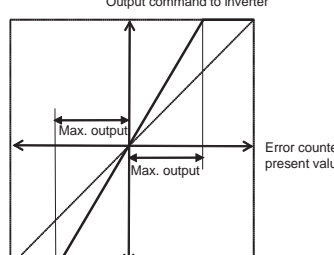
## In-position Range

| Setting           | Description  | Set value  | Default | Application   | Refresh timing                   |
|-------------------|--|--|---------|---|----------------------------------|
| In-position range | <p>The In-position Flag (A26.03) will turn ON when pulse output to the error counter has been completed and the error counter present value is less equal to or less than the in-position range.</p>  | 1 to 65,535<br>Setting 0 is the same as setting 1. | 0: 1    | When using the inverter's servo lock, the command value to the inverter is set to zero during in-position status. | When CPU Unit power is turned ON |

## Minimum Output Value

| Setting           | Description  | Set value  | Default | Application  | Refresh timing                   |
|-------------------|--|--|---------|--|----------------------------------|
| Min. output value | <p>If the error counter present value times the gain setting is less than the minimum output value, the minimum output value will be output.</p> <p>Set the minimum output value so that it is equal to or smaller than the maximum output value.</p>  | 1 to 65,535<br>Setting 0 is the same as setting 1. | 0: 1    | A minimum output value can be set to ensure an output of a specified size even when the error counter present value is very small. | When CPU Unit power is turned ON |

## Maximum Output Value

| Setting           | Description  | Set value   | Default      | Application  | Refresh timing                   |
|-------------------|--|---|--------------|--|----------------------------------|
| Max. output value | <p>If the error counter present value times the gain setting is greater than the maximum output value, the maximum output value will be output.</p> <p>Set the maximum output value so that it is equal to or greater than the minimum output value.</p>  | 1 to 4,294,967,295<br>Setting 0 is the same as setting 2,000,000. | 0: 2,000,000 | A maximum output value can be set to prevent the output value from becoming too large. | When CPU Unit power is turned ON |

### Error Counter Overflow Detection Value

| Setting                                | Description  | Set value   | Default   | Application  | Refresh timing                   |
|--|--|---|-----------|--|----------------------------------|
| Error counter overflow detection value | If the absolute value of the error counter present value is greater than the error counter overflow detection value, the Error Counter Error Flag (A26.03) will turn ON. | 1 to 32,767<br>Setting 0 is the same as setting 10,000. | 0: 10,000 | Provides notification of excessive pulses in the error counter, e.g., when manually moving the motor shaft while positioning is stopped. | When CPU Unit power is turned ON |

### Error Counter Alarm Detection Value

| Setting                             | Description   | Set value   | Default   | Application  | Refresh timing                   |
|-------------------------------------|---|---|-----------|--|----------------------------------|
| Error counter alarm detection value | If the absolute value of the error counter present value is greater than the error counter alarm detection value, the Error Counter Alarm Flag (A26.08) will turn ON. | 1 to 32,767<br>Setting 0 is the same as setting 10,000. | 0: 10,000 | Provides notification of excessive pulses in the error counter, e.g., when encoder wiring breaks during positioning. | When CPU Unit power is turned ON |

### Error Counter Cycle

| Setting             | Description   | Set value   | Default  | Application                                  | Refresh timing                   |
|---------------------|---|---|--|--|----------------------------------|
| Error counter cycle | <p>The calculation cycle of the error counter can be set. If the cycle is too short when using a motor with a slow response, pulses may easily accumulate in the error counter. Change the error counter cycle according to the machine load and motor response.</p> <p><b>Note</b> The setting is made in increments of 4 ms. The error counter cycle will thus be the set value times 4 ms. For example, if the set value is 10, the error counter cycle will be 40 ms.</p> | 1 to 255 (in 4-ms increments)<br>Setting 0 is the same as setting 3 (4-ms increments) | 0: 3 (4-ms increments)<br>The error counter cycle will be 12 ms. | Set when using a motor with a slow response. | When CPU Unit power is turned ON |

### Power Supply Frequency for One Motor Revolution per Second

| Setting  | Description   | Set value                          | Default               | Application   | Refresh timing                   |
|--|---|------------------------------------|-----------------------|---|----------------------------------|
| Power Supply Freq. for One Motor Revolution per Sec. | <p>Calculate the power supply frequency for one revolution per second from the motor specifications. For example, with a 1,800-r/min (60-Hz) motor (30 r/s), the power supply frequency for one revolution per second would be calculated as follows:<br/> <math>60 \text{ [Hz]} \div 30 \text{ [r/s]} = 2 \text{ [Hz]}</math>.</p> <p><b>Note</b> The setting is made in increments of 0.1 Hz. The frequency will thus be the set value times 0.1 Hz. For example, if the set value is 20, the frequency will be 2 Hz.</p> | 0 to 65,535 Hz (0.1-Hz increments) | 0 (0.1-Hz increments) | This setting is used when converting the output value to an inverter frequency command. | When CPU Unit power is turned ON |

### Number of Encoder Pulses for One Motor Revolution

| Setting   | Description  | Set value   | Default | Application   | Refresh timing                   |
|---|--|-------------|---------|---|----------------------------------|
| Number of Encoder Pulses for One Motor Revolution | Calculate the number of encoder pulses for one motor revolution from the encoder resolution (pulses/revolution), high-speed counter's multiplier, and motor-encoder shaft gear ratio. For example, if the encoder resolution is 1,000, the high-speed counter multiplier is 4, and the gear ratio is 1/4, the number of encoder pulses for one motor revolution is $1,000 \times 4 \times (1/4) = 1,000$ . | 0 to 65,535 | 0       | This setting is used when converting the output value to an inverter frequency command. | When CPU Unit power is turned ON |

### Operation Adjustment Settings

Use the following settings if the gain adjustment in the basic settings does not produce stable operation.

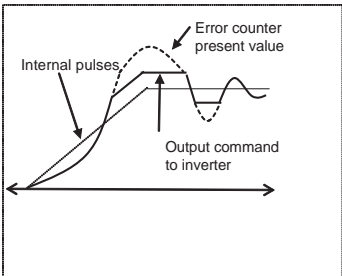
#### Limit Output during Acceleration and Constant Speed

| Setting   | Description   | Set value      | Default    | Application   | Refresh timing                   |
|---|---|----------------|------------|---|----------------------------------|
| Limit output during acceleration and constant speed | Select this option to limit the upper and lower values of the output value based on the pulse output value during internal pulse output acceleration or constant speed. | Use/Do not use | Do not use | Use this setting when positioning precision is bad. | When CPU Unit power is turned ON |

#### Limit Output during Deceleration and When Stopped

| Setting   | Description   | Set value      | Default    | Application   | Refresh timing                   |
|---|---|----------------|------------|---|----------------------------------|
| Limit output during deceleration and when stopped | Select this option to multiply the error of the output value by a coefficient during internal pulse output deceleration or after output has been completed. | Use/Do not use | Do not use | Use this setting when positioning precision is bad. | When CPU Unit power is turned ON |

### Output Coefficient during Acceleration and Constant Speed

| Setting   | Description  | Set value   | Default                | Application  | Refresh timing                   |
|---|--|---|------------------------|--|----------------------------------|
| Output coefficient during acceleration and constant speed | <p>Upper and lower limits are placed on the output value by multiplying the pulse output value by a coefficient during internal pulse output acceleration or constant speed.</p> <p>Output Upper Limit =<br/>Internal pulse output value + Internal pulse output value × Output coefficient</p> <p>Output Lower Limit =<br/>Internal pulse output value – Internal pulse output value × Output coefficient</p>  <p><b>Note</b> The setting is made in increments of 0.01. The coefficient will thus be the set value times 0.01. For example, if the set value is 10, the coefficient will be 0.1 ms.</p> | 1 to 255 (0.01 increments)<br>Setting 0 is the same as setting 6 (0.01 increments). | 0: 6 (0.01 increments) | This coefficient can be used to restrict the output range to prevent excessive values, based on the internal pulse output value when the motor response is slow even if a large error is produced. | When CPU Unit power is turned ON |

### Output Coefficient during Deceleration

| Setting                                | Description  | Set value  | Default                 | Application  | Refresh timing                   |
|--|--|--|-------------------------|--|----------------------------------|
| Output coefficient during deceleration | <p>The output value can be changed by multiplying the value in the error counter by a coefficient during deceleration of internal pulse output.</p> <p>Output value =<br/>Error × Error counter cycle (s) × Gain × Coefficient</p> <p><b>Note</b> The setting is made in increments of 0.01. The coefficient will thus be the set value times 0.01. For example, if the set value is 10, the coefficient will be 0.1 ms.</p> | 1 to 255 (0.01 increments)<br>Setting 0 is the same as setting 96 (0.01 increments). | 0: 96 (0.01 increments) | This coefficient can be used to reduce the output value when the motor response is slow and the target position is exceeded when stopping. | When CPU Unit power is turned ON |

### Output Coefficient after Pulse Output

| Setting                               | Description   | Set value   | Default                 | Application   | Refresh timing                   |
|---------------------------------------|---|---|-------------------------|---|----------------------------------|
| Output coefficient after pulse output | <p>The output value can be changed by multiplying the value in the error counter by a coefficient after deceleration of internal pulse output.</p> <p>Output value =<br/>Error × Error counter cycle (s) × Gain × Coefficient</p> <p><b>Note</b> The setting is made in increments of 0.01. The coefficient will thus be the set value times 0.01. For example, if the set value is 10, the coefficient will be 0.1 ms.</p> | <p>1 to 255 (0.01 increments)</p> <p>Setting 0 is the same as setting 50 (0.01 increments).</p> | 0: 50 (0.01 increments) | This coefficient can be used to reduce the output value when it the value in the error counter is too large after completing internal pulse output. | When CPU Unit power is turned ON |

## 7-3-9 Automatic Calculation of Inverter Frequency Command Value

Set the Power Supply Frequency for One Motor Revolution per Second, Number of Encoder Pulses for One Motor Revolution, and Error Counter Cycle in the PLC Setup to automatically calculate the inverter frequency command value and store it in A23 for inverter positioning 0 and A33 for inverter positioning 1.

**Note** The inverter frequency command values are stored in A23 and A33 in increments of 0.01 Hz. Divide the value in A23 or A33 by 100 to obtain the value in hertz.

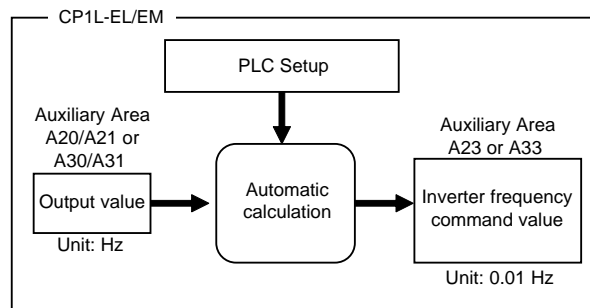
The values stored in A23 and A33 can be used in converting the output value to the frequency command value for the inverter. This value can be output to the inverter from the program using serial communications or an Analog Output Unit.

**Note** The following formula is used inside the PLC to automatically calculate the inverter frequency command value from the output value (i.e., the error counter present value multiplied by the gain). (The output value is stored in A20 and A21 for inverter positioning 0 and in A30 and A31 for inverter positioning 1.)

|   |   |  |  |  |
|---|---|--|--|--|
| Conversion Factor   |   |  |  |  |
| Inverter frequency command value (Hz) =   | $\frac{\text{Motor frequency for 1 rotation per second (Hz)} \times \frac{1}{\text{Error counter cycle (s)}}}{\text{Encoder resolution (pulses/rotation)} \times \text{High-speed counter multiplier} \times \text{Motor-encoder shaft gear ratio (See note 2.)}} \times \text{Output value}$ |  |  |  |
|   | $\times \begin{matrix} \text{A20/A21} \\ \text{A30/A31} \end{matrix}$   |  |  |  |
| <p><b>Note:</b> The inverter frequency command value is stored in A23/A33 in increments of 0.01 Hz.</p> |   |  |  |  |

- Note**
- (1) Calculate the power supply frequency for one revolution per second from the motor specifications. For example, with a 1,800-r/min (60-Hz) motor (30 r/s), the power supply frequency for one revolution per second would be calculated as follows: 60 [Hz] ÷ 30 [r/s] = 2 [Hz].
  - (2) The encoder resolution times the counter multiplier times the gear ratio equals the number of pulses output by the encoder for one motor shaft revolution.





### Example of Calculating Conversion Factor

#### Conditions

- Power Supply Frequency for One Motor Revolution per Second: 2 Hz (PLC Setup)
- Number of Encoder Pulses for One Motor Revolution: 1,000 (PLC Setup)
  - Rotary encoder resolution: 1,000 pulses/revolution (encoder specification)
  - High-speed counter multiplier: x4 (PLC Setup)
  - Gear ratio between motor and encoder shafts: 1/4 (machine specification)
- Error Counter Cycle: 12 ms (PLC Setup)

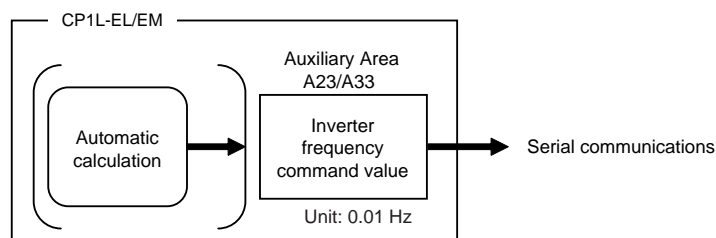
#### Calculation

The calculation performed inside the PLC is as shown below.

$$\begin{aligned}
 \text{A23/A33 Inverter frequency command value (0.1-Hz increments)} &= \frac{2}{1000 \times 0.012} \times \text{(To 0.01-Hz increments)} \times 100 \times \text{Output value: Hz A20/A21 A30/A31} \\
 &= 17 \times \text{Output value: Hz A20/A21 A30/A31}
 \end{aligned}$$

### Serial Communications

The command value calculated above is used in the Modbus-RTU command frame, adjusting for the frequency unit. (See note.)



Refer to 8-3-3 *Modbus-RTU Easy Master Function* and to the inverter manual for details on Modbus-RTU communications.

#### Note

If the frequency command unit set in the inverter is 0.1 Hz, divide the command frequency in A23 or A33 by 10.

### Analog Output

The following example is for the CP1W-DA041/CP1W-DA021.

The analog output resolution is 6,000, so the command value calculated above is multiplied by 6,000 divided by the inverter's maximum output frequency.

Stored analog  
output value

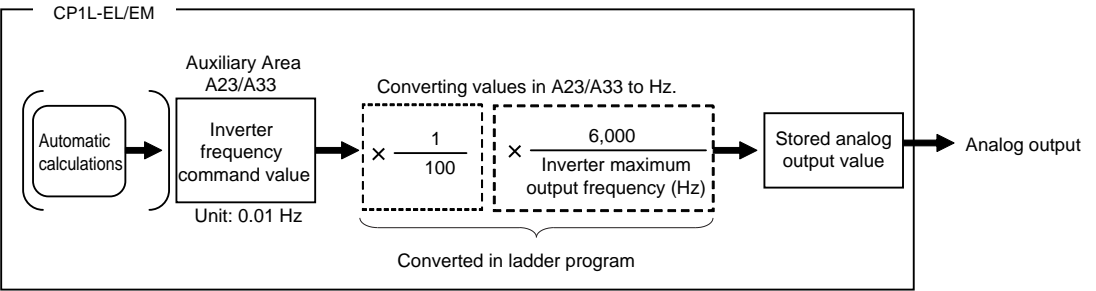
=

Inverter frequency  
command value (Hz)

×

6,000

Inverter's max. output frequency (Hz)



Refer to 9-3 *Analog Output Units* for operating procedures for the Analog Output Unit.

■ **Calculation Example**

**Conditions**

Inverter's maximum output frequency: 60 Hz

**Calculation**

The stored analog output value is calculated as follows:

Stored analog  
output value

=

Auxiliary Area  
A23/A33  
(Unit: 0.01 Hz)

×

1

100

×

6,000

60

=

Auxiliary Area  
A23/A33  
(Unit: 0.01 Hz)

×

1

## 7-3-10 Memory Allocations

### Built-in Input Area

| Input terminal block |     | Default         | Pulse output origin searches enabled          | Inverter positioning enabled  |
|----------------------|-----|-----------------|---|-------------------------------|
| Word                 | Bit | Normal inputs   | Origin search                                 |                               |
| CIO 0<br>(See note.) | 00  | Normal input 0  | ---   | High-speed counter 0: Phase A |
|                      | 01  | Normal input 1  | ---   | High-speed counter 0: Phase B |
|                      | 02  | Normal input 2  | ---   | High-speed counter 1: Phase A |
|                      | 03  | Normal input 3  | ---   | High-speed counter 1: Phase B |
|                      | 04  | Normal input 4  | ---   | ---                           |
|                      | 05  | Normal input 5  | ---   | ---                           |
|                      | 06  | Normal input 6  | Pulse output 0: Origin input signal           | ---                           |
|                      | 07  | Normal input 7  | Pulse output 1: Origin input signal           | ---                           |
|                      | 08  | Normal input 8  | ---   | ---                           |
|                      | 09  | Normal input 9  | ---   | ---                           |
|                      | 10  | Normal input 10 | Pulse output 0: Origin proximity input signal | ---                           |
|                      | 11  | Normal input 11 | Pulse output 1: Origin proximity input signal | ---                           |

**Note** The above table shows only allocations related to inverter positioning.

### Built-in Output Area

This area is not used for inverter positioning.

When inverter positioning is enabled, bits 00 to 03 in CIO 100 can be used as normal outputs 0 to 3. The corresponding pulse output and PWM output cannot be used.

**Auxiliary Area****Read Area****■ Inverter Positioning 0**

Use one of the following for the inverter frequency command.

| Word | Bits     | Function  | Data range   | Refresh timing  | Application examples   |
|------|----------|---|--|---|--|
| A20  | 00 to 15 | Lower 4 digits of present value of unsigned output value (output value = present value of error counter × error counter cycle (s) × gain)<br><b>Note</b> The maximum and minimum output values are applied. | 0000 0000 to 8000 0000 hex<br>(0 to 2,147,483,648) | Cleared to zero at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When an error counter error occurs<br>Updated at following times:<br>• Cyclically according to error counter cycle | This value can be used when not using automatic frequency command calculations and instead to convert the output value provided here in the user program for output to the inverter.<br><br>This value is used when signed data is not required, i.e., when using communications or normal I/O to specify the direction. |
| A21  | 00 to 15 | Upper 4 digits of present value of unsigned output value (output value = present value of error counter × error counter cycle (s) × gain)<br><b>Note</b> The maximum and minimum output values are applied. |  |   |  |

| Word | Bits     | Function  | Data range   | Refresh timing  | Application examples  |
|------|----------|---|--|---|---|
| A23  | 00 to 15 | Inverter frequency command value (0.01-Hz increments, unsigned)<br><b>Note</b> Set the Power Supply Frequency for One Motor Revolution per Second, Number of Encoder Pulses for One Motor Revolution, and Error Counter Cycle in the PLC Setup before using this value. | 0000 to FFFF hex (0.00 to 655.35 Hz)                     | Cleared to zero at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When an error counter error occurs<br>Updated at following times:<br>Cyclically according to error counter cycle   | These words contain the automatically calculated frequency command value for the inverter. (This value is normally used.)<br>For example, if the frequency setting unit of the inverter is 0.01 Hz, this value can be used as it in serial communications with the inverter. When converting to an analog output (0 to 5 V, 1 to 5 V, 0 to 10 V, 0 to 20 mA, or 4 to 20 mA), this value can be used to simplify the conversion.<br>This value is used when signed data is not required, i.e., when using communications or normal I/O to specify the direction. |
| A24  | 00 to 15 | Lower 4 digits of present value of signed output value (output value = present value of error counter $\times$ error counter cycle (s) $\times$ gain)<br><b>Note</b> The maximum and minimum output values are applied.   | 8000 0000 to 7FFF FFFF hex (–214,748,348 to 214,748,347) | Cleared to zero at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When an error counter error occurs<br>Updated at following times:<br>• Cyclically according to error counter cycle | This value can be used when not using automatic frequency command calculations and instead to convert the output value provided here in the user program for output to the inverter.<br>This value is used when signed data is required, i.e., when outputting the frequency command with an analog output from –10 to 10 V.  |
| A25  | 00 to 15 | Upper 4 digits of present value of signed output value (output value = present value of error counter $\times$ error counter cycle (s) $\times$ gain)<br><b>Note</b> The maximum and minimum output values are applied.   |  |   |   |

Use the following for inverter positioning status and the workpiece position.

| Word | Bits | Function                       | Data range   | Refresh timing   | Application examples  |
|------|------|--------------------------------|--|--|---|
| A26  | 00   | Operation Command Flag         | ON: Operation command executed.<br>OFF: Stop command executed.                 | Turned ON at following times:<br>• When inverter positioning is started<br>Turned OFF at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When CPU Unit operation stops<br>• When inverter positioning is stopped using INI instruction   | This flag is used as a NO input condition when calculating the frequency command value in the user program. It is also used as a NC input condition when clearing the frequency command value to zero.                    |
|      | 01   | Forward Operation Command Flag | ON: Forward command in progress<br>OFF: Reverse command in progress or stopped | Turned ON at following times:<br>• When error counter present value is greater than 0 (i.e., positive)<br>Turned OFF at following times:<br>• When error counter present value is less than 0 (i.e., negative) or zero<br>• When power to CPU Unit is turned ON<br>• When CPU Unit operation starts<br>• When CPU Unit operation stops | This flag is used as a NO input condition when outputting a forward operation command to the inverter from the user program<br>It is also used as a NC input condition when outputting a reverse command to the inverter. |
|      | 02   | Reverse Operation Command Flag | ON: Reverse command in progress<br>OFF: Forward command in progress or stopped | Turned ON at following times:<br>• When error counter present value is less than 0 (i.e., negative)<br>Turned OFF at following times:<br>• When error counter present value is greater than 0 (i.e., positive) or zero<br>• When power to CPU Unit is turned ON<br>• When CPU Unit operation starts<br>• When CPU Unit operation stops | This flag is used as a NO input condition when outputting a reverse operation command to the inverter from the user program<br>It is also used as a NC input condition when outputting a forward command to the inverter. |

| Word | Bits | Function  | Data range  | Refresh timing   | Application examples  |
|------|------|---|---|--|---|
| A26  | 03   | In-position Flag  | ON: In position<br>OFF: Not in position   | Turned ON at following times:<br><ul style="list-style-type: none"> <li>• When pulse output to error counter is stopped and absolute value of error counter present value is less than in-position range</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>• When pulses are being output to error counter</li> <li>• When absolute value of error counter present value is greater than in-position range.</li> <li>• When power to CPU Unit is turned ON</li> <li>• When CPU Unit operation starts</li> <li>• When CPU Unit operation stops</li> </ul> | This flag is used as an NO condition when clearing the frequency command value to zero from the user program.   |
|      | 04   | Error Counter Error Flag                                  | ON: Error counter error<br>OFF: No error  | Turned ON at following times:<br><ul style="list-style-type: none"> <li>• When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter error detection value</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>• When error counter error is reset</li> <li>• When power to CPU Unit is turned ON</li> <li>• When CPU Unit operation starts</li> <li>• When CPU Unit operation stops</li> </ul>   | This flag can be used to provide notification of excessive pulses in the error counter, e.g., when manually moving the motor shaft while positioning is stopped.  |
|      | 05   | Error Counter Pulse Output Flag                           | ON: Pulses being output<br>OFF: Pulse output stopped  | Turned ON at following times:<br><ul style="list-style-type: none"> <li>• When pulse output to error counter is started</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>• When pulse output to error counter is stopped (including immediate stops and deceleration stops)</li> <li>• When power to CPU Unit is turned ON</li> <li>• When CPU Unit operation starts</li> <li>• When CPU Unit operation stops</li> </ul>  | This flag is used to determine whether pulses are being output to the error counter.<br><br>This flag can be used to determine when internal pulse output has been completed and start the next instruction.  |
|      | 06   | Error Counter Pulse Output Acceleration/Deceleration Flag | ON: Pulse output to the error counter is accelerating or decelerating (i.e., the frequency is changing)<br>OFF: Pulse output to the error counter is constant | Turned ON at following times:<br><ul style="list-style-type: none"> <li>• When pulse output frequency to error counter is changed by ACC or PLS2 instruction</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>• During output of a constant pulse frequency to error counter</li> <li>• When pulse output to error counter is stopped (including immediate stops and deceleration stops)</li> <li>• When power to CPU Unit is turned ON</li> <li>• When CPU Unit operation starts</li> <li>• When CPU Unit operation stops</li> </ul>                   | This flag is used to detect changes in the output frequency when the frequency is changed stepwise for internal pulses are being output by the ACC or PLS2 instruction. It can be used as a condition for executing ACC or PLS2 during internal pulse output. |

| Word | Bits     | Function   | Data range   | Refresh timing   | Application examples   |
|------|----------|--|--|--|--|
| A26  | 07       | Error Counter Alarm Flag                           | ON: Error counter alarm<br>OFF: No error counter alarm         | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter alarm detection value</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When error counter alarm is reset</li> <li>When power to CPU Unit is turned ON</li> <li>When CPU Unit operation starts</li> <li>When CPU Unit operation stops</li> </ul> | This flag can be used to provide notification of excessive pulses in the error counter, e.g., when encoder wiring breaks during positioning. |
|      | 08 to 14 | Not used.  |  |  |  |
|      | 15       | Inverter Positioning Output Value Sign Flag        | ON: Positive value<br>OFF: Negative value                      | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When signed output value is between 0000 0000 and 7FFF FFFF hex.</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When signed output value is between FFFF FFFF and 8000 0000 hex.</li> </ul>   | This flag can be used as a direction signal  |
| A270 | 00 to 15 | Lower 4 digits of high-speed counter present value | 8000 000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | The present value of the feedback pulse from the encoder.<br>Operation is the same as for a high-speed counter.  | Use as the absolute position of the workpiece positioned with inverter positioning.  |
| A271 | 00 to 15 | Upper 4 digits of high-speed counter present value |  |  |  |

Use the following for the present values of the internal pulse and error counter of inverter positioning.

| Word | Bits     | Function   | Data range  | Refresh timing  | Application examples  |
|------|----------|--|---|---|---|
| A22  | 00 to 15 | Error counter 0 present value (signed)                                       | 8000 to 7FFF hex<br>(-32,768 to 32,767)                         | Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>When power to CPU Unit is turned ON</li> <li>At start of operation</li> <li>When an error counter error occurs</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>Cyclically according to error counter cycle</li> </ul> Held at following times:<br><ul style="list-style-type: none"> <li>When Error Counter Disable Bit (A562.01) is turned ON.</li> </ul> | Use to monitor the difference between the target value and the present value.   |
| A28  | 00 to 15 | Lower 4 digits of present value of pulse output to inverter (relative value) | 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | Contains relative internal pulse output value when pulses are output to error counter.<br>Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>When power to CPU Unit is turned ON</li> <li>When operation is started</li> <li>When pulse output to error counter is started</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>Cyclically on error counter cycle</li> </ul>                                       | These values can be used to monitor the present value of internal pulse output. |
| A29  | 00 to 15 | Upper 4 digits of present value of pulse output to inverter (relative value) |   |   |   |



| Word | Bits     | Function   | Data range  | Refresh timing   | Application examples   |
|------|----------|--|---|--|--|
| A276 | 00 to 15 | Lower 4 digits of the present value of the internal pulse output (absolute value for absolute coordinates) | 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | Contains absolute movement value from the internal pulse origin when pulses are output to error counter.<br>Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>• When power to CPU Unit is turned ON</li> <li>• When operation is started</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>• Cyclically on error counter cycle</li> </ul> | This value can be used to monitor the present value of the internal pulse output as an absolute value when using absolute coordinates. |
| A277 | 00 to 15 | Upper 4 digits of the present value of the internal pulse output (absolute value for absolute coordinates) |   |  |  |

### ■ Inverter Positioning 1

Use one of the following for the inverter frequency command.

| Word | Bits     | Function  | Data range   | Refresh timing   | Application examples   |
|------|----------|---|--|--|--|
| A30  | 00 to 15 | Lower 4 digits of present value of unsigned output value (output value = present value of error counter × error counter cycle (s) × gain)<br><b>Note</b> The maximum and minimum output values are applied. | 0000 0000 to 8000 0000 hex<br>(0 to 2,147,483,648) | Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>• When power to CPU Unit is turned ON</li> <li>• At start of operation</li> <li>• When an error counter error occurs</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>• Cyclically according to error counter cycle</li> </ul> | This value can be used when not using automatic frequency command calculations and instead to convert the output value provided here in the user program for output to the inverter.<br><br>This value is used when signed data is not required, i.e., when using communications or normal I/O to specify the direction. |
| A31  | 00 to 15 | Upper 4 digits of present value of unsigned output value (output value = present value of error counter × error counter cycle (s) × gain)<br><b>Note</b> The maximum and minimum output values are applied. |  |  |  |

| Word | Bits     | Function  | Data range   | Refresh timing  | Application examples  |
|------|----------|---|--|---|---|
| A33  | 00 to 15 | Inverter frequency command value (0.01-Hz increments, unsigned)<br><b>Note</b> Set the Power Supply Frequency for One Motor Revolution per Second, Number of Encoder Pulses for One Motor Revolution, and Error Counter Cycle in the PLC Setup before using this value. | 0000 to FFFF hex (0.00 to 655.35 Hz)                     | Cleared to zero at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When an error counter error occurs<br>Updated at following times:<br>Cyclically according to error counter cycle   | These words contain the automatically calculated frequency command value for the inverter. (This value is normally used.)<br>For example, if the frequency setting unit of the inverter is 0.01 Hz, this value can be used as it in serial communications with the inverter. When converting to an analog output (0 to 5 V, 1 to 5 V, 0 to 10 V, 0 to 20 mA, or 4 to 20 mA), this value can be used to simplify the conversion.<br>This value is used when signed data is not required, i.e., when using communications or normal I/O to specify the direction. |
| A34  | 00 to 15 | Lower 4 digits of present value of signed output value (output value = present value of error counter $\times$ error counter cycle (s) $\times$ gain)<br><b>Note</b> The maximum and minimum output values are applied.   | 8000 0000 to 7FFF FFFF hex (–214,748,348 to 214,748,347) | Cleared to zero at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When an error counter error occurs<br>Updated at following times:<br>• Cyclically according to error counter cycle | This value can be used when not using automatic frequency command calculations and instead to convert the output value provided here in the user program for output to the inverter.<br>This value is used when signed data is required, i.e., when outputting the frequency command with an analog output from –10 to 10 V.  |
| A35  | 00 to 15 | Upper 4 digits of present value of signed output value (output value = present value of error counter $\times$ error counter cycle (s) $\times$ gain)<br><b>Note</b> The maximum and minimum output values are applied.   |  |   |   |

Use the following for inverter positioning status and the workpiece position.

| Word | Bits | Function                       | Data range   | Refresh timing   | Application examples  |
|------|------|--------------------------------|--|--|---|
| A36  | 00   | Operation Command Flag         | ON: Operation command executed.<br>OFF: Stop command executed.                 | Turned ON at following times:<br>• When inverter positioning is started<br>Turned OFF at following times:<br>• When power to CPU Unit is turned ON<br>• At start of operation<br>• When CPU Unit operation stops<br>• When inverter positioning is stopped using INI instruction   | This flag is used as a NO input condition when calculating the frequency command value in the user program. It is also used as a NC input condition when clearing the frequency command value to zero.                    |
|      | 01   | Forward Operation Command Flag | ON: Forward command in progress<br>OFF: Reverse command in progress or stopped | Turned ON at following times:<br>• When error counter present value is greater than 0 (i.e., positive)<br>Turned OFF at following times:<br>• When error counter present value is less than 0 (i.e., negative) or zero<br>• When power to CPU Unit is turned ON<br>• When CPU Unit operation starts<br>• When CPU Unit operation stops | This flag is used as a NO input condition when outputting a forward operation command to the inverter from the user program<br>It is also used as a NC input condition when outputting a reverse command to the inverter. |
|      | 02   | Reverse Operation Command Flag | ON: Reverse command in progress<br>OFF: Forward command in progress or stopped | Turned ON at following times:<br>• When error counter present value is less than 0 (i.e., negative)<br>Turned OFF at following times:<br>• When error counter present value is greater than 0 (i.e., positive) or zero<br>• When power to CPU Unit is turned ON<br>• When CPU Unit operation starts<br>• When CPU Unit operation stops | This flag is used as a NO input condition when outputting a reverse operation command to the inverter from the user program<br>It is also used as a NC input condition when outputting a forward command to the inverter. |

| Word | Bits | Function  | Data range  | Refresh timing   | Application examples  |
|------|------|---|---|--|---|
| A36  | 03   | In-position Flag  | ON: In position<br>OFF: Not in position   | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When pulse output to error counter is stopped and absolute value of error counter present value is less than in-position range</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When pulses are being output to error counter</li> <li>When absolute value of error counter present value is greater than in-position range.</li> <li>When power to CPU Unit is turned ON</li> <li>When CPU Unit operation starts</li> <li>When CPU Unit operation stops</li> </ul> | This flag is used as an NO condition when clearing the frequency command value to zero from the user program.   |
|      | 04   | Error Counter Error Flag                                  | ON: Error counter error<br>OFF: No error  | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter error detection value</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When error counter error is reset</li> <li>When power to CPU Unit is turned ON</li> <li>When CPU Unit operation starts</li> <li>When CPU Unit operation stops</li> </ul>   | This flag can be used to provide notification of excessive pulses in the error counter, e.g., when manually moving the motor shaft while positioning is stopped.  |
|      | 05   | Error Counter Pulse Output Flag                           | ON: Pulses being output<br>OFF: Pulse output stopped  | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When pulse output to error counter is started</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When pulse output to error counter is stopped (including immediate stops and deceleration stops)</li> <li>When power to CPU Unit is turned ON</li> <li>When CPU Unit operation starts</li> <li>When CPU Unit operation stops</li> </ul>  | This flag is used to determine whether pulses are being output to the error counter.<br><br>This flag can be used to determine when internal pulse output has been completed and start the next instruction.  |
|      | 06   | Error Counter Pulse Output Acceleration/Deceleration Flag | ON: Pulse output to the error counter is accelerating or decelerating (i.e., the frequency is changing)<br>OFF: Pulse output to the error counter is constant | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When pulse output frequency to error counter is changed by ACC or PLS2 instruction</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>During output of a constant pulse frequency to error counter</li> <li>When pulse output to error counter is stopped (including immediate stops and deceleration stops)</li> <li>When power to CPU Unit is turned ON</li> <li>When CPU Unit operation starts</li> <li>When CPU Unit operation stops</li> </ul>                   | This flag is used to detect changes in the output frequency when the frequency is changed stepwise for internal pulses are being output by the ACC or PLS2 instruction. It can be used as a condition for executing ACC or PLS2 during internal pulse output. |

| Word | Bits     | Function   | Data range  | Refresh timing   | Application examples   |
|------|----------|--|---|--|--|
| A36  | 07       | Error Counter Alarm Flag   | ON: Error counter alarm<br>OFF: No error counter alarm          | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter alarm detection value</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When error counter alarm is reset</li> <li>When power to CPU Unit is turned ON</li> <li>When CPU Unit operation starts</li> <li>When CPU Unit operation stops</li> </ul> | This flag can be used to provide notification of excessive pulses in the error counter, e.g., when encoder wiring breaks during positioning. |
|      | 08 to 14 | Not used.  |   |  |  |
|      | 15       | Inverter Positioning Output Value Sign Flag  | ON:<br>OFF:   | Turned ON at following times:<br><ul style="list-style-type: none"> <li>When signed output value is between 0000 0000 and 7FFF FFFF hex.</li> </ul> Turned OFF at following times:<br><ul style="list-style-type: none"> <li>When signed output value is between FFFF FFFF and 8000 0000 hex.</li> </ul>   | This flag can be used as a direction signal.   |
| A272 | 00 to 15 | Lower 4 digits of the present value of the internal pulse output (absolute value for absolute coordinates) | 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | Contains absolute movement value when pulses are output to error counter.<br>Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>When power to CPU Unit is turned ON</li> <li>When operation is started</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>Cyclically on error counter cycle</li> </ul>  | This value can be used to monitor the present value of the internal pulse output as an absolute value when using absolute coordinates.       |
| A273 | 00 to 15 | Upper 4 digits of the present value of the internal pulse output (absolute value for absolute coordinates) |   |  |  |

Use the following for the present values of the internal pulse and error counter of inverter positioning.

| Word | Bits     | Function   | Data range  | Refresh timing   | Application examples  |
|------|----------|--|---|--|---|
| A32  | 00 to 15 | Error counter 0 present value (signed)                                       | 8000 to 7FFF hex<br>(-32,768 to 32,767)                         | Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>When power to CPU Unit is turned ON</li> <li>At start of operation</li> <li>When an error counter error occurs</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>Cyclically according to error counter cycle</li> </ul> Saved at following times:<br><ul style="list-style-type: none"> <li>When Error Counter Disable Bit (A562.01) is turned ON.</li> </ul> | Use to monitor the difference between the target value and the present value.   |
| A38  | 00 to 15 | Lower 4 digits of present value of pulse output to inverter (relative value) | 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | Contains relative internal pulse output value when pulses are output to error counter.<br>Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>When power to CPU Unit is turned ON</li> <li>When operation is started</li> <li>When pulse output to error counter is started</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>Cyclically on error counter cycle</li> </ul>  | These values can be used to monitor the present value of internal pulse output. |
| A39  | 00 to 15 | Upper 4 digits of present value of pulse output to inverter (relative value) |   |  |   |

| Word | Bits     | Function   | Data range  | Refresh timing   | Application examples   |
|------|----------|--|---|--|--|
| A278 | 00 to 15 | Lower 4 digits of the present value of the internal pulse output (absolute value for absolute coordinates) | 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | Contains absolute movement value from the internal pulse origin when pulses are output to error counter.<br>Cleared to zero at following times:<br><ul style="list-style-type: none"> <li>• When power to CPU Unit is turned ON</li> <li>• When operation is started</li> </ul> Updated at following times:<br><ul style="list-style-type: none"> <li>• Cyclically on error counter cycle</li> </ul> | This value can be used to monitor the present value of the internal pulse output as an absolute value when using absolute coordinates. |
| A279 | 00 to 15 | Upper 4 digits of the present value of the internal pulse output (absolute value for absolute coordinates) |   |  |  |

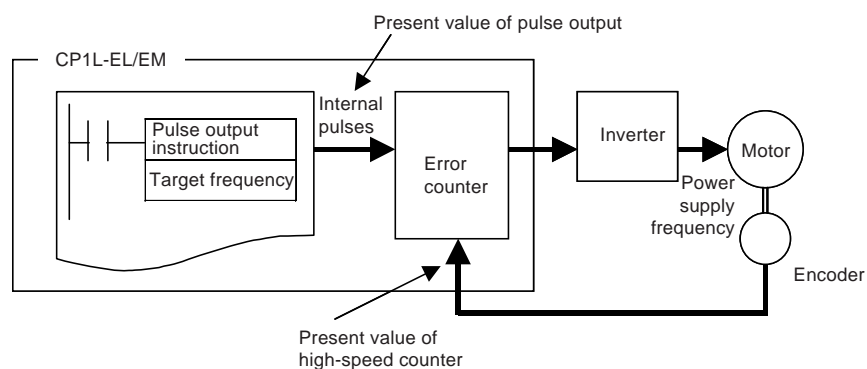
**Read/Write Area**

| Word | Bits     | Function               |                           | Data range   | Refresh timing | Application   |
|------|----------|------------------------|---------------------------|--|----------------|---|
| A562 | 00       | Inverter positioning 0 | Error Counter Reset Bit   | Turned ON: Error counter 0 present value (A22) reset and Error Counter Error Flag cleared. | ---            | Turn ON this bit to clear the error counter error status.   |
|      | 01       |                        | Error Counter Disable Bit | While ON: Error counter value held.  | ---            | Turn ON this bit, for example, to disable accumulating pulses in the error counter when stopping positioning and moving the motor shaft manually. |
|      | 02 to 15 | Not used.              |                           |  |                |   |
| A563 | 00       | Inverter positioning 1 | Error Counter Reset Bit   | Turned ON: Error counter 0 present value (A32) reset and Error Counter Error Flag cleared. | ---            | Turn ON this bit to clear the error counter error status.   |
|      | 01       |                        | Error Counter Disable Bit | While ON: Error counter value held.  | ---            | Turn ON this bit, for example, to disable accumulating pulses in the error counter when stopping positioning and moving the motor shaft manually. |
|      | 02 to 15 | Not used.              |                           |  |                |   |

**Note Present Values of High-speed Counter and Pulse Outputs**

The present value of the high-speed counter when inverter positioning is used is stored in the same memory location as for normal high-speed counter application. This value can be used as the present value of feedback pulses from the encoder, i.e., as the absolute position of inverter positioning. Target value and range comparisons for high-speed counters are also valid.

The present value of the pulse output (A276/A277 or A278/A279), i.e., the pulse output value to the error counter, is an absolute position if an absolute coordinate system is specified and is a relative position if a relative coordinate system is specified.



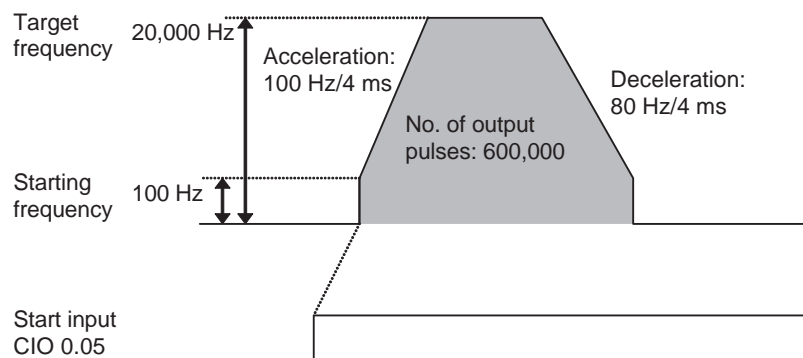
## 7-3-11 Application Example with Serial Communications

### Positioning with Trapezoidal Control

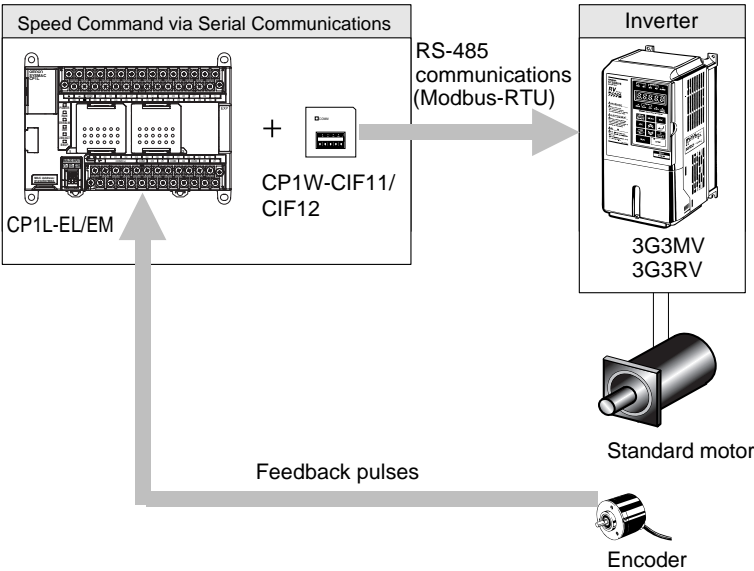
#### Specifications and Operation

When start input CIO 1.04 turns ON, 600,000 pulses are output internally for inverter positioning 0 to turn the motor shaft.

**Note** Refer to 7-3-7 *Determining the Internal Pulse Output Frequency* for the formula to convert the frequency and use the converted internal pulse frequency. The number of output pulses is calculated from the encoder specifications and the high-speed counter multiplier.



System Configuration

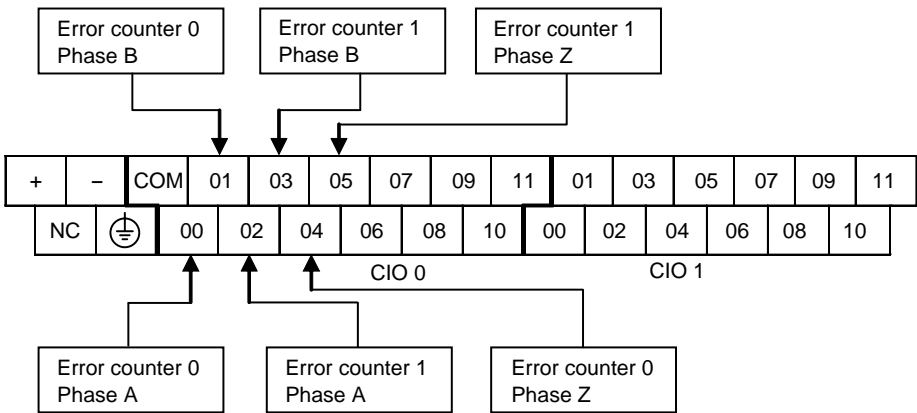


Instructions Used

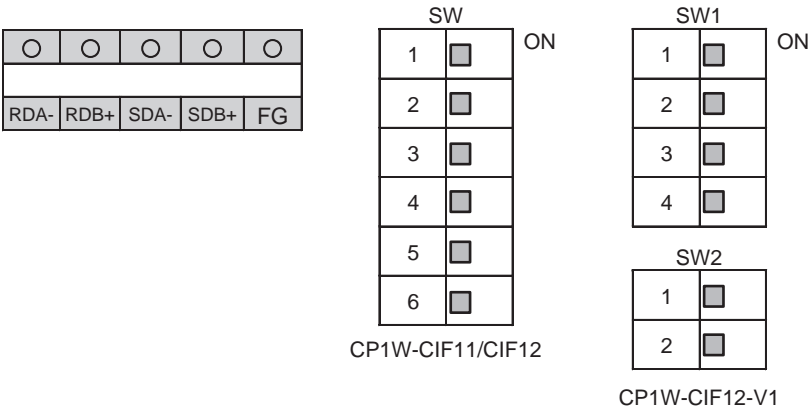
PLS2(887)

Terminal Allocations

■ Error Counter

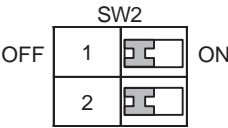
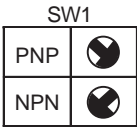
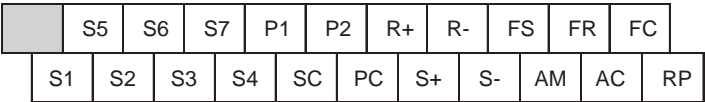


■ RS-422A/485 Communications (CP1W-CIF11/CIF12/CIF12-V1)

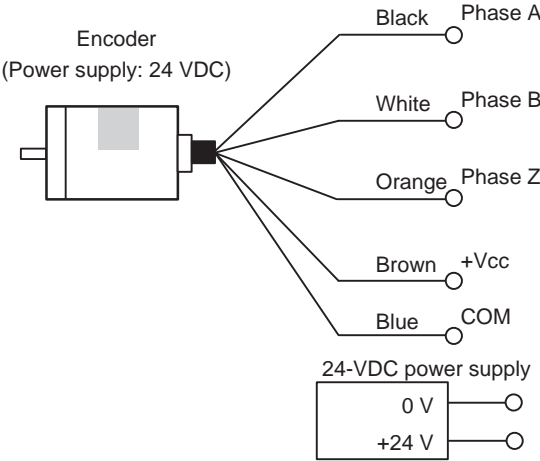




■ Inverter (3G3MV)

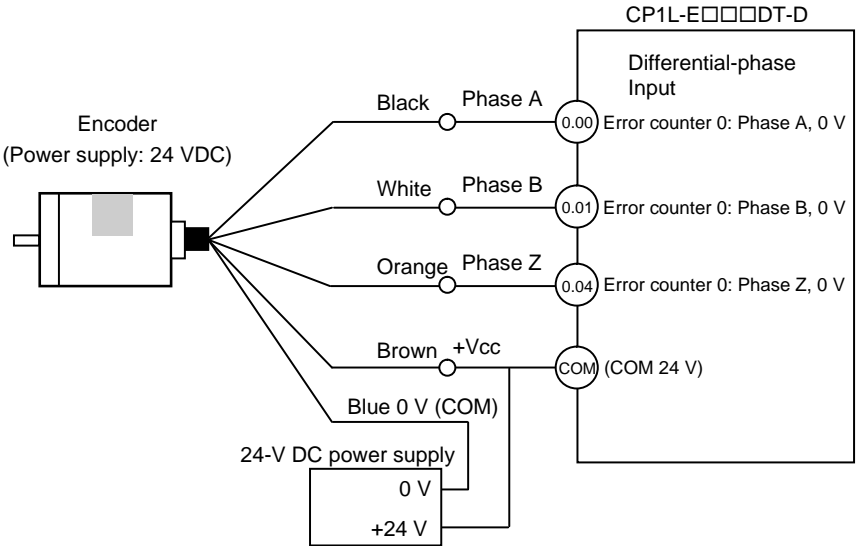


■ Encoder

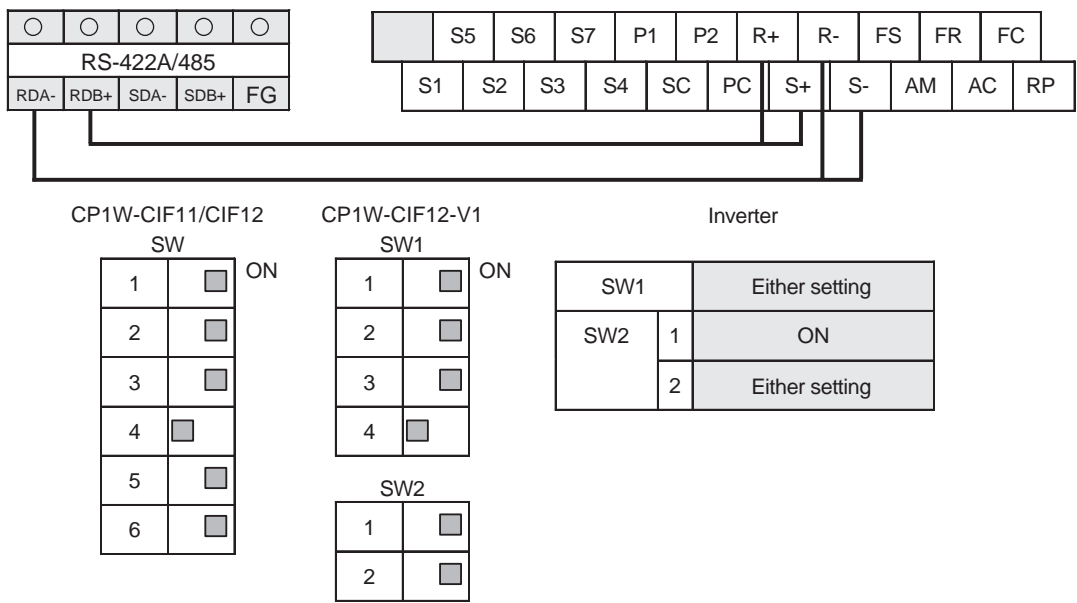


Connection Example

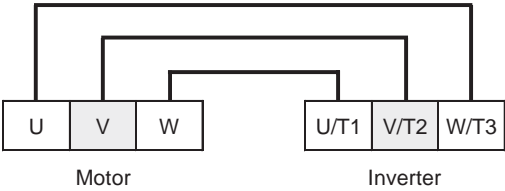
■ Encoder (24 VDC) Connections to High-speed Counter 0



■ RS-422A/485 (CP1W-CIF11/CIF12/CIF12-V1) Connections to Inverter



■ Inverter Connections to Motor



**Parameter Settings for 3G3MV Inverter**

When connecting the Inverter to the PLC, communications parameters must be set in the Inverter. The settings of parameters n152 to n157 cannot be changed while communications are in progress. Always set them before starting communications.

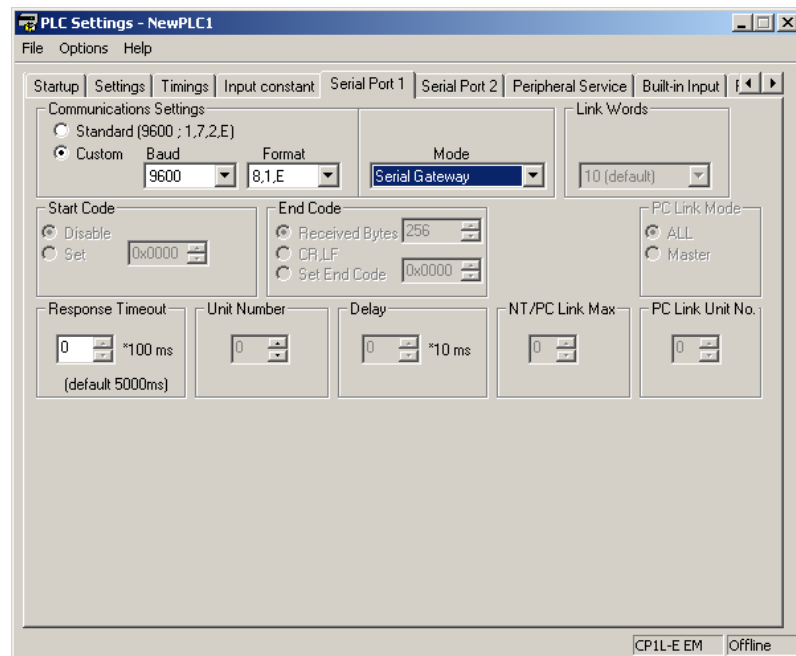
Example settings of 3G3MV parameters are listed below. Refer to the *User's Manual* of the Inverter for details on the parameters.

| Parameter No. | Name   | Description  | Default | Setting  |
|---------------|--|--|---------|--|
| n003          | RUN command selection  | 0: The RUN Key and STOP/RESET Key on the Digital Operator are enabled.<br>1: Multi-function input is enabled through the control circuit terminals.<br>2: RS-422A/485 communications are enabled.<br>3: Input is enabled from the optional Communications Unit.  | 0       | 2  |
| n004          | Frequency reference selection  | 0: Frequency reference adjustment<br>1: Frequency reference 1 (n024)<br>2: Frequency reference control terminal (0 to 10 V)<br>3: Frequency reference control terminal (4 to 20 mA)<br>4: Frequency reference control terminal (0 to 20 mA)<br>5: Pulse train reference control terminal<br>6: Frequency reference through RS-422A/RS-485<br>7: Multi-function analog voltage input (0 to 10 V)<br>8: Multi-function analog current input (4 to 20 mA)<br>9: Frequency reference input through optional Communications Unit. | 0       | 6  |
| n005          | Stopping method selection  | 0: Decelerates to stop<br>1: Coasts to stop  | 0       | 0  |
| n006          | Reverse rotation-prohibit selection  | 0: Reverse enabled<br>1: Reverse disabled  | 0       | 0  |
| n011          | Maximum frequency (FMAX)   | 50.0 to 400.0 Hz (0.1-Hz increments)   | 60.0 Hz | 60.0 Hz<br>(Depends on machine configuration.) |
| n016          | Minimum output frequency (FMIN)  | 0.1 Hz to 10.0 Hz (0.1-Hz increments)  | 1.5 Hz  | 0.1 Hz   |
| n018          | Acceleration/deceleration time setting unit  | 0: 0.1 s<br>1: 0.01 s  | 0       | 0  |
| n019          | Acceleration time 1  | 0 to 6,000 s   | 10.0 s  | 0  |
| n020          | Deceleration time 1  | 0 to 6,000 s   | 10.0 s  | 0  |
| n151          | RS-422A/485 communications timeover detection selection<br>(The time between receiving PLC signals is monitored, Timeout time: 2 s.) | 0: Detects time-over, fatal error, and the Inverter coasts to a stop.<br>1: Detects time-over, detects fatal error, and the Inverter decelerates to a stop in deceleration time 1.<br>2: Detects time-over, detects fatal error, and the Inverter decelerates to a stop in deceleration time 2.<br>3: Detects time-over, detects nonfatal error warning, and the Inverter continues operating.<br>4: No time-over is detected.   | 0       | 0  |
| n152          | RS-422A/485 communications frequency reference/display unit selection  | 0: 0.1 Hz<br>1: 0.01 Hz<br>2: Converted value based on 30,000 decimal as maximum frequency<br>3: 0.1% (Maximum frequency: 100%)  | 0       | 1  |

| Parameter No. | Name                                     | Description  | Default | Setting |
|---------------|--|--|---------|---------|
| n153          | RS-422A/485 communications Slave address | Setting range: 0 to 32<br>00: Communications disabled<br>01 to 32: Slave address | 0       | 1       |
| n154          | RS-422A/485 baud rate selection          | 0: 2,400 bps<br>1: 4,800 bps<br>2: 9,600 bps<br>3: 19,200 bps                    | 2       | 2       |
| n155          | RS-422A/485 parity selection             | 0: Even<br>1: Odd<br>2: No parity  | 0       | 0       |
| n156          | RS-422A/485 send wait time               | Set value: 10 to 65 ms<br>Setting unit: 1 ms                                     | 10 ms   | 10 ms   |
| n157          | RS-422A/485 RTS control selection        | 0: RTS control enabled<br>1: RTS control disabled                                | 0       | 0       |

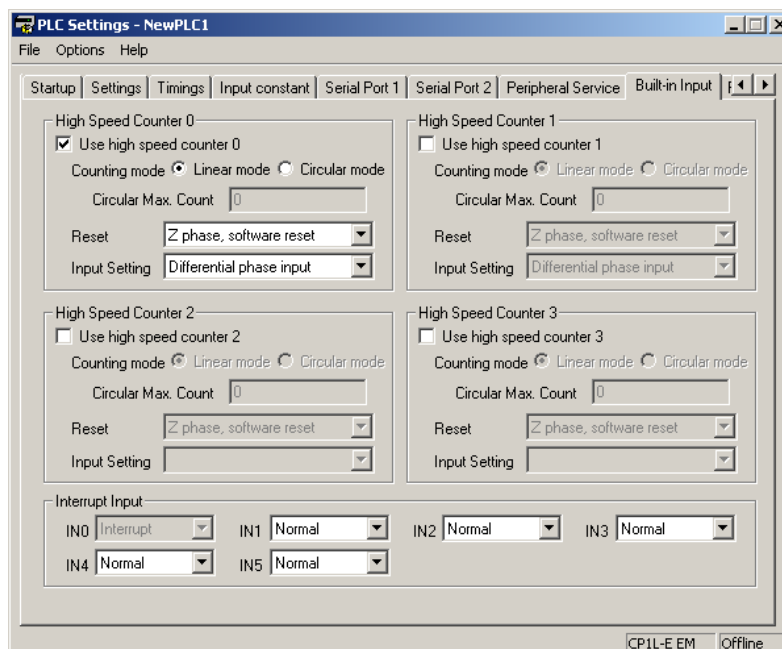
## PLC Setup

### ■ Serial Port Communications Settings



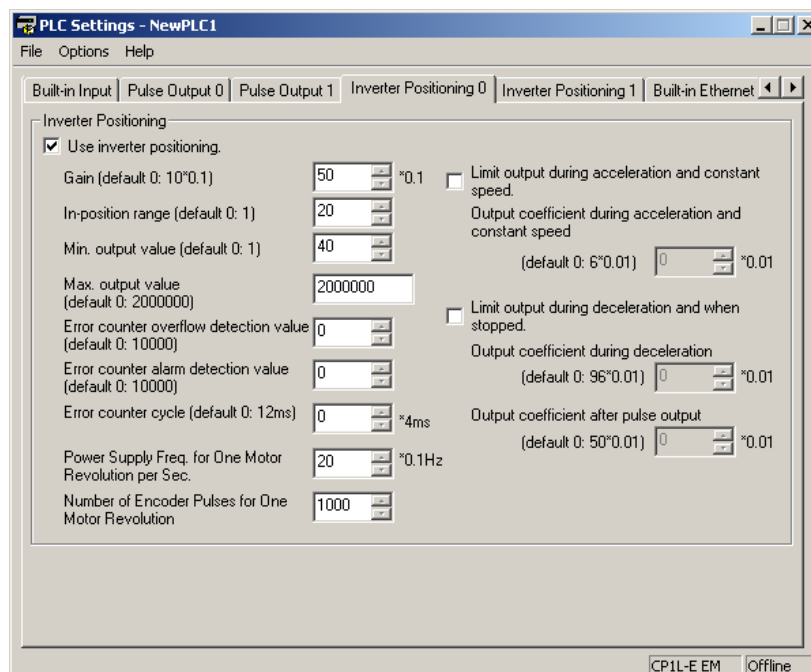
- Note**
- (1) Set the baud rate and parity check settings to the same value as for the Inverter communications parameters.
  - (2) Set the serial port to the serial gateway communications mode.

### ■ High-speed Counter Settings (on Built-in Input Tab Page)



- Note**
- (1) Set high-speed counter 0 when using inverter positioning 0. Set high-speed counter 1 when using inverter positioning 1.
  - (2) Use linear mode for inverter positioning.

### ■ Inverter Positioning Settings (on Inverter Positioning 0 or 1 Tab Page)



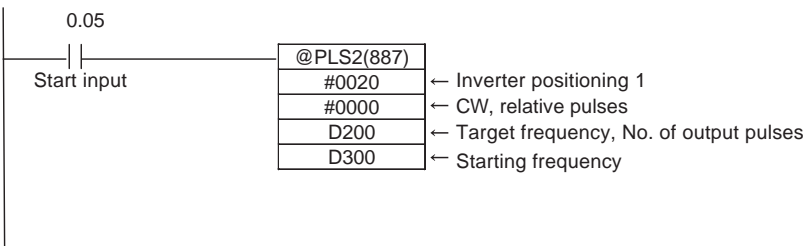
### Ladder Program

The following Modbus-RTU communications parameters are used.

|                            |                |
|----------------------------|----------------|
| Baud rate                  | 9,600 bits/s   |
| Format                     | 8, 1, E        |
| Serial communications mode | Serial Gateway |

Serial port 1 is used for communications with the Inverter.

Starting Inverter Positioning

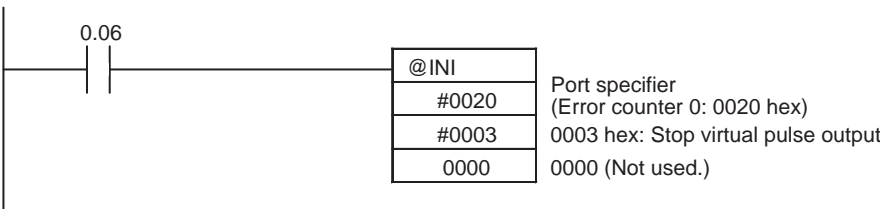


■ PLS2(887) Settings

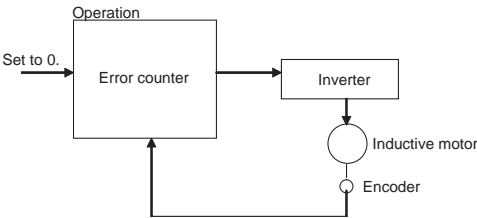
| Setting details                         | Address | Data |
|---|---------|------|
| Acceleration rate: 100 Hz/4 ms          | D200    | 0064 |
| Deceleration rate: 80 Hz/4 ms           | D201    | 0050 |
| Target frequency: 20,000 Hz             | D202    | 4E20 |
|   | D203    | 0000 |
| Number of output pulses: 600,000 pulses | D204    | 27C0 |
|   | D205    | 0009 |
| Starting frequency: 100 Hz              | D300    | 0064 |
|   | D301    | 0000 |

- High-speed counter 0 (i.e., error counter 0) is used for the feedback pulse input port.

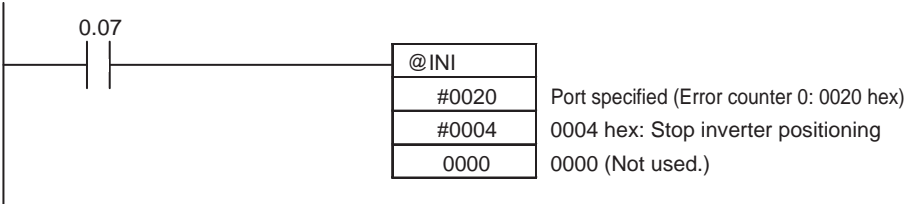
Stopping Internal Pulse Output to the Error Counter



- Internal pulse output is stopped immediately.
- Inverter positioning (i.e., the error counter) will continue to function.

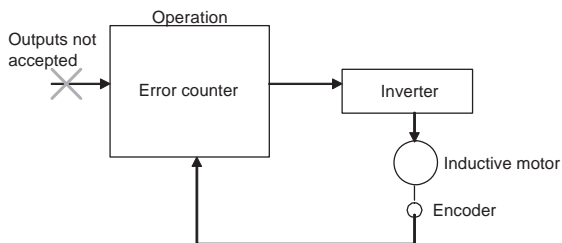


Stopping Inverter Positioning



- Internal pulse output is stopped immediately.
- The output value will remain at 0 until the error counter is reset.

- Pulse outputs will not be accepted until the error counter is reset. (Executing a pulse output instruction will cause an error.)

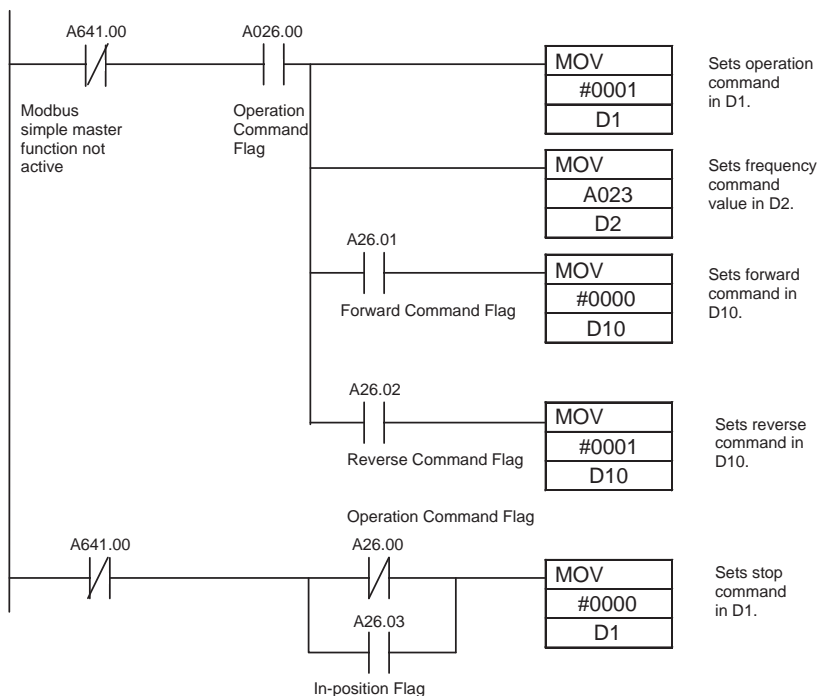


### Referencing the Automatically Calculated Inverter Frequency Command Value

If the following settings are made in the PLC Setup, the inverter frequency command value will be calculated automatically and set in A23 in the Auxiliary Area. These settings are on the Inverter Positioning 0 Tab Page in the PLC Setup.

- Power Supply Frequency for One Motor Revolution per Second (0.1-Hz increments)
- Number of Encoder Pulses for One Motor Revolution
- Error Counter Cycle (x 4 ms)

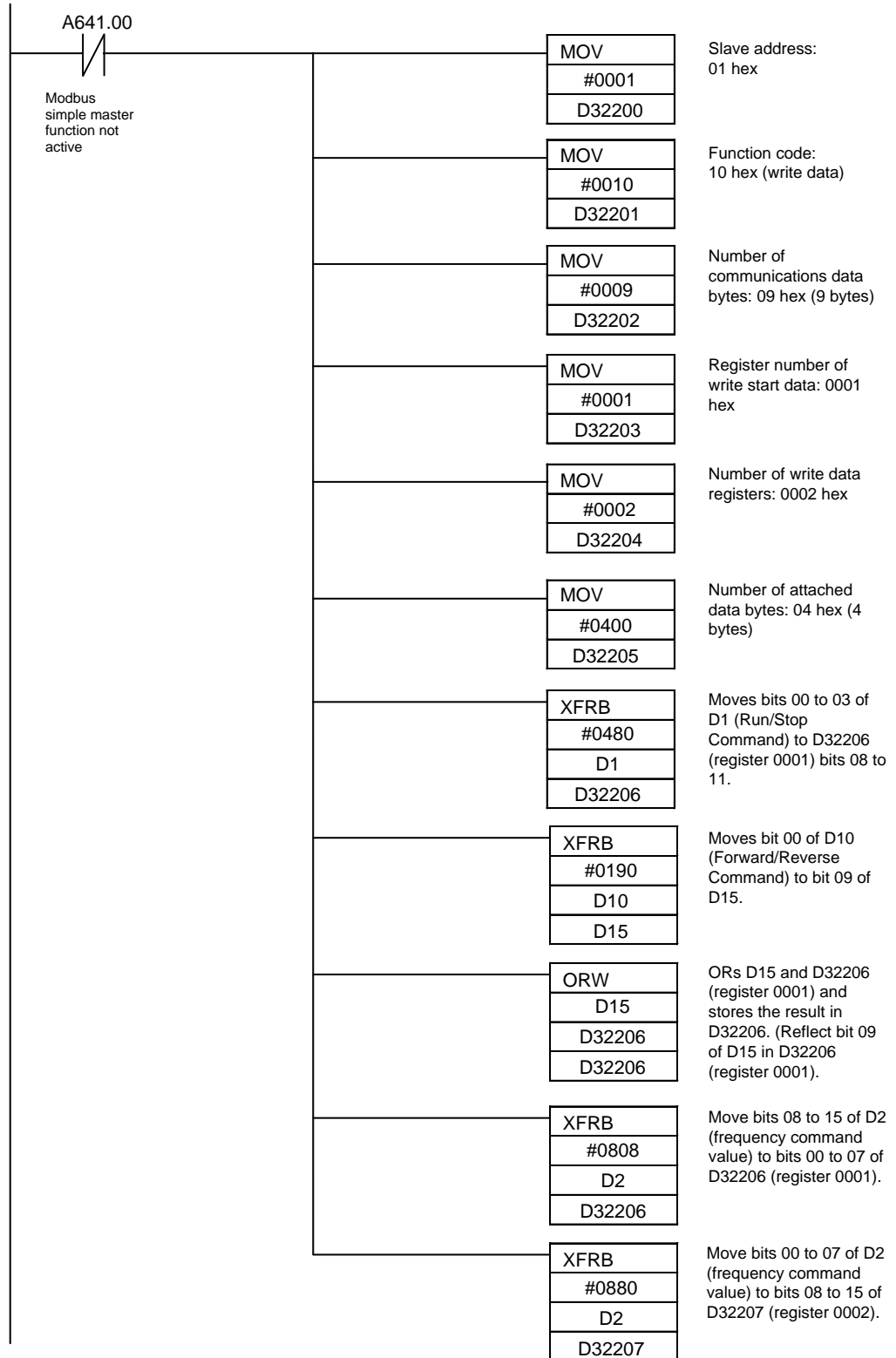
The inverter frequency command value in A23 is accessed. The value is stored in 0.01-Hz increments.



### Internal Work Addresses

| Address | Usage                                  |
|---------|--|
| D1      | Bits 00 to 03: Run/Stop Command        |
| D2      | Bits 00 to 15: Frequency Command Value |
| D10     | Bits 00 to 03: Forward/Reverse Command |

## Setting Modbus Communications Registers





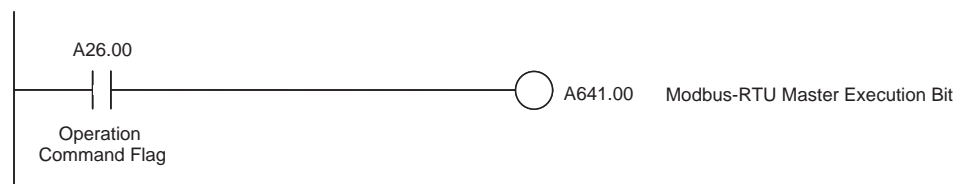
### ■ Internal Work Addresses

| Address | Usage                                  |
|---------|--|
| D1      | Bits 00 to 03: Run/Stop Command        |
| D2      | Bits 00 to 15: Frequency Command Value |
| D10     | Bits 00 to 03: Forward/Reverse Command |
| D15     | Bit 09: Forward/Reverse Command        |

### ■ Settings Addresses

| Address | Usage  | Data |
|---------|--|------|
| D32200  | Bits 00 to 07: Slave address   | 01   |
| D32201  | Bits 00 to 07: Function code   | 10   |
| D32202  | Bits 00 to 07: Number of communications data bytes   | 09   |
| D32203  | Bits 00 to 15: Register number of write start data   | 0001 |
| D32204  | Bits 00 to 15: Number of data registers to write   | 0002 |
| D32205  | Bits 08 to 15: Number of attached data bytes   | 04   |
| D32206  | Bits 00 to 07: Upper bytes of frequency command value in D2<br>Bit 08: Run/Stop Command<br>Bit 09: Forward/Reverse Command | ---  |
| D32207  | Bits 08 to 15: Lower bytes of frequency command value in D2  | ---  |

### Modbus Communications



Add the above instructions to the end of the program as a starting condition for the ladder programming example. For error processing, refer to the ladder program in *8-3-3 Modbus-RTU Easy Master Function* and to the inverter's manual.

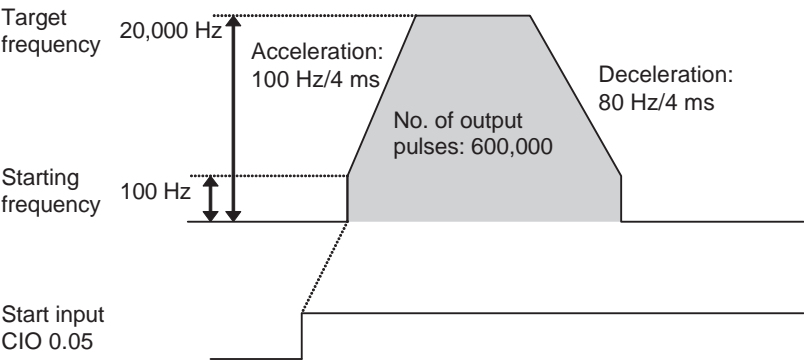
## 7-3-12 Application Example with an Analog Output

### Positioning with Trapezoidal Control

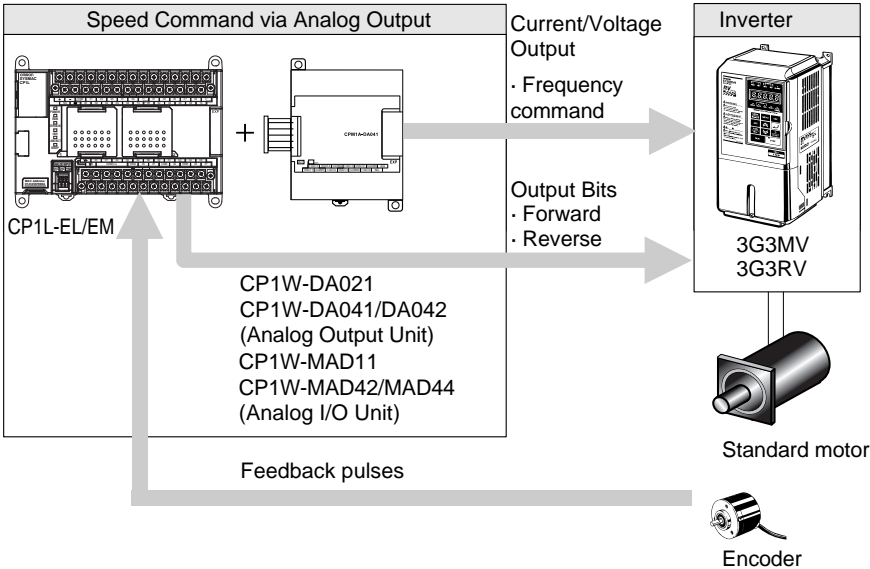
#### Specifications and Operation

When start input CIO 1.04 turns ON, 600,000 pulses are output internally for inverter positioning 0 to turn the motor shaft.

**Note** Refer to *7-3-7 Determining the Internal Pulse Output Frequency* for the formula to convert the frequency and use the converted internal pulse frequency. The number of output pulses is calculated from the encoder specifications and the high-speed counter multiplier.



System Configuration

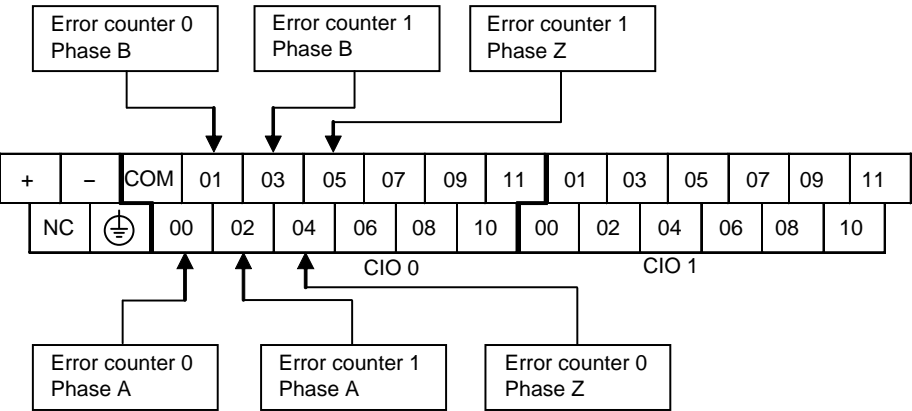


Instructions Used

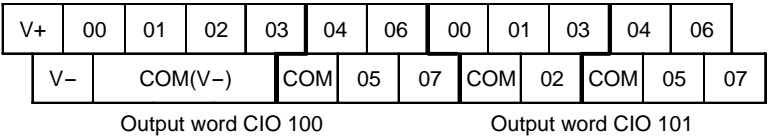
PLS2(887)

Terminal Allocations

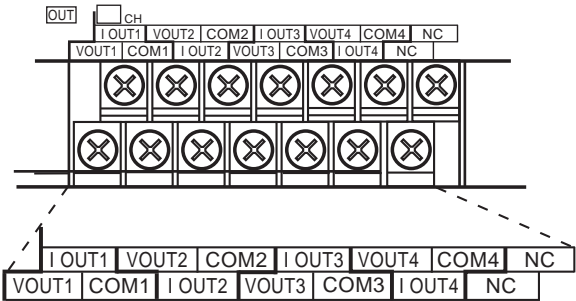
Error Counter



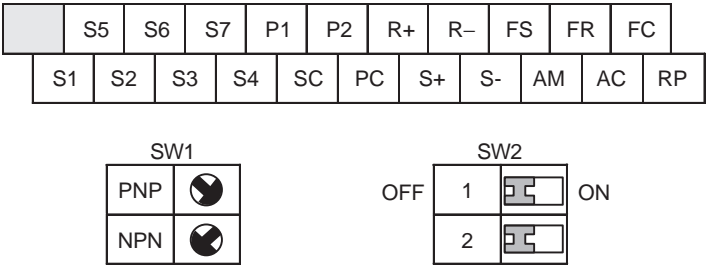
■ Built-in Outputs (Example: Sinking Transistor Outputs)



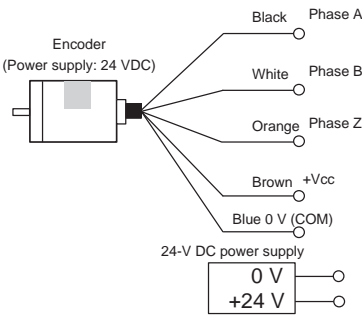
■ CP1W-DA041



■ Inverter (3G3MV)

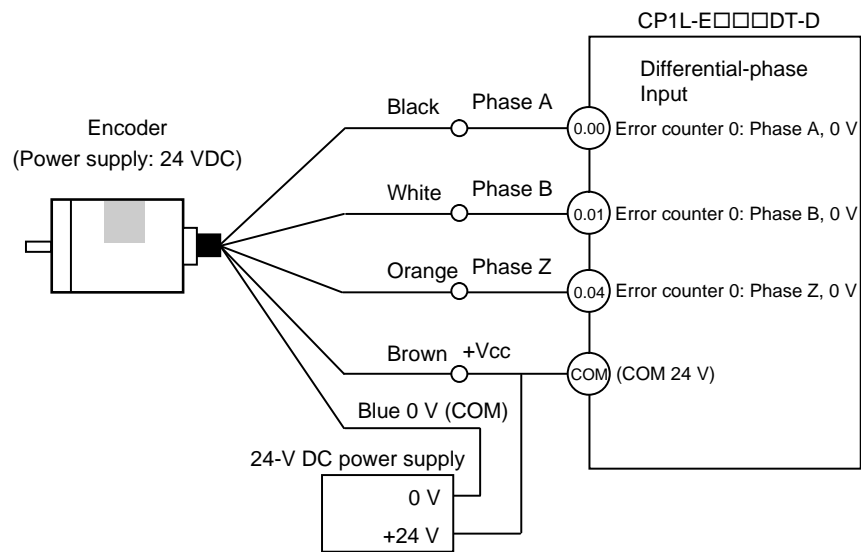


■ Encoder

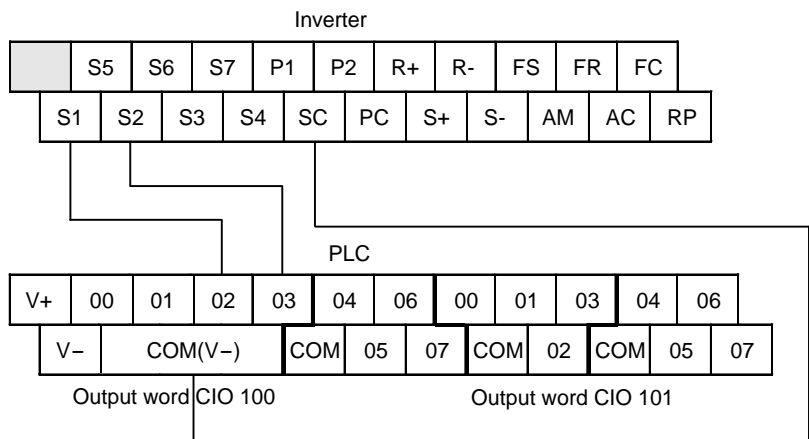


Connection Example

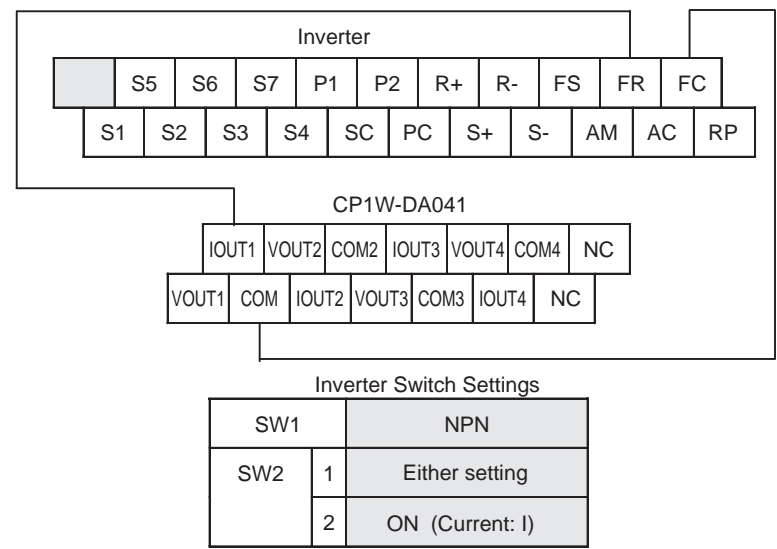
Encoder (24 VDC) Connections to High-speed Counter 0



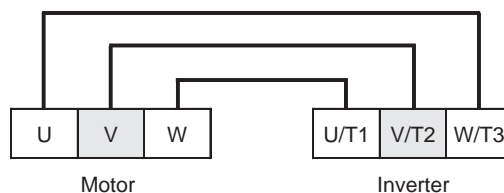
Output Terminal Connections to Inverter



CP1W-DA041 (Current Output) Connections to Inverter



### ■ Inverter Connections to Motor



### Parameter Settings for 3G3MV Inverter

When connecting the Inverter to the PLC, communications parameters must be set in the Inverter.

Example settings of 3G3MV parameters are listed below. Refer to the *User's Manual* of the Inverter for details on the parameters.

| Parameter No. | Name  | Description  | Default | Setting  |
|---------------|---|--|---------|--|
| n003          | RUN command selection                       | 0: The RUN Key and STOP/RESET Key on the Digital Operator are enabled.<br>1: Multi-function input is enabled through the control circuit terminals.<br>2: RS-422A/485 communications are enabled.<br>3: Input is enabled from the optional Communications Unit.  | 0       | 1  |
| n004          | Frequency reference selection               | 0: Digital Operator<br>1: Frequency reference 1 (n024)<br>2: Frequency reference control terminal (0 to 10 V)<br>3: Frequency reference control terminal (4 to 20 mA)<br>4: Frequency reference control terminal (0 to 20 mA)<br>5: Pulse train reference control terminal<br>6: Frequency reference through RS-422A/RS-485<br>7: Multi-function analog voltage input (0 to 10 V)<br>8: Multi-function analog current input (4 to 20 mA)<br>9: Frequency reference input through optional Communications Unit. | 0       | 4  |
| n050          | Multi-function input 1                      | 1 to 25  | 1       | 1  |
| n051          | Multi-function input 2                      | 1 to 25  | 2       | 2  |
| n060          | Frequency reference gain                    | 0% to 255% (1% increments)   | 100%    | 100%   |
| n061          | Frequency reference bias                    | –100% to 100% (1% increments)  | 0%      | 0%   |
| n005          | Stopping method selection                   | 0: Decelerates to stop<br>1: Coasts to stop  | 0       | 0  |
| n006          | Reverse rotation-prohibit selection         | 0: Reverse enabled<br>1: Reverse disabled  | 0       | 0  |
| n011          | Maximum frequency (FMAX)                    | 50.0 to 400.0 Hz (0.1-Hz increments)   | 60.0 Hz | 60.0 Hz<br>(Depends on machine configuration.) |
| n016          | Minimum output frequency (FMIN)             | 0.1 Hz to 10.0 Hz (0.1-Hz increments)  | 1.5 Hz  | 0.1 Hz   |
| n018          | Acceleration/deceleration time setting unit | 0: 0.1 s<br>1: 0.01 s  | 0       | 0  |
| n019          | Acceleration time 1                         | 0 to 6,000 s   | 10.0 s  | 0  |
| n020          | Deceleration time 1                         | 0 to 6,000 s   | 10.0 s  | 0  |

## PLC Setup

### ■ High-speed Counter Settings (on Built-in Input Tab Page)

PLC Settings - NewPLC1

File Options Help

Built-in Input | Pulse Output 0 | Pulse Output 1 | Inverter Positioning 0 | Inverter Positioning 1 | Built-in Ethernet

**High Speed Counter 0**

☒ Use high speed counter 0

Counting mode: ☒ Linear mode ☐ Circular mode

Circular Max. Count: 0

Reset: Z phase, software reset

Input Setting: Differential phase input

**High Speed Counter 1**

☐ Use high speed counter 1

Counting mode: ☒ Linear mode ☐ Circular mode

Circular Max. Count: 0

Reset: Z phase, software reset

Input Setting: Differential phase input

**High Speed Counter 2**

☐ Use high speed counter 2

Counting mode: ☒ Linear mode ☐ Circular mode

Circular Max. Count: 0

Reset: Z phase, software reset

Input Setting:

**High Speed Counter 3**

☐ Use high speed counter 3

Counting mode: ☒ Linear mode ☐ Circular mode

Circular Max. Count: 0

Reset: Z phase, software reset

Input Setting:

**Interrupt Input**

IN0: Interrupt IN1: Normal IN2: Normal IN3: Normal

IN4: Normal IN5: Normal

CP1L-E EM Offline

- Note**
- (1) Set high-speed counter 0 when using inverter positioning 0. Set high-speed counter 1 when using inverter positioning 1.
  - (2) Use linear mode for inverter positioning.

### ■ Inverter Positioning Settings (on Inverter Positioning 0 or 1 Tab Page)

PLC Settings - NewPLC1

File Options Help

Built-in Input | Pulse Output 0 | Pulse Output 1 | Inverter Positioning 0 | Inverter Positioning 1 | Built-in Ethernet

**Inverter Positioning**

☒ Use inverter positioning

Gain (default 0: 10\*0.1): 50 \*0.1

In-position range (default 0: 1): 20

Min. output value (default 0: 1): 40

Max. output value (default 0: 2000000): 2000000

Error counter overflow detection value (default 0: 10000): 0

Error counter alarm detection value (default 0: 10000): 0

Error counter cycle (default 0: 12ms): 0 \*4ms

Power Supply Freq. for One Motor Revolution per Sec.: 20 \*0.1Hz

Number of Encoder Pulses for One Motor Revolution: 1000

☐ Limit output during acceleration and constant speed.

Output coefficient during acceleration and constant speed (default 0: 6\*0.01): 0 \*0.01

☐ Limit output during deceleration and when stopped.

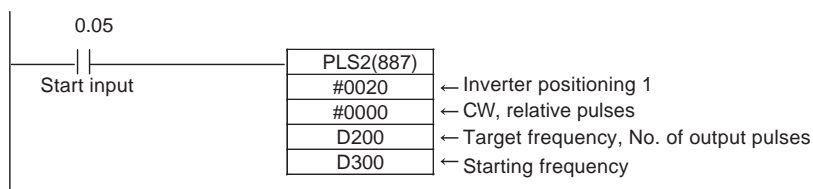
Output coefficient during deceleration (default 0: 96\*0.01): 0 \*0.01

Output coefficient after pulse output (default 0: 50\*0.01): 0 \*0.01

CP1L-E EM Offline

## Ladder Program

### Starting Inverter Positioning



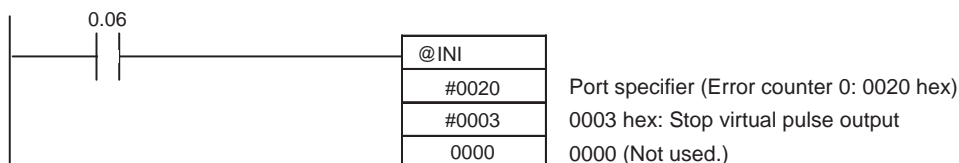
**Note** The pulse output method (CCW/CW or pulse + direction) setting and direction setting are not used.

#### ■ PLS2(887) Settings

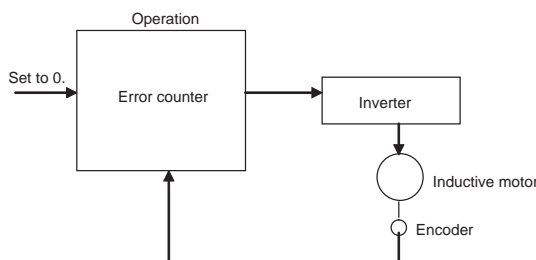
| Setting details                         | Address | Data |
|---|---------|------|
| Acceleration rate: 100 Hz/4 ms          | D200    | 0064 |
| Deceleration rate: 80 Hz/4 ms           | D201    | 0050 |
| Target frequency: 20,000 Hz             | D202    | 4E20 |
|   | D203    | 0000 |
| Number of output pulses: 600,000 pulses | D204    | 27C0 |
|   | D205    | 0009 |
| Starting frequency: 100 Hz              | D300    | 0064 |
|   | D301    | 0000 |

- High-speed counter 0 (i.e., error counter 0) is used for the feedback pulse input port.

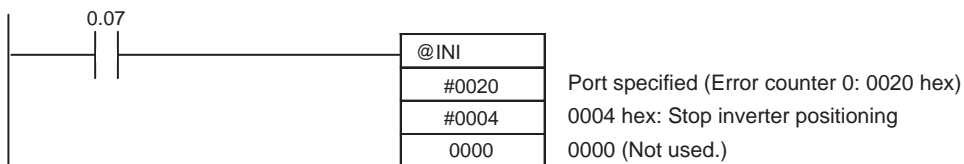
### Stopping Internal Pulse Output to the Error Counter



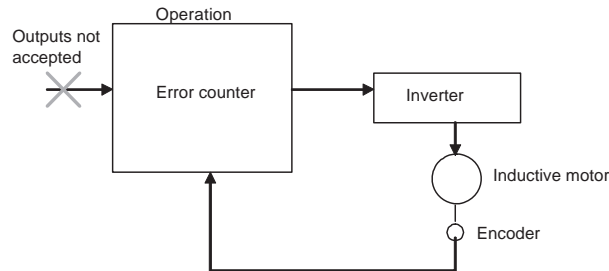
- Internal pulse output is stopped immediately.
- Inverter positioning (i.e., the error counter) will continue to function.



### Stopping Inverter Positioning



- Internal pulse output is stopped immediately.
- The output value will remain at 0 until the error counter is reset.
- Pulse outputs will not be accepted until the error counter is reset. (Executing a pulse output instruction will cause an error.)



### Referencing the Automatically Calculated Inverter Frequency Command Value

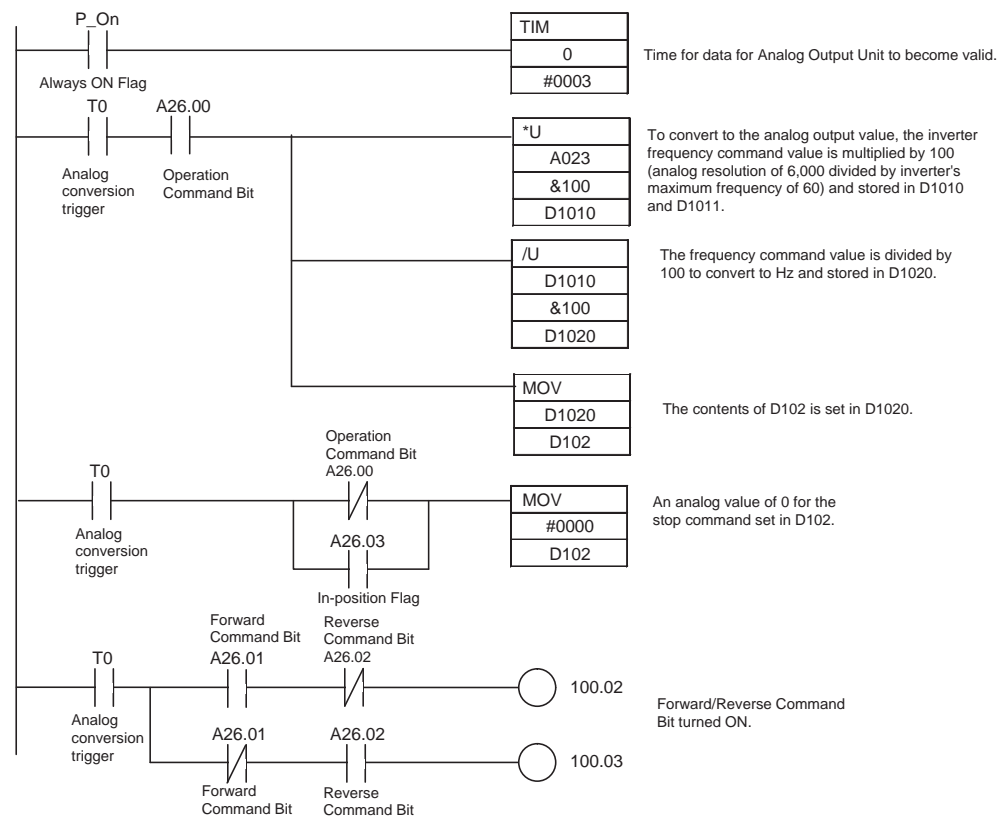
If the following settings are made in the PLC Setup, the inverter frequency command value will be calculated automatically and set in A23 in the Auxiliary Area. These settings are on the Inverter Positioning 0 Tab Page in the PLC Setup.

- Power Supply Frequency for One Motor Revolution per Second (0.1-Hz increments)
- Number of Encoder Pulses for One Motor Revolution
- Error Counter Cycle (x 4 ms)

The inverter frequency command value in A23 is accessed and converted to an analog output signal. The CP1W-DA041 has a resolution of 6,000, so the conversion to an analog signal is performed as follows:

$$6,000 \div 60 \text{ Hz (inverter's maximum output frequency)} \div 100 = 1$$

The conditions are as follows:



In this example, the results of \*U and /U are 1, so the value in A23 is moved directly to D102 with MOV.



### ■ Internal Work Addresses

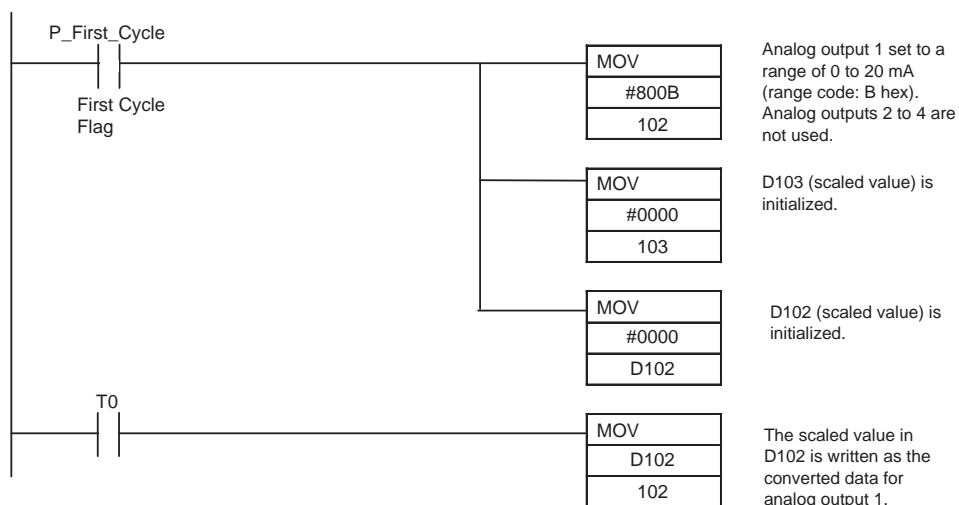
| Address | Usage   |
|---------|---|
| D1010   | Holds the frequency command value converted for the analog output resolution. |
| D1011   |   |
| D1020   | Holds the frequency command value converted from 0.01-Hz increments to hertz. |
| T0      | Analog conversion trigger   |

### ■ Settings Addresses

| Address    | Usage                              |
|------------|------------------------------------|
| D102       | Bits 00 to 15: Analog output value |
| CIO 100.02 | Forward (external output)          |
| CIO 100.03 | Reverse (external output)          |

### CP1W-DA041 Analog Output Settings

Analog output 1 is used in this example. It is set to a range of 4 to 20 mA. The scaled value is set in the analog conversion area of the Analog Output Unit.



Refer to the first line in the programming example in *Referencing the Automatically Calculated Inverter Frequency Command Value* on page 370 for a timer for the time required for the Analog Output Unit's data to be valid (analog conversion trigger: T0).

### ■ Internal Work Addresses

| Address | Usage                              |
|---------|------------------------------------|
| D102    | Bits 00 to 15: Analog output value |
| T0      | Analog conversion trigger          |

### ■ Settings Addresses

| Address | Usage                                 |
|---------|---------------------------------------|
| CIO 102 | Bits 00 to 15: Analog conversion area |
| CIO 103 | Bits 00 to 15: Analog conversion area |

### 7-3-13 Supplemental Information

#### Restrictions

- Inverter positioning 0 and inverter positioning 1 each use one high-speed counter and one serial port (except that a serial port is not used when an Analog Output Unit is used). (High-speed counter 0 is allocated to inverter positioning 0 and high-speed counter 1 is allocated to inverter positioning 1.)
- When inverter positioning 0 or 1 is used, the corresponding pulse output (0 or 1) and the corresponding PWM command (pulse output 0 or 1) cannot be used.

#### Precautions

- Determine the in-position range based on the mechanical system. Use a smaller range if positioning precision is required. If the range is too small, however, time may be required when stopping. If stopping quickly is more important than precision, increase the in-position range.
- The error counter cycle also affects the conversion between the output value and the inverter frequency command value. Refer to 7-3-9 *Automatic Calculation of Inverter Frequency Command Value* for details.
- If inverter positioning does not end normally, adjust the following settings.
  - Reduce the acceleration/deceleration rates.  
Lower rates will stabilize operation at the end of acceleration/deceleration.
  - Reduce the target frequency.
  - Change the error counter cycle. Increasing the error counter cycle improve stopping precision, but it may also cause unstable speeds during operation.
  - Adjust the gain.  
Increasing the gain will improve stopping precision, but it may also cause unstable speeds during operation.

## SECTION 8

### Advanced Functions

This section describes all of the advanced functions of the CP1L-EL/EM that can be used to achieve specific application needs.

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| 8-1-4 | Scheduled Interrupts .....  | 386 |
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## 8-1 Interrupt Functions

### 8-1-1 Overview of CP1L-EL/EM Interrupt Functions

The CP1L-EL/EM CPU Unit's processing is normally cyclical (overseeing processing → program execution → I/O refreshing → peripheral servicing), with cyclic tasks executed in the program execution stage of the cycle. The interrupt functions can be used to temporarily interrupt this cyclic processing and execute a particular program when a predefined condition occurs.

#### Types of Interrupt Functions

##### **Input Interrupts (Direct Mode)**

When one of the CPU Unit's built-in inputs goes from OFF to ON (or ON to OFF), the corresponding interrupt task is executed. Interrupt tasks 140 to 145 are allocated to the 8 input terminals used for the input interrupts.

##### **Input Interrupts (Counter Mode)**

This function counts input pulses at one of the CPU Unit's built-in inputs and executes the corresponding interrupt task when the count reaches the SV.

The maximum input response frequency for input interrupts (in counter mode) is 5 kHz.

##### **Scheduled Interrupts**

This function executes an interrupt task at a fixed time interval measured by the CPU Unit's built-in timer. The time interval units can be set to 10 ms, 1 ms, or 0.1 ms. The minimum timer SV is 0.5 ms.

Interrupt task 2 is allocated to scheduled interrupt.

##### **High-speed Counter Interrupts**

This function counts input pulses with the CPU Unit's built-in high-speed counter and executes an interrupt task when the count reaches the preset value or falls within a preset range (target-value or zone comparison). An interrupt task between 0 and 255 can be allocated with an instruction.

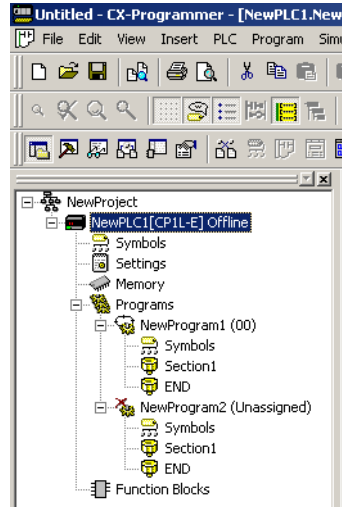
Refer to *7-1 High-speed Counters* for details on high-speed counters.

#### **Note**

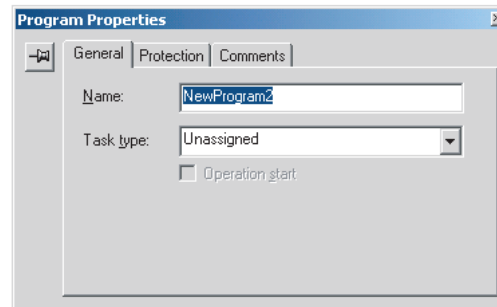
- (1) Power OFF interrupts cannot be used with CP1L-EL/EM CPU Units.
- (2) The input terminals are used for input interrupts, but cannot be used for quick-response inputs, high-speed counters, origin searches and normal inputs.

## Creating an Interrupt Task Program

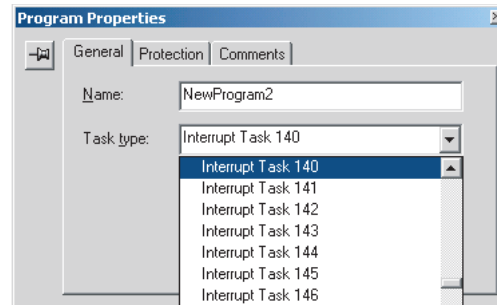
- 1,2,3... 1. Right-click *NewPLC1 [CP1L-E] Offline* in the project workspace and select **Insert Program** from the pop-up menu. A new program called *NewProgram2 (unassigned)* will be inserted in the project workspace.



2. Right-click *NewProgram2 (unassigned)* and select **Properties** from the pop-up menu to display the Program Properties Window.



3. Set the *Task type* in the Program Properties Window. In this example, interrupt task 140 was allocated to NewProgram2.



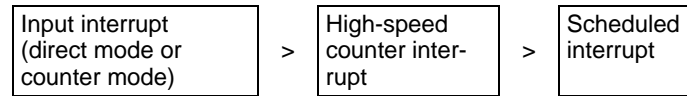
If you click the **X** Button in the upper-right corner of the window, you can create the program that will be executed as interrupt task 140.

The programs allocated to each task are independent and an END(001) instruction must be input at the end of each program.

**Interrupt Task Priority**

The input interrupts (direct mode and counter mode), high-speed counter interrupts, scheduled interrupts, and external interrupts all have the same priority. If interrupt task A (an input interrupt, for example) is being executed when interrupt task B (a scheduled interrupt, for example) is called, task A processing will not be interrupted. Task B processing will be started when task A is completed.

If two different types of interrupt occur simultaneously, they are executed in the following order:



If two of the same type interrupt occur simultaneously, the task with the lower interrupt task number is executed first.

**Note**

If a user program is likely to generate multiple interrupts simultaneously, the interrupt tasks will be executed in the order shown above, so it may take some time from the occurrence of the interrupt condition to the actual execution of the corresponding interrupt task. In particular, it is possible that scheduled interrupts will not be executed in the preset time, so the program must be designed to avoid interrupt conflicts if necessary.

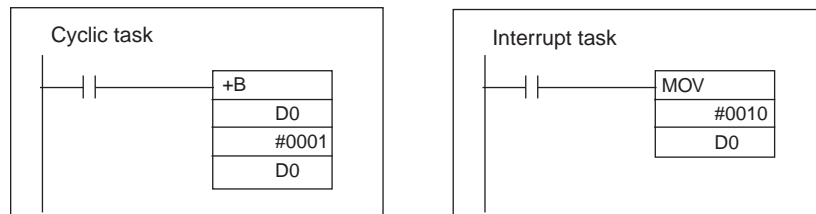
**Duplicate Processing in Cyclic and Interrupt Tasks**

If a memory address is processed both by a cyclic task and an interrupt task, an interrupt mask must be set to disable interrupts.

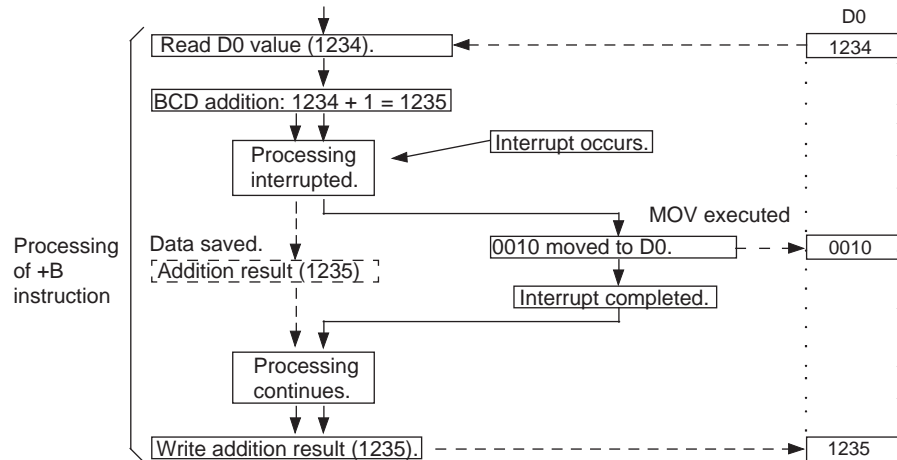
When an interrupt occurs, execution of the cyclic task will be interrupted immediately, even during execution of a cyclic task's instruction, and the partially processed data is saved. After the interrupt task is completed, processing returns to the cyclic task and the interrupted processing restarts with the data saved before the interrupt processing. If the interrupt task overwrites a memory address used by one of the interrupted instruction's operands, that overwrite may not be reflected after the saved data is restored as processing returns to the cyclic task.

To prevent an instruction from being interrupted during processing, enter DI(693) just before the instruction to disable interrupts and EI(694) just after the instruction to enable interrupts again.

- a. The following example shows duplicate processing by an interrupt task, which interrupts processing of a +B instruction between the first and third operands and overwrites the same memory address.



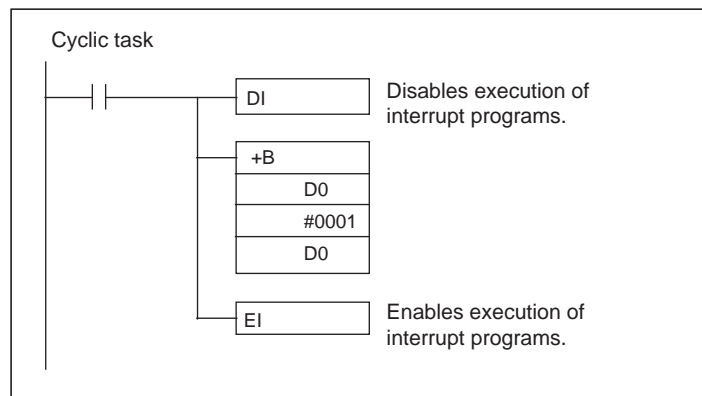
### Flow of Processing



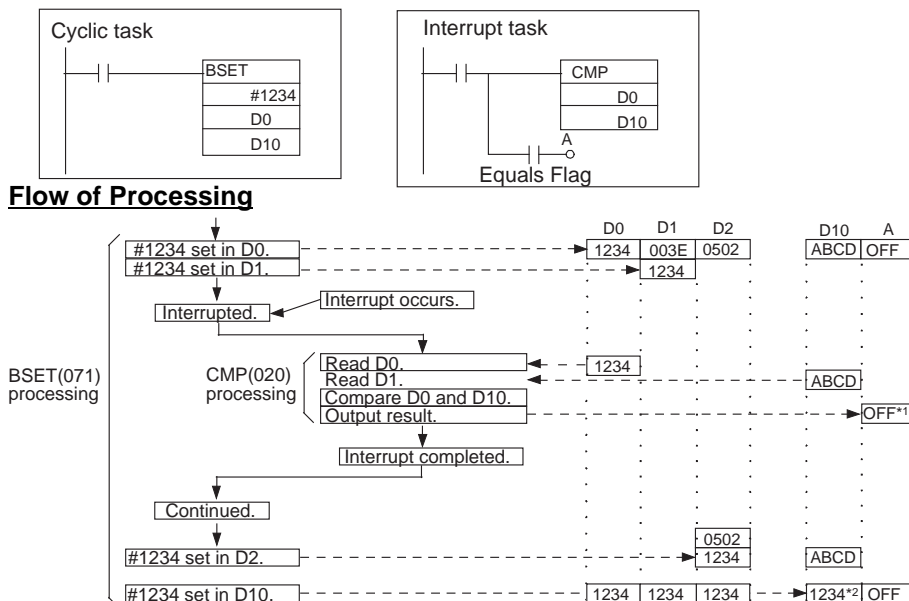
The interrupt occurs during processing of the +B instruction and the result is saved temporarily without being written to the destination word (D0).

The interrupt task transfers the value of #0010 to D0, but the saved result of the +B instruction (1235) is written to D0 when processing returns to the cyclic task. In the end, the interrupt task's processing has no effect.

### Prevention of Duplicate Processing



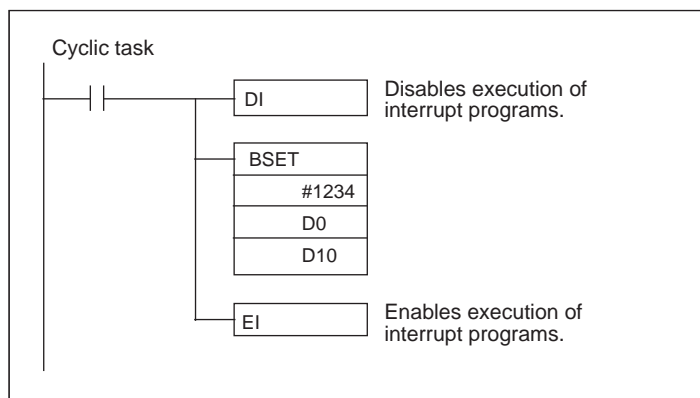
- b. The following example shows duplicate processing by an interrupt task, which interrupts processing while BSET is writing to a block of words and yields an incorrect comparison result.



Since the interrupt occurs during BSET(071) processing and before #1234 is set in D10, the content of D0 and D10 do not match when the comparison is made in the interrupt task (\*1) and output A remains OFF.

In the end (\*2), the D0 and D10 both contain #1234 and match, but the correct comparison result is not reflected in comparison result output A.

### Prevention of Duplicate Processing





## 8-1-2 Input Interrupts (Direct Mode)

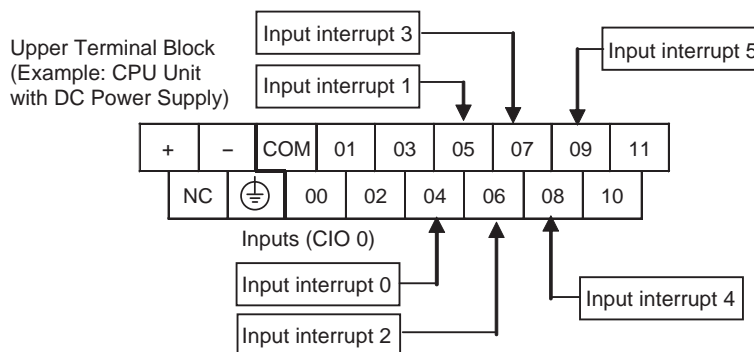
This function executes an interrupt task when the corresponding input signal (up or down differentiated) is received.

### Input Interrupt Bit and Terminal Allocations

#### Input Terminal Block of CPU Units with 20 I/O Points

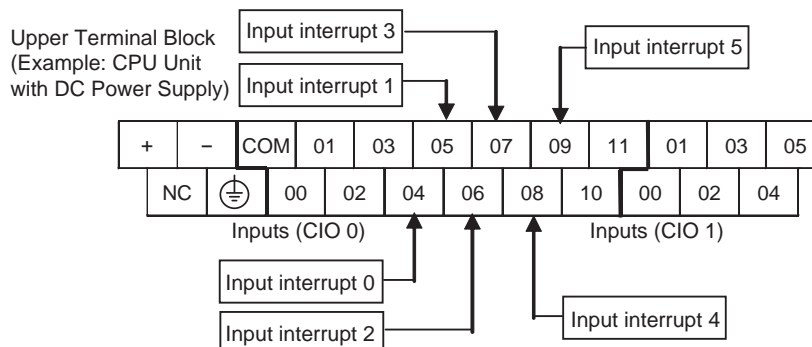
The following diagrams show the input bits and terminals that are used for the input interrupt function in each CPU Unit.

The 6 input bits CIO 0.04 to CIO 0.09 can be used for input interrupts.



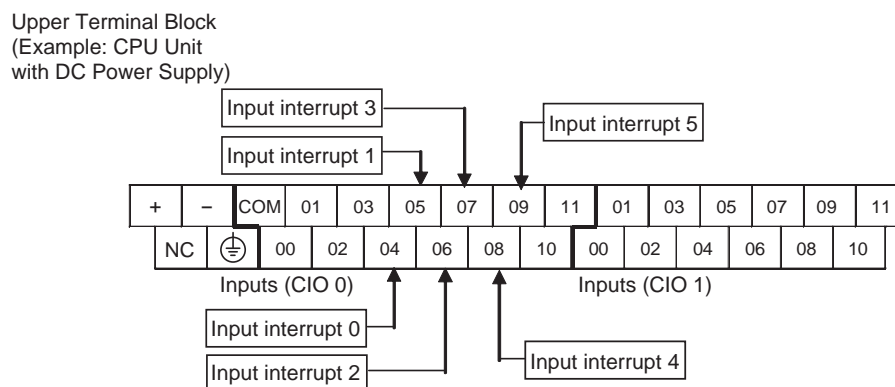
#### Input Terminal Block of CPU Units with 30 I/O Points

The 6 input bits CIO 0.04 to CIO 0.09 can be used for input interrupts.



#### Input Terminal Block of CPU Units with 40 I/O Points

The 6 input bits CIO 0.04 to CIO 0.09 can be used for input interrupts.

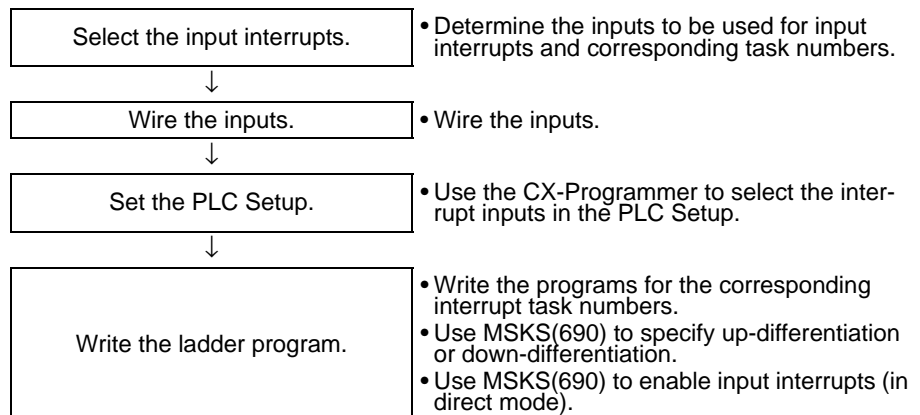


### Setting the Input Functions in the PLC Setup

Normally, bits CIO 0.04 to CIO 0.09 are used as normal inputs. When using these inputs for input interrupts, use the CX-Programmer to change the input's setting in the PLC Setup.

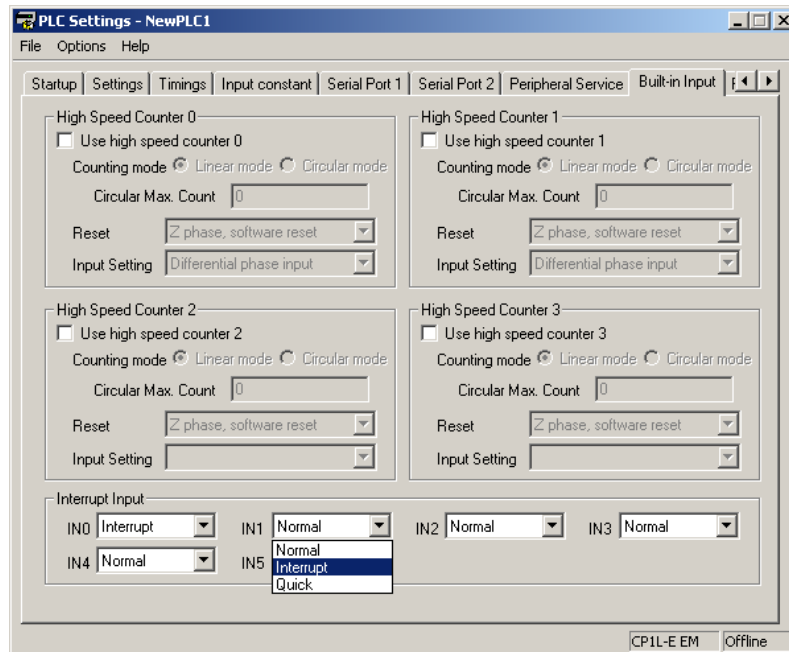
| Input terminal block |          | CPU Unit                     |                              |                              | Input interrupt   | Task number        |
|----------------------|----------|------------------------------|------------------------------|------------------------------|-------------------|--------------------|
| Word                 | Bit      | CPU Units with 40 I/O Points | CPU Units with 30 I/O Points | CPU Units with 20 I/O Points |                   |                    |
| CIO 0                | 00       | Normal input 0               | Normal input 0               | Normal input 0               | ---               | ---                |
|                      | 01       | Normal input 1               | Normal input 1               | Normal input 1               | ---               | ---                |
|                      | 02       | Normal input 2               | Normal input 2               | Normal input 2               | ---               | ---                |
|                      | 03       | Normal input 3               | Normal input 3               | Normal input 3               | ---               | ---                |
|                      | 04       | Normal input 4               | Normal input 4               | Normal input 4               | Input interrupt 0 | Interrupt task 140 |
|                      | 05       | Normal input 5               | Normal input 5               | Normal input 5               | Input interrupt 1 | Interrupt task 141 |
|                      | 06       | Normal input 6               | Normal input 6               | Normal input 6               | Input interrupt 2 | Interrupt task 142 |
|                      | 07       | Normal input 7               | Normal input 7               | Normal input 7               | Input interrupt 3 | Interrupt task 143 |
|                      | 08       | Normal input 8               | Normal input 8               | Normal input 8               | Input interrupt 4 | Interrupt task 144 |
|                      | 09       | Normal input 9               | Normal input 9               | Normal input 9               | Input interrupt 5 | Interrupt task 145 |
|                      | 10       | Normal input 10              | Normal input 10              | Normal input 10              | ---               | ---                |
|                      | 11       | Normal input 11              | Normal input 11              | Normal input 11              | ---               | ---                |
| CIO 1                | 00 to 05 | Normal input 12 to 17        | Normal input 12 to 17        | ---                          | ---               | ---                |
|                      | 06 to 11 | Normal inputs 18 to 23       | ---                          | ---                          | ---               | ---                |

### Procedure



## PLC Setup

Click the Built-in Input Tab to display the *Interrupt Input* settings (at the bottom of the tab). Set the input function to *Interrupt* for each input that will be used as an input interrupt.



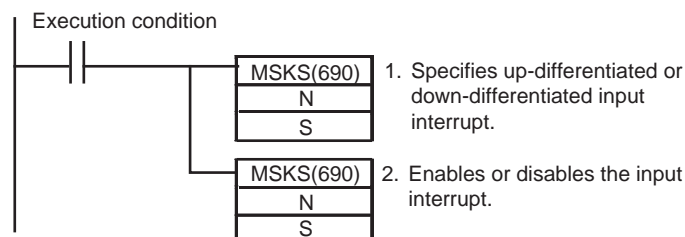
- Note**
- (1) Interrupt Input settings IN0 to IN7 correspond to input interrupt numbers 0 to 7.
  - (2) When using an input as a general-purpose (normal) input, set the input function to *Normal*.

## Writing the Ladder Program

### MSKS(690) Settings

The MSKS(690) instruction must be executed in order to use input interrupts. The settings made with MSKS(690) are enabled with just one execution, so in general execute MSKS(690) in just one cycle using an up-differentiated condition.

MSKS(690) has the following two functions and two of the instructions are used in combination. If an up-differentiated input interrupt is being used, the first MSKS(690) instruction can be omitted since the input is set for up-differentiation by default.



### MSKS(690) Operands

| Input interrupt number | Interrupt task number | 1. Up-differentiation or Down-differentiation |  | 2. Enabling/Disabling the input interrupt |   |
|------------------------|-----------------------|---|--|---|---|
|                        |                       | N   | S  | N   | S   |
|                        |                       | Input interrupt number                        | Execution condition                              | Input interrupt number                    | Enable/Disable                                |
| Input interrupt 0      | 140                   | 110 (or 10)                                   | #0: Up-differentiated<br>#1: Down-differentiated | 100 (or 6)                                | #0: Enable interrupt<br>#1: Disable interrupt |
| Input interrupt 1      | 141                   | 111 (or 11)                                   |  | 101 (or 7)                                |   |
| Input interrupt 2      | 142                   | 112 (or 12)                                   |  | 102 (or 8)                                |   |
| Input interrupt 3      | 143                   | 113 (or 13)                                   |  | 103 (or 9)                                |   |
| Input interrupt 4      | 144                   | 114   |  | 104                                       |   |
| Input interrupt 5      | 145                   | 115   |  | 105                                       |   |

### Writing the Interrupt Task's Program

Create programs for interrupt tasks 140 to 145, which are executed by the corresponding input interrupt. Always put an END(001) instruction at the last address of the program.

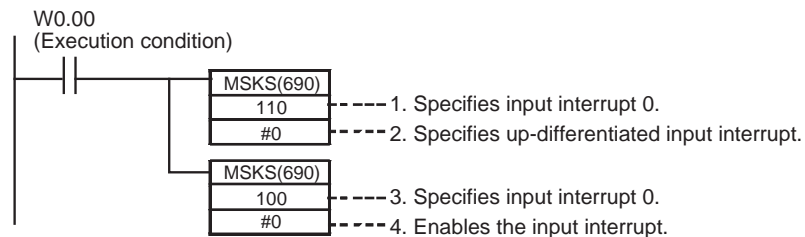
### Input Interrupt Settings and Operation

This example shows how to execute interrupt task 140 when input CIO 0.04 goes ON.

### Settings

1,2,3...

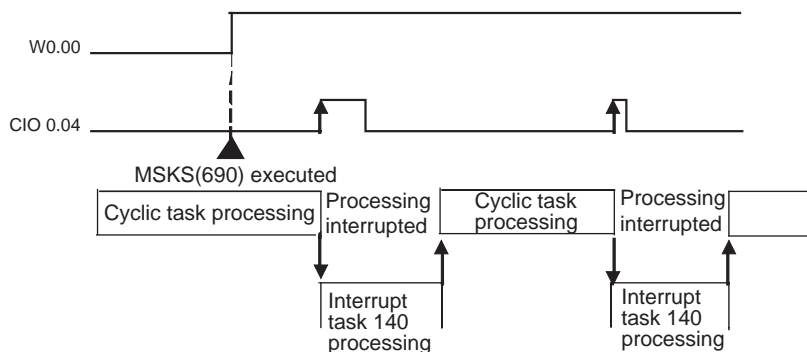
1. Connect an input device to input CIO 0.04.
2. Use the CX-Programmer to set input 0 as an input interrupt in the PLC Set-up.
3. Use the CX-Programmer to create the program to use for interrupt processing and allocate the program to interrupt task 140.
4. Use the CX-Programmer to write MSKS(690) in the program.



**Operation**

When execution condition W0.00 goes ON, MSKS(690) is executed to enable CIO 0.04 as an up-differentiated input interrupt.

If CIO 0.04 goes from OFF to ON (up-differentiation), processing of the cyclic task that is currently being executed will be interrupted and processing of interrupt task 140 will start. When the interrupt task processing is completed, processing of the interrupted ladder program will restart.

**Restrictions**

Inputs cannot be used for input interrupts when they are being used as general-purpose (normal) inputs or quick-response inputs.

**8-1-3 Input Interrupts (Counter Mode)****Overview**

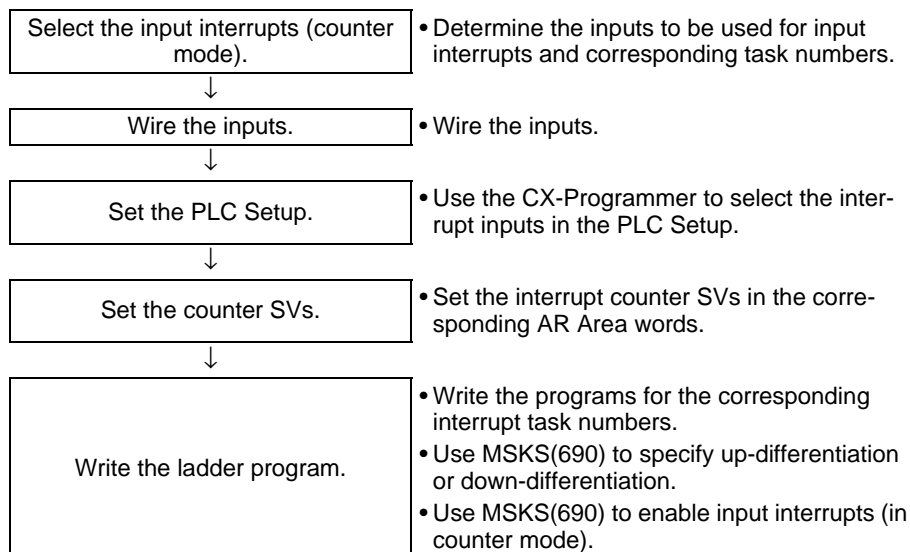
This function counts up-differentiated or down-differentiated input signals and executes an interrupt task when the count reaches the set value.

- The counter-mode input interrupts use the same input terminals as the direct-mode input interrupts. Refer to 8-1-2 *Input Interrupts (Direct Mode)* for details.
- The counter input mode can be set to up or down (incrementing or decrementing) with MSKS(690).
- The counter-mode input interrupts start the same interrupt tasks (140 to 145) as the direct-mode input interrupts.
- The maximum input response frequency is 5 kHz total for all counter-mode input interrupts.

**Relationship of Input Bits, Task Numbers, and Counters**

| Input bits | Function               |                       | Counter words     |      |
|------------|------------------------|-----------------------|-------------------|------|
|            | Input interrupt number | Interrupt task number | SV (0000 to FFFF) | PV   |
| CIO 0.04   | Input interrupt 0      | 140                   | A532              | A536 |
| CIO 0.05   | Input interrupt 1      | 141                   | A533              | A537 |
| CIO 0.06   | Input interrupt 2      | 142                   | A534              | A538 |
| CIO 0.07   | Input interrupt 3      | 143                   | A535              | A539 |
| CIO 0.08   | Input interrupt 4      | 144                   | A544              | A548 |
| CIO 0.09   | Input interrupt 5      | 145                   | A545              | A549 |

## Procedure



**Note** The input interrupt (counter mode) function is one of the input interrupt functions and executes an interrupt based on the pulse count. If the input pulse frequency is too high, interrupts will occur too frequently and prevent normal cyclic task processing. In this case, cycle time too long errors may occur or the pulse input may not be read.

The maximum total frequency of the counter-mode interrupt inputs is 5 kHz. Even in this case, the high frequencies may adversely affect other devices' operation or the system load, so check the system's operation thoroughly before using the counters at high frequencies.

## PLC Setup

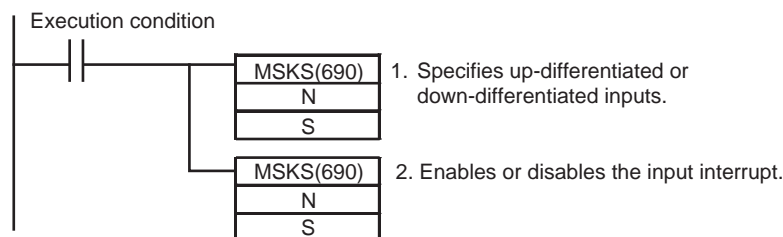
The procedures for using the CX-Programmer to set the PLC Setup are the same as the procedures for input interrupts (direct mode). Refer to *8-1-2 Input Interrupts (Direct Mode)* for details.

## Writing the Ladder Program

### MSKS(690) Settings

The MSKS(690) instruction must be executed in order to use input interrupts. The settings made with MSKS(690) are enabled with just one execution, so in general execute MSKS(690) in just one cycle using an up-differentiated condition.

MSKS(690) has the following two functions and three of the instructions are used in combination. If up-differentiated input pulses are being used, the first MSKS(690) instruction can be omitted since the input is set for up-differentiation by default.



### MSKS(690) Operands

| Input interrupt number | Interrupt task number<br>Count | 1. Up-differentiation or Down-differentiation |  | 2. Enabling/Disabling the input interrupt |  |
|------------------------|--------------------------------|---|--|---|--|
|                        |                                | N   | S  | N   | S  |
|                        |                                | Input interrupt number                        | Count trigger  | Input interrupt number                    | Enable/Disable   |
| Input interrupt 0      | 140                            | 110 (or 10)                                   | #0: Up-differentiated pulses<br>#1: Down-differentiated pulses | 100 (or 6)                                | #2: Start counting down (decrementing) and enable interrupts<br>#3: Start counting up (incrementing) and enable interrupts |
| Input interrupt 1      | 141                            | 111 (or 11)                                   |  | 101 (or 7)                                |  |
| Input interrupt 2      | 142                            | 112 (or 12)                                   |  | 102 (or 8)                                |  |
| Input interrupt 3      | 143                            | 113 (or 13)                                   |  | 103 (or 9)                                |  |
| Input interrupt 4      | 144                            | 114   |  | 104                                       |  |
| Input interrupt 5      | 145                            | 115   |  | 105                                       |  |

### Writing the Interrupt Task's Program

Create programs for interrupt tasks 140 to 145, which are executed by the corresponding input interrupt. Always put an END(001) instruction at the last address of the program.

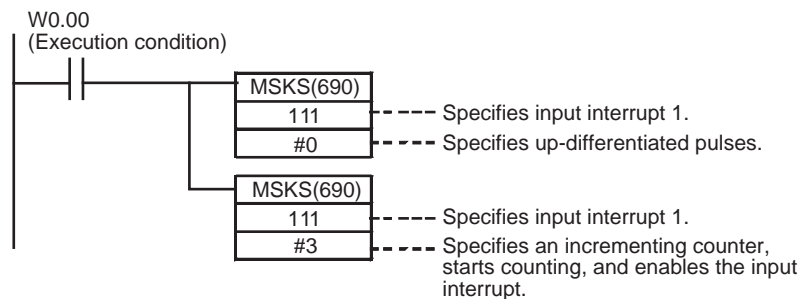
### Input Interrupt Settings and Operation

This example shows how to execute interrupt task 141 when 200 up-differentiated pulses have been counted at input CIO 0.05. (The counter is an incrementing counter.)

#### Settings

1,2,3...

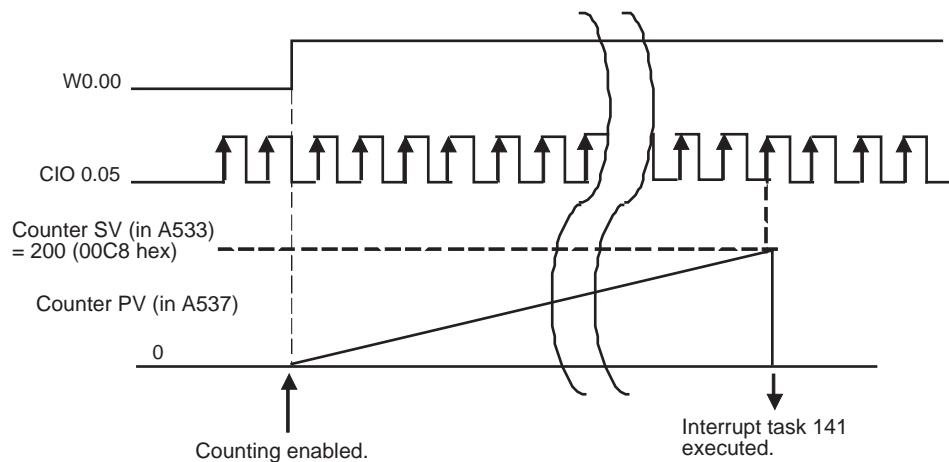
1. Connect an input device to input CIO 0.05.
2. Use the CX-Programmer to set input 0.05 as an input interrupt in the PLC Setup.
3. Use the CX-Programmer to create the program to use for interrupt processing and allocate the program to interrupt task 141.
4. Use the CX-Programmer to set a high-speed counter SV of 00C8 hex (200 decimal) in A533.
5. Use the CX-Programmer to write MSKS(690) in the program.



#### Operation

When execution condition W0.00 goes ON, MSKS(690) is executed to enable operation of the input interrupt in counter mode.

When CIO 0.05 goes from OFF to ON 200 times, processing of the cyclic task that is currently being executed will be interrupted and processing of interrupt task 141 will start. When the interrupt task processing is completed, processing of the interrupted ladder program will restart.



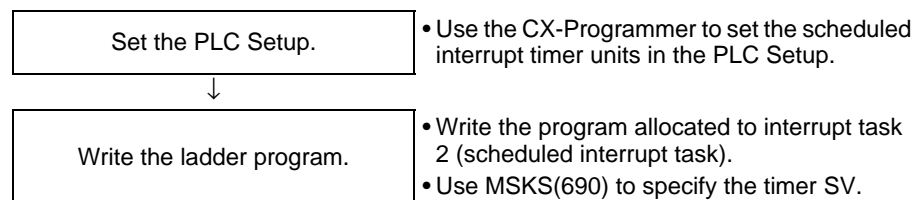
### Restrictions

Inputs cannot be used for input interrupts when they are being used as general-purpose (normal) inputs or quick-response inputs.

## 8-1-4 Scheduled Interrupts

This function executes an interrupt task at a fixed time interval measured by the CPU Unit's built-in timer. Interrupt task 2 is allocated to scheduled interrupt.

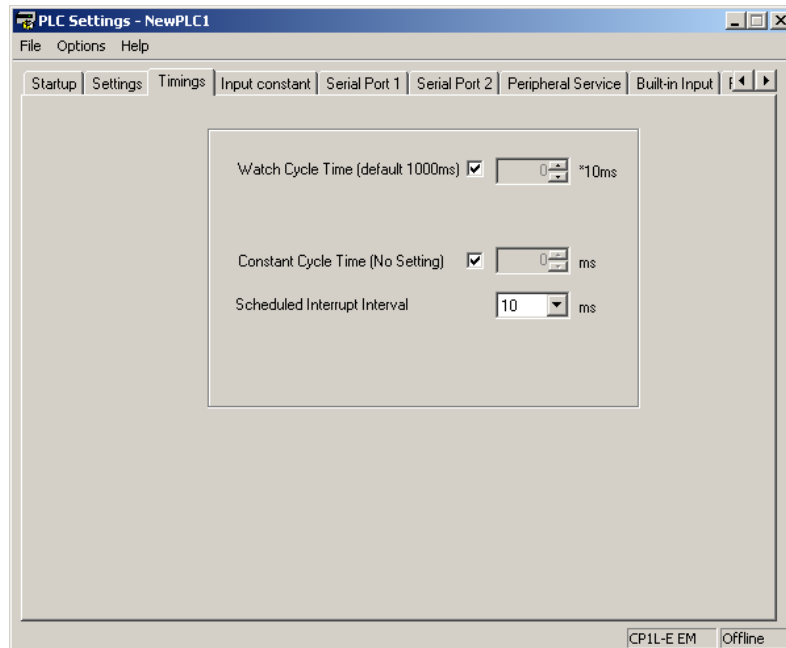
### Procedure



### PLC Setup

Click the **Timings** Tab and set the input function to *Scheduled Interrupt Interval* (the scheduled interrupt timer's units). The timing units can be set to 10 ms, 1 ms, or 0.1 ms. The scheduled interrupt timer SV is calculated by multiplying this interval setting by the timer SV set with MSKS(690).



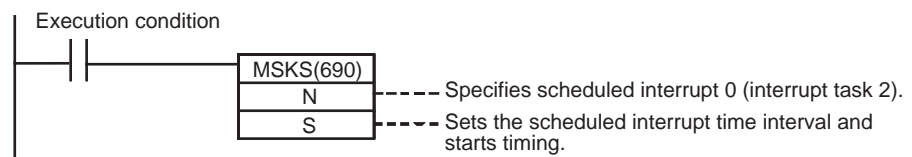
**Scheduled Interrupt Interval Setting****Note**

- (1) Set a scheduled interrupt time (interval) that is longer than the time required to execute the corresponding interrupt task.
- (2) If the scheduled time interval is too short, the scheduled interrupt task will be executed too frequently, which may cause a long cycle time and adversely affect the cyclic task processing.
- (3) If an interrupt task is being executed for another interrupt (input interrupt, high-speed counter interrupt, or external interrupt) when the scheduled interrupt occurs, the scheduled interrupt will not be executed until the other interrupt task is completed.

When different kinds of interrupts are being used, design the program to handle multiple interrupts smoothly. Even if two interrupts occur at the same time, the scheduled interrupts will continue as programmed, so the scheduled interrupt tasks will continue to occur at the scheduled times even if specific scheduled interrupts are delayed.

**Writing the Ladder Program****MSKS(690) Settings**

The MSKS(690) instruction must be executed in order to use the scheduled interrupt. The settings made with MSKS(690) are enabled with just one execution, so in general execute MSKS(690) in just one cycle using an up-differentiated condition.

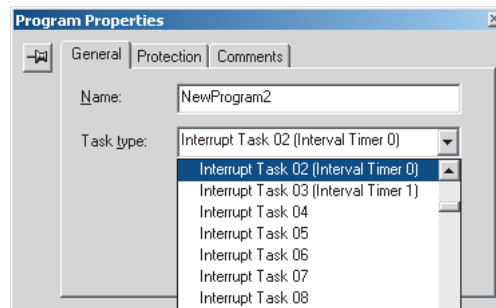


**MSKS(690) Operands**

| Operand   |                            | Interrupt time interval (period) |                         |
|---|----------------------------|----------------------------------|-------------------------|
| N   | S                          | Time units set in PLC Setup      | Scheduled time interval |
| Scheduled interrupt number  | Interrupt time             |                                  |                         |
| Scheduled interrupt 0 (interrupt task 2)<br>14: Reset start<br>4: Start without reset | #0000 to #270F (0 to 9999) | 10 ms                            | 10 to 99,990 ms         |
|   |                            | 1 ms                             | 1 to 9,999 ms           |
|   |                            | 0.1 ms                           | 0.5 to 999.9 ms         |

**Writing the Scheduled Interrupt Task's Program**

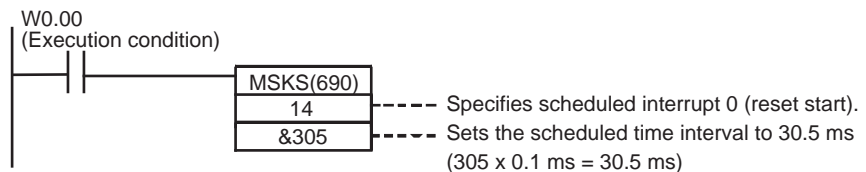
Create the program for interrupt task 2 (scheduled interrupt 0), which is executed by the input interrupt. Always put an END(001) instruction at the last address of the program.

**Selecting the Scheduled Interrupt Task****Input Interrupt Settings and Operation****Settings**

This example shows how to execute interrupt task 2 at 30.5 ms intervals.

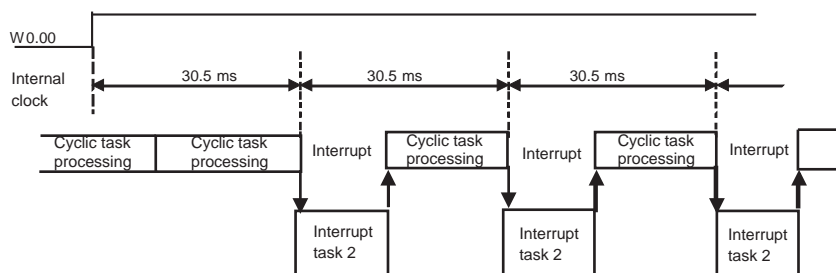
**1,2,3...**

1. Use the CX-Programmer to set the scheduled interrupt time units to 0.1 ms.
2. Use the CX-Programmer to create the interrupt program allocated to interrupt task 2.

**Operation**

When execution condition W0.00 goes ON, MSKS(690) is executed to enable the scheduled interrupt with the reset start specified. The timer is reset and timing starts.

Scheduled interrupt 2 is executed every 30.5 ms.



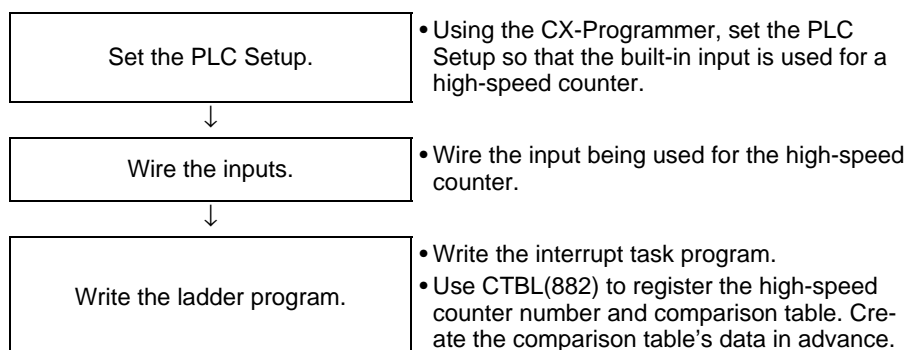
### 8-1-5 High-speed Counter Interrupts

This function executes the specified interrupt task (0 to 255) when the CP1L-EL/EM CPU Unit's built-in high-speed counter PV matches a pre-registered value (target value comparison) or lies within a pre-registered range (range comparison).

- CTBL(882) is used to register the comparison table.
- Either CTBL(882) or INI(880) can be used to start comparison.
- INI(880) is used to stop comparison.

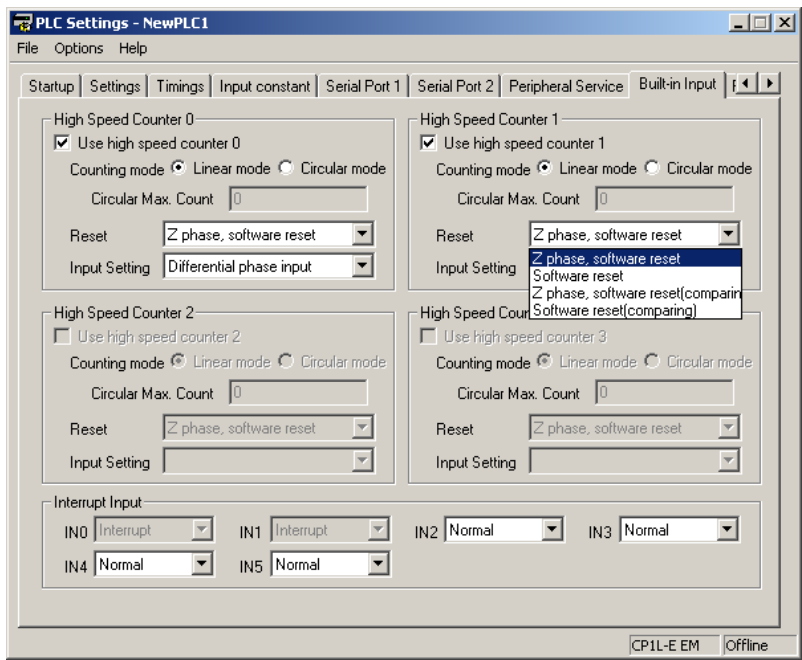
For details on the built-in high-speed counter, refer to *7-1 High-speed Counters*.

#### Procedure



PLC Setup

Click the **Built-in Input** Tab to and set the high-speed counters that will be used for interrupts.



Settings

| Item                          | Setting  |
|-------------------------------|--|
| Use high speed counter 0 to 3 | Use counter  |
| Counting mode                 | Linear mode  |
|                               | Circular mode (ring mode)  |
| Circular Max. Count           | 0 to FFFF FFFF hex<br>(When circular (ring) mode is selected as the counting mode, set maximum ring value here.) |
| Reset method                  | Phase Z and software reset   |
|                               | Software reset   |
|                               | Phase Z and software reset (continue comparing)  |
|                               | Software reset (continue comparing)  |
| Input Setting                 | Differential phase inputs (4x)   |
|                               | Pulse + direction inputs   |
|                               | Up/Down inputs   |
|                               | Increment pulse input  |

Input Function Settings  
According to the PLC Setup  
Setting

If the built-in inputs are set to be used as high-speed counters 0 to 3, the function of the input bits will change as shown in the following table. If a high-speed counter is set to be used, the bits in CIO 0 and CIO 1 can no longer be used for normal inputs, input interrupts, or quick-response inputs.

## ■ CPU Units with 20, 30 or 40 I/O Points

| Address |          | Default setting              |                              |                              | High-speed counter operation settings: |   |   |
|---------|----------|------------------------------|------------------------------|------------------------------|--|---|---|
| Word    | Bit      | CPU Units with 40 I/O Points | CPU Units with 30 I/O Points | CPU Units with 20 I/O Points | Single-phase (increment pulse input)   | Two-phase (differential phases x4, up/down, or pulse/direction) | Origin searches                               |
| CIO 0   | 00       | Normal input 0               | Normal input 0               | Normal input 0               | Counter 0, increment input             | Counter 0, A phase, up, or count input                          | ---   |
|         | 01       | Normal input 1               | Normal input 1               | Normal input 1               | Counter 1, increment input             | Counter 0, B phase, down, or direction input                    | ---   |
|         | 02       | Normal input 2               | Normal input 2               | Normal input 2               | Counter 2, increment input             | Counter 1, A phase, up, or count input                          | ---   |
|         | 03       | Normal input 3               | Normal input 3               | Normal input 3               | Counter 3, increment input             | Counter 1, B phase, down, or direction input                    | ---   |
|         | 04       | Normal input 4               | Normal input 4               | Normal input 4               | Counter 0, phase-Z reset input         | Counter 0, phase-Z reset input                                  | ---   |
|         | 05       | Normal input 5               | Normal input 5               | Normal input 5               | Counter 1, phase-Z reset input         | Counter 1, phase-Z reset input                                  | ---   |
|         | 06       | Normal input 6               | Normal input 6               | Normal input 6               | Counter 2, phase-Z reset input         | ---   | Pulse output 0: Origin input signal           |
|         | 07       | Normal input 7               | Normal input 7               | Normal input 7               | Counter 3, phase-Z reset input         | ---   | Pulse output 1: Origin input signal           |
|         | 08       | Normal input 8               | Normal input 8               | Normal input 8               | ---                                    | ---   | ---   |
|         | 09       | Normal input 9               | Normal input 9               | Normal input 9               | ---                                    | ---   | ---   |
|         | 10       | Normal input 10              | Normal input 10              | Normal input 10              | ---                                    | ---   | Pulse output 0: Origin proximity input signal |
|         | 11       | Normal input 11              | Normal input 11              | Normal input 11              | ---                                    | ---   | Pulse output 1: Origin proximity input signal |
| CIO 1   | 00 to 05 | Normal input 12 to 17        | Normal input 12 to 17        | ---                          | ---                                    | ---   | ---   |
|         | 06 to 11 | Normal input 18 to 23        | ---                          | ---                          | ---                                    | ---   | ---   |

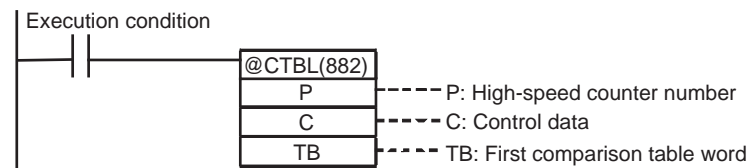
## High-speed Counter Memory Areas

| Content                              |   | High-speed counter |         |
|--------------------------------------|---|--------------------|---------|
|                                      |   | 0                  | 1       |
| PV                                   | Leftmost 4 digits   | A271               | A273    |
|                                      | Rightmost 4 digits  | A270               | A272    |
| Range Comparison Condition Met Flags | ON for match in range 1   | A274.00            | A275.00 |
|                                      | ON for match in range 2   | A274.01            | A275.01 |
|                                      | ON for match in range 3   | A274.02            | A275.02 |
|                                      | ON for match in range 4   | A274.03            | A275.03 |
|                                      | ON for match in range 5   | A274.04            | A275.04 |
|                                      | ON for match in range 6   | A274.05            | A275.05 |
|                                      | ON for match in range 7   | A274.06            | A275.06 |
|                                      | ON for match in range 8   | A274.07            | A275.07 |
| Comparison In-progress Flags         | ON while the comparison is in progress.                                   | A274.08            | A275.08 |
| Overflow/Underflow Flags             | ON if a PV overflow or underflow occurred while operating in linear mode. | A274.09            | A275.09 |
| Count Direction Flags                | 0: Decrementing<br>1: Incrementing  | A274.10            | A275.10 |

**Note** The comparison table and comparison conditions 1 to 8 are different for target-value comparison and range comparison operations. For details, refer to next page.

## REGISTER COMPARISON TABLE Instruction: CTBL(882)

CTBL(882) compares the PV of a high-speed counter (0 to 3) to target values or target value ranges and executes the corresponding interrupt task (0 to 255) when the specified condition is met.

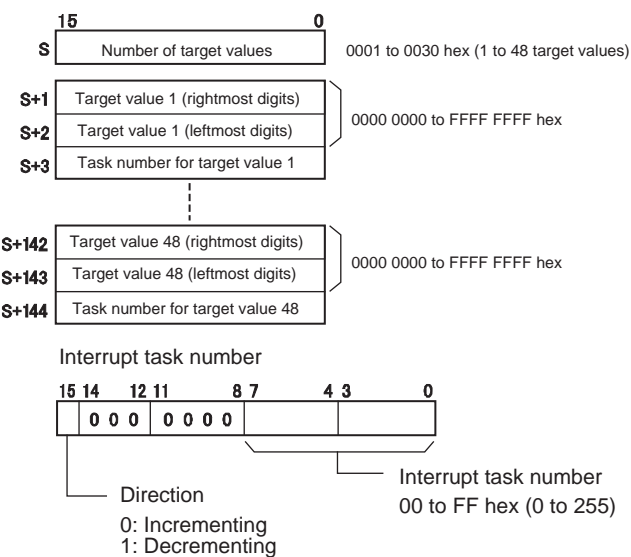


| Operand |                             | Settings  |  |
|---------|-----------------------------|---|--|
| P       | High-speed counter number   | #0000   | High-speed counter 0   |
|         |                             | #0001   | High-speed counter 1   |
| C       | Control data                | #0000   | Registers a target-value comparison table and starts the comparison operation. |
|         |                             | #0001   | Registers a range comparison table and starts the comparison operation.        |
|         |                             | #0002   | Registers a target-value comparison table.                                     |
|         |                             | #0003   | Registers a range comparison table.  |
| TB      | First comparison table word | Specifies the leading word address of the comparison table, which is described below. |  |

## Contents of the Comparison Table

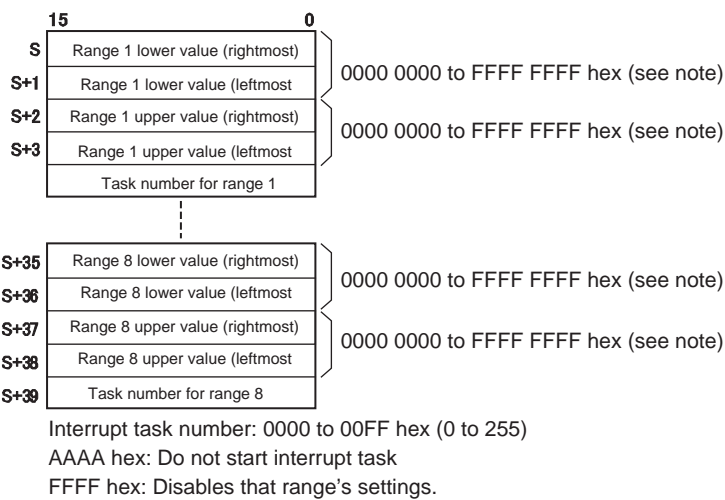
### Target-value Comparison Table

Depending on the number of target values in the table, the target-value comparison table requires a continuous block of 4 to 145 words.



Range Comparison Table

The range comparison table requires a continuous block of 40 words because comparison conditions 1 to 8 require 5 words each (2 words for the upper range value, 2 words for the lower range value, and one word for the interrupt task number).

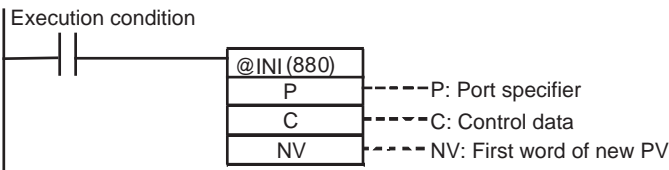


**Note** Always set the upper limit greater than or equal to the lower limit in each range.

MODE CONTROL

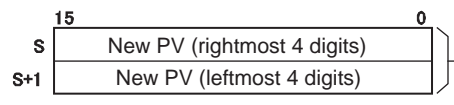
**Instruction: INI(880)**

INI(880) can be used to start/stop comparison with the high-speed counter's comparison table, change the high-speed counter's PV, change the PV of interrupt inputs in counter mode, and control the pulse output functions.



| Operand |                      | Settings   |   |
|---------|----------------------|--|---|
| P       | Port specifier       | #0000, #0001   | Pulse outputs 0 or 1                      |
|         |                      | #0010  | High-speed counter 0                      |
|         |                      | #0011  | High-speed counter 1                      |
|         |                      | #0100 to #0105   | Input interrupts 0 to 5 (in counter mode) |
|         |                      | #1000 or #1001   | PWM(891) output 0 or 1                    |
| C       | Control data         | #0000  | Start comparison.                         |
|         |                      | #0001  | Stop comparison.                          |
|         |                      | #0002  | Change the PV.                            |
|         |                      | #0003  | Stop pulse output.                        |
| NV      | First word of new PV | NV and NV+1 contain the new PV when C is set to #0002 (change the PV). |   |

### New PV Setting in NV and NV+1



Setting range for pulse outputs and high-speed counter inputs:  
0000 0000 to FFFF FFFF hex

Setting range for input interrupts (counter mode):  
0000 0000 to 0000 FFFF hex

## Ladder Program Examples

### Example 1: High-speed Counter (Linear Mode)

In this example, high-speed counter 0 operates in linear mode and starts interrupt task 10 when the PV reaches 30,000 (0000 7530 hex).

1,2,3...

- Set high-speed counter 0 in the PLC Setup's Built-in Input Tab.

| Item                 | Setting        |
|----------------------|----------------|
| High-speed counter 0 | Use counter    |
| Counting mode        | Linear mode    |
| Circular Max. Count  | ---            |
| Reset method         | Software reset |
| Input Setting        | Up/Down inputs |

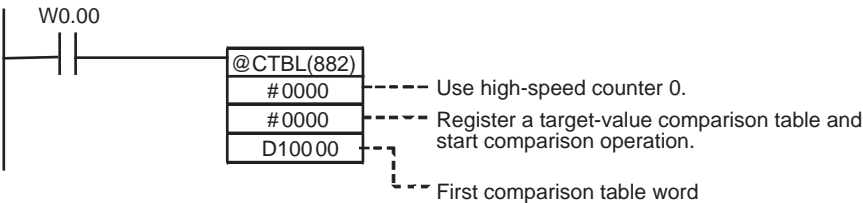
- Set the target-value comparison table in words D10000 to D10003.

| Word   | Setting | Function  |                                       |
|--------|---------|---|---------------------------------------|
| D10000 | #0001   | Number of target values = 1   |                                       |
| D10001 | #7530   | Rightmost 4 digits of the target value 1 data                             | Target value = 30,000 (0000 7530 hex) |
| D10002 | #0000   | Leftmost 4 digits of the target value 1 data                              |                                       |
| D10003 | #000A   | Bit 15: 0 (incrementing)<br>Bits 0 to 7: A hex (interrupt task number 10) |                                       |

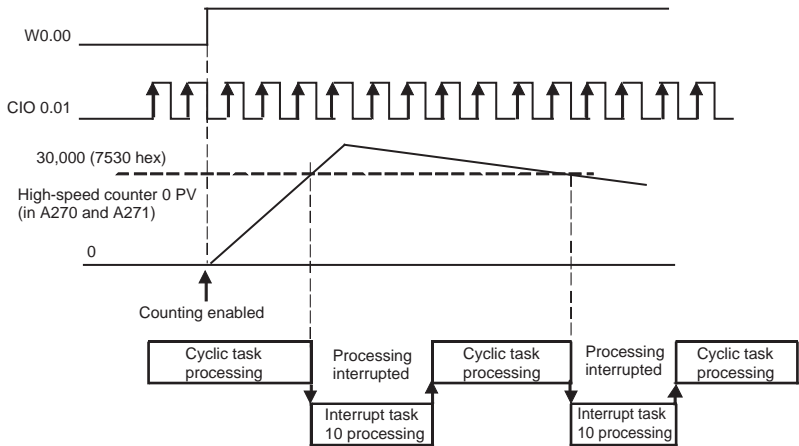
- Create the program for interrupt task 10. Always put an END(001) instruction at the program's last address.



4. Use CTBL(882) to start the comparison operation with high-speed counter 0 and interrupt task 10.



5. Operation
- When execution condition W0.00 goes ON, the comparison starts with high-speed counter 0.
- When the PV of high speed counter 0 reaches 30,000, cyclic task processing is interrupted, and interrupt task 10 is processed. When interrupt task 10 processing is completed, processing of the interrupted cyclic task resumes.



**Example 2: High-speed Counter (Ring Mode)**

In this example, high-speed counter 1 operates in circular (ring) mode and starts interrupt task 12 when the PV is between 25,000 (0000 61A8 hex) and 25,500 (0000 639C hex).

The maximum ring count is set at 50,000 (0000 C350 hex).

- 1,2,3... 1. Set high-speed counter 1 in the PLC Setup's Built-in Input Tab.

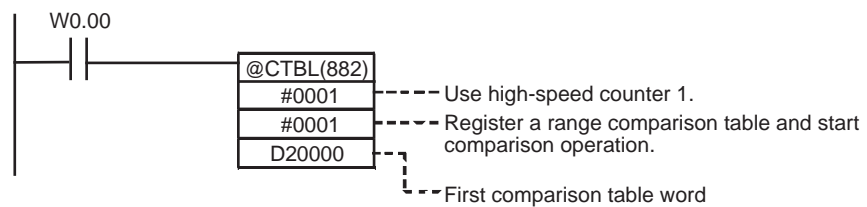
| Item                 | Setting                             |
|----------------------|-------------------------------------|
| High-speed counter 1 | Use counter                         |
| Counting mode        | Circular mode                       |
| Circular Max. Count  | 50,000                              |
| Reset method         | Software reset (continue comparing) |
| Input Setting        | Up/Down inputs                      |

2. Set the range comparison table starting at word D20000. Even though range 1 is the only range being used, all 40 words must still be dedicated to the range comparison table.

| Word   | Setting | Function                                  |                           |
|--------|---------|---|---------------------------|
| D20000 | #61A8   | Rightmost 4 digits of range 1 lower limit | Lower limit value: 25,000 |
| D20001 | #0000   | Leftmost 4 digits of range 1 lower limit  |                           |
| D20002 | #639C   | Rightmost 4 digits of range 1 upper limit | Upper limit value: 25,500 |
| D20003 | #0000   | Leftmost 4 digits of range 1 upper limit  |                           |

| Word   | Setting   | Function  |                  |
|--|-----------|---|------------------|
| D20004   | #000C     | Range 1 interrupt task number = 12 (C hex)  |                  |
| D20005 to D20008                               | All #0000 | Range 2 lower and upper limit values (Not used and don't need to be set.)               | Range 2 settings |
| D20009   | #FFFF     | Disables range 2.   |                  |
| ~  |           |   |                  |
| D20014<br>D20019<br>D20024<br>D20029<br>D20034 | #FFFF     | Set the fifth word for ranges 3 to 7 (listed at left) to #FFFF to disable those ranges. |                  |
| ~  |           |   |                  |
| D20035 to D20038                               | All #0000 | Range 8 lower and upper limit values (Not used and don't need to be set.)               | Range 8 settings |
| D20039   | #FFFF     | Disables range 8.   |                  |

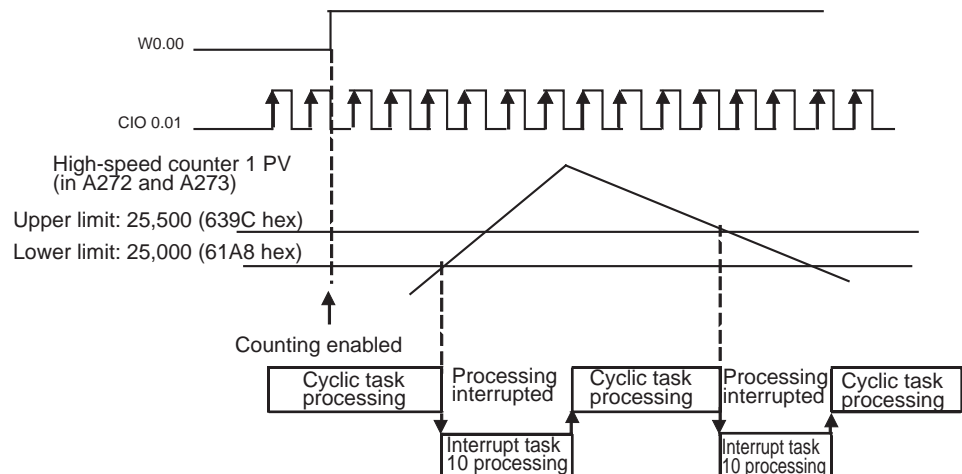
3. Create the program for interrupt task 12. Always put an END(001) instruction at the program's last address.
4. Use CTBL(882) to start the comparison operation with high-speed counter 1 and interrupt task 12.



#### 5. Operation

When execution condition W0.00 goes ON, the comparison starts with high-speed counter 1.

When the PV of high speed counter 1 is between 25,000 and 25,500, cyclic task processing is interrupted, and interrupt task 12 is processed. When interrupt task 12 processing is completed, processing of the interrupted cyclic task resumes.



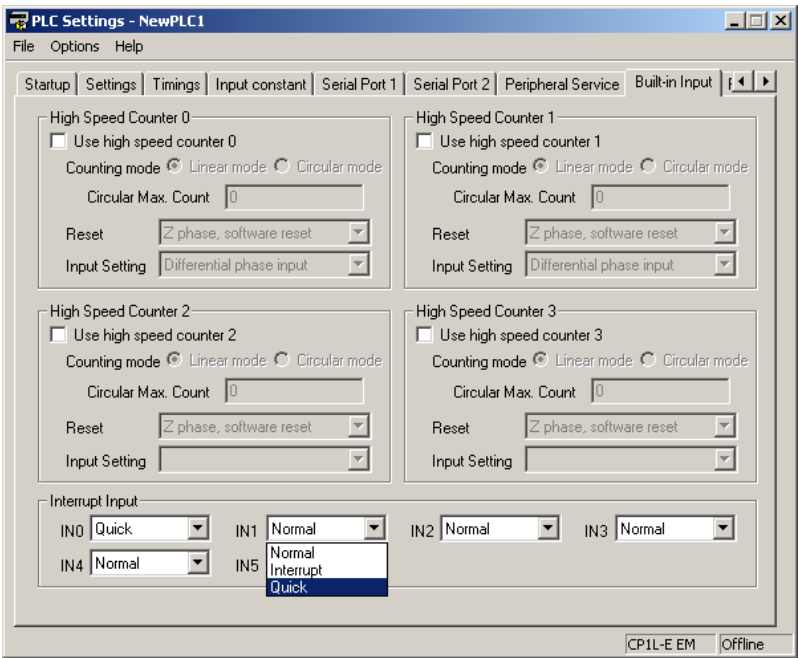
## 8-2 Quick-response Inputs

### Overview

The quick-response inputs can read pulses with an ON time shorter than the cycle time (as short as 50  $\mu$ s). Use the quick-response inputs to read signals shorter than the cycle time, such as inputs from photomicrosensors.

### PLC Setup

Use the CX-Programmer to set a built-in input as a quick-response input in the PLC Setup. Click the Built-in Input Tab to display the *Interrupt Input* settings (at the bottom of the tab). Set the input function from *Normal* to *Quick* for each input that will be used as a quick-response input.

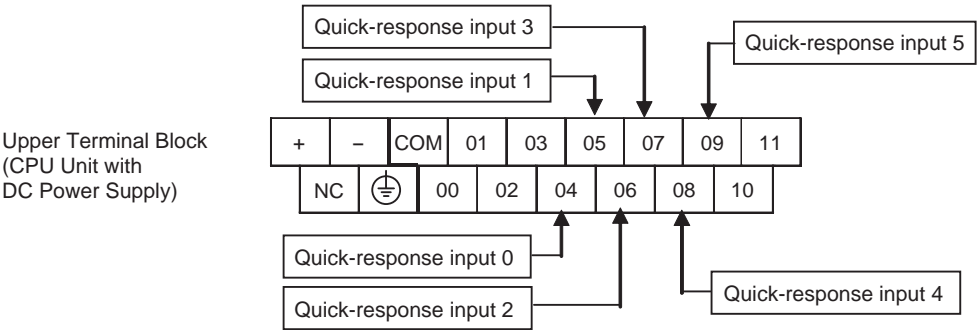


### Bit Allocation for Quick-Response Inputs

The following diagrams show the input bits and terminals that can be used for quick-response inputs in each CPU Unit.

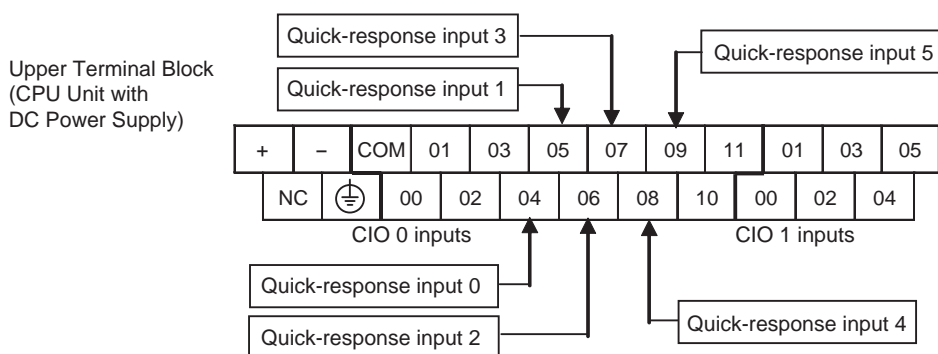
#### CPU Units with 20 I/O Points

The 6 input bits CIO 0.04 to CIO 0.09 can be used as quick-response inputs.

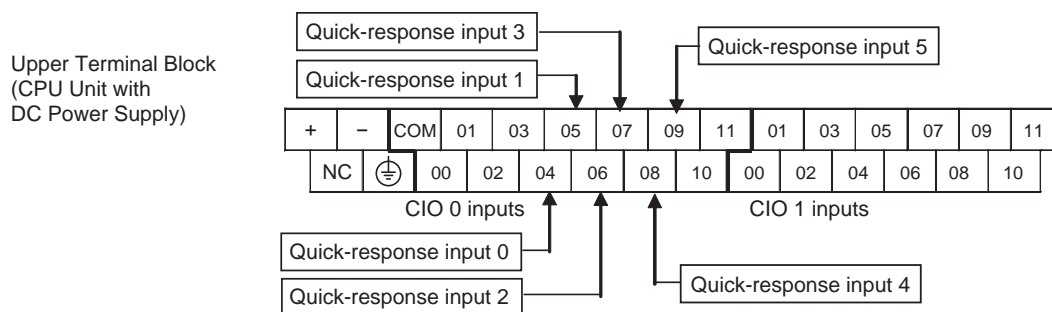


**CPU Units with 30 I/O Points**

The 6 input bits CIO 0.04 to CIO 0.09 can be used as quick-response inputs.

**CPU Units with 40 I/O Points**

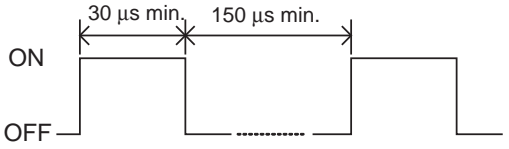
The 6 input bits CIO 0.04 to CIO 0.09 can be used as quick-response inputs.

**Setting the Input Functions in the PLC Setup**

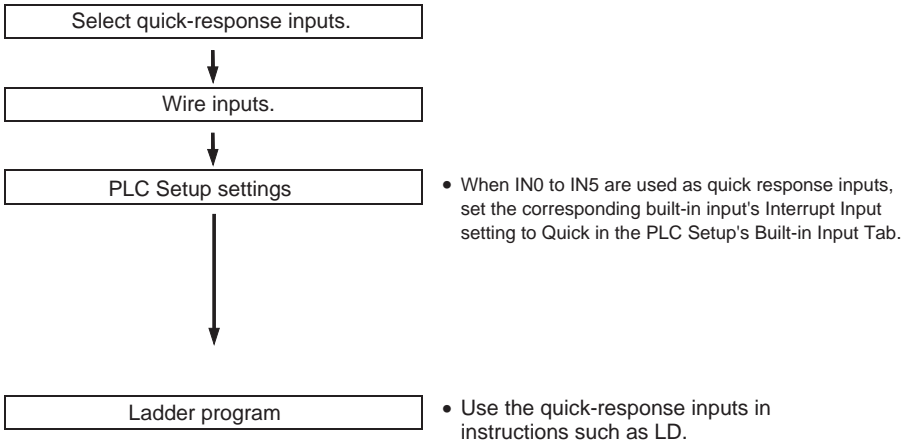
Normally, bits CIO 0.04 to CIO 0.09 are used as normal inputs. When using these inputs as quick-response inputs, use the CX-Programmer to change the input's setting in the PLC Setup.

| Input terminal block |          | CPU Unit                     |                              |                              | Quick-response inputs  |
|----------------------|----------|------------------------------|------------------------------|------------------------------|------------------------|
| Word                 | Bit      | CPU Units with 40 I/O Points | CPU Units with 30 I/O Points | CPU Units with 20 I/O Points |                        |
| CIO 0                | 00       | Normal input 0               | Normal input 0               | Normal input 0               | ---                    |
|                      | 01       | Normal input 1               | Normal input 1               | Normal input 1               | ---                    |
|                      | 02       | Normal input 2               | Normal input 2               | Normal input 2               | ---                    |
|                      | 03       | Normal input 3               | Normal input 3               | Normal input 3               | ---                    |
|                      | 04       | Normal input 4               | Normal input 4               | Normal input 4               | Quick-response input 0 |
|                      | 05       | Normal input 5               | Normal input 5               | Normal input 5               | Quick-response input 1 |
|                      | 06       | Normal input 6               | Normal input 6               | Normal input 6               | Quick-response input 2 |
|                      | 07       | Normal input 7               | Normal input 7               | Normal input 7               | Quick-response input 3 |
|                      | 08       | Normal input 8               | Normal input 8               | Normal input 8               | Quick-response input 4 |
|                      | 09       | Normal input 9               | Normal input 9               | Normal input 9               | Quick-response input 5 |
|                      | 10       | Normal input 10              | Normal input 10              | Normal input 10              | ---                    |
|                      | 11       | Normal input 11              | Normal input 11              | Normal input 11              | ---                    |
| CIO 1                | 00 to 05 | Normal input 12 to 17        | Normal input 12 to 17        | ---                          | ---                    |
|                      | 06 to 11 | Normal input 18 to 23        | ---                          | ---                          | ---                    |

Interrupt Input and Quick-response Input Specifications

| Item           | Specification  |
|----------------|--|
| ON delay       | 30 μs max.   |
| OFF delay      | 150 μs max.  |
| Response pulse |  |

Procedure



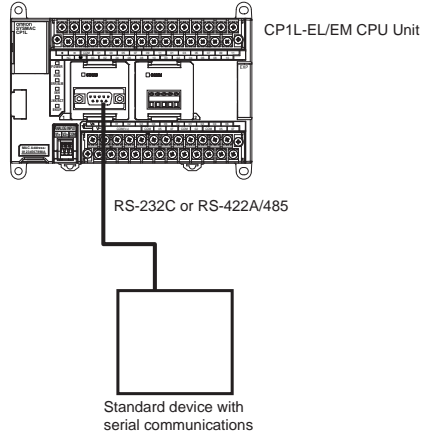
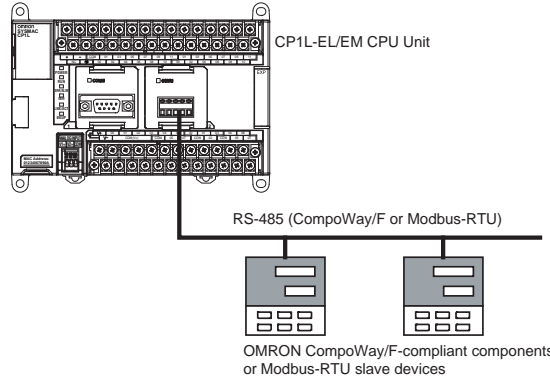
Restrictions

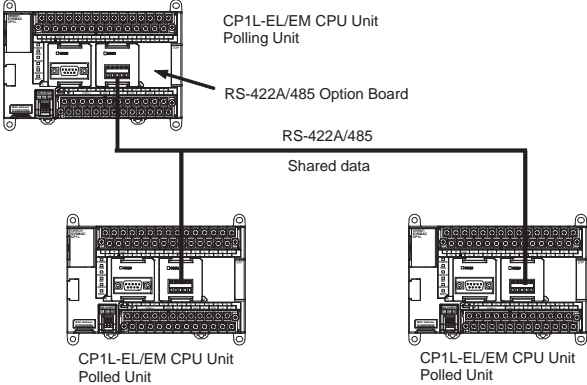
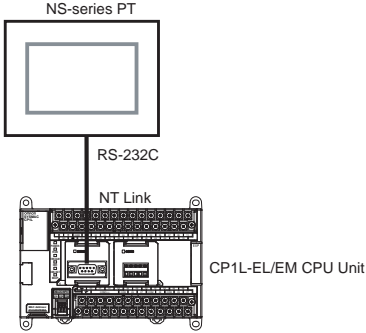
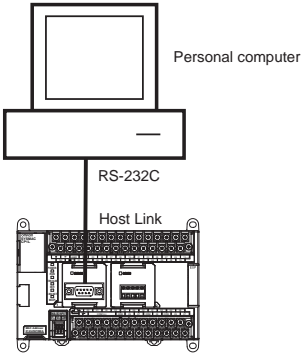
Inputs cannot be used as quick-response inputs when they are being used as general-purpose (normal) inputs, input interrupts, or high-speed counter inputs.

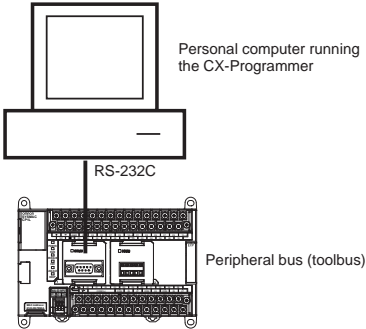
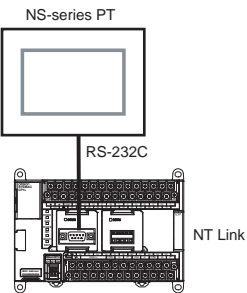
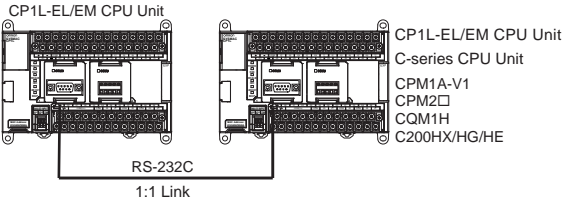
## 8-3 Serial Communications

### 8-3-1 Overview

The CP1L-EL/EM CPU Units support the following serial communications functions.

| Protocol                                     | Connected devices   | Description  | Serial port 1 | Serial port 2 |
|--|---|--|---------------|---------------|
| No-protocol                                  | <p>Standard devices supporting serial communications</p>  <p>CP1L-EL/EM CPU Unit</p> <p>RS-232C or RS-422A/485</p> <p>Standard device with serial communications</p>   | Communicates with standard devices with an RS-232C or RS-422A/485 port without a command-response format. Instead the TXD(236) and RXD(235) instructions are executed from the program to transmit data from the transmission port or read data in the reception port. The frame headers and end codes can be specified. | OK            | OK            |
| Serial gateway (to CompoWay/F or Modbus-RTU) | <p>OMRON components supporting CompoWay/F or Modbus-RTU slave devices</p>  <p>CP1L-EL/EM CPU Unit</p> <p>RS-485 (CompoWay/F or Modbus-RTU)</p> <p>OMRON CompoWay/F-compliant components or Modbus-RTU slave devices</p> | Converts received FINS commands into CompoWay/F or Modbus-RTU commands and transfers them on the serial communications path.   | OK            | OK            |

| Protocol  | Connected devices  | Description   | Serial port 1 | Serial port 2 |
|---|--|---|---------------|---------------|
| Serial PLC Link   | <p>CP-series CPU Units or CJ1M CPU Units</p>  <p>CP1L-EL/EM CPU Unit Polling Unit</p> <p>RS-422A/485 Option Board</p> <p>RS-422A/485</p> <p>Shared data</p> <p>CP1L-EL/EM CPU Unit Polled Unit</p> <p>CP1L-EL/EM CPU Unit Polled Unit</p> | <p>Up to ten words per Unit can be shared by up to nine CPU Units, including one Polling Unit and eight Polled Units.</p> <p>An RS-422A/485 Option Boards (CP1W-CIF11/CIF12) are used to communicate via RS-422A/485, or RS-232C Option Boards (CP1W-CIF01) can be used to communicate between two CPU Units via an RS-232C connection.</p> <p>CJ1M CPU Units can also be included in Serial PLC Links, and the Serial PLC Links can also include PTs as Polled Units via 1:N NT Links.</p> <p><b>Note</b> Serial PLC Links can be created on serial port 1 or serial port 2, but not on both ports at the same time.</p> | OK            | OK            |
| 1:N NT links<br>(1:N NT Links are also used for 1:1 connections.) |  <p>NS-series PT</p> <p>RS-232C</p> <p>NT Link</p> <p>CP1L-EL/EM CPU Unit</p>  | Data can be exchanged with PTs without using a communications program in the CPU Unit.  | OK            | OK            |
| Host Link   |  <p>Personal computer</p> <p>RS-232C</p> <p>Host Link</p>   | <p>1) Various control commands such as reading and writing I/O memory, changing the operating mode, and force-setting/resetting bits can be executed by sending C-mode host link commands or FINS commands from the host computer to the CPU Unit.</p> <p>2) It is also possible to send FINS commands from the CPU Unit to the host computer to send data or information.</p> <p>Use Host Link communications to monitor data, such as operating status, error information, and quality data in the PLC or send data, such as production planning information, to the PLC.</p>   | OK            | OK            |

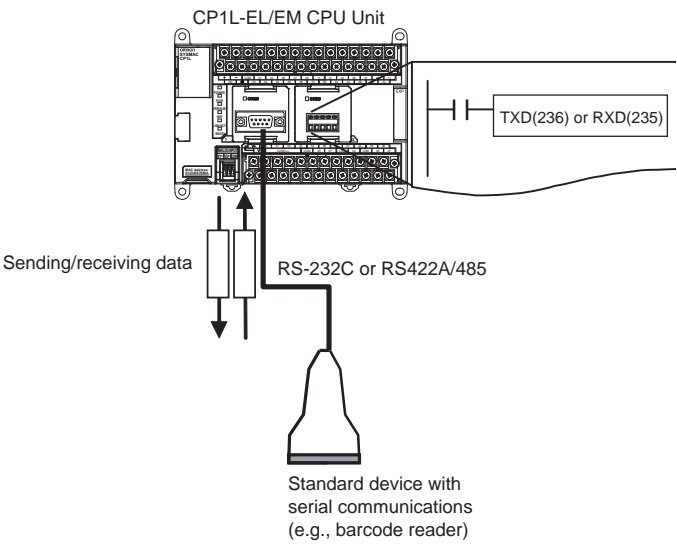
| Protocol                 | Connected devices  | Description   | Serial port 1 | Serial port 2 |
|--------------------------|--|---|---------------|---------------|
| Peripheral bus (toolbus) | <b>CX-Programmer</b><br> <p>Personal computer running the CX-Programmer</p> <p>RS-232C</p> <p>Peripheral bus (toolbus)</p>                                      | Provides high-speed communications with the CX-Programmer.  | OK            | OK            |
| 1:1 NT Links             | <b>OMRON PTs (Programmable Terminals)</b><br> <p>NS-series PT</p> <p>RS-232C</p> <p>NT Link</p>   | Enables data exchange with a PT without communications programming in the CPU Unit. (The 1:N NT Link protocol is used for communications even for 1:1 connections.) | OK            | OK            |
| 1:1 Links                |  <p>CP1L-EL/EM CPU Unit</p> <p>CP1L-EL/EM CPU Unit<br/>C-series CPU Unit<br/>CPM1A-V1<br/>CPM2□<br/>CQM1H<br/>C200HX/HG/HE</p> <p>RS-232C</p> <p>1:1 Link</p> | Enables linking data in a 64-word Link Area between two PLCs connected by an RS-232C cable.   | OK            | OK            |

### 8-3-2 No-protocol Communications

No-protocol communications enable sending and receiving data using the TRANSMIT (TXD(236)) and RECEIVE (RXD(235)) instructions without using a protocol and without data conversion (e.g., no retry processing, data type conversion, or process branching based on received data). The communications mode for the serial port must be set for no-protocol communications in the PLC Setup.

No-protocol communications are used to send data in one direction to or from standard devices that have an RS-232C or RS-422A/485 port using TXD(236) or RXD(235).



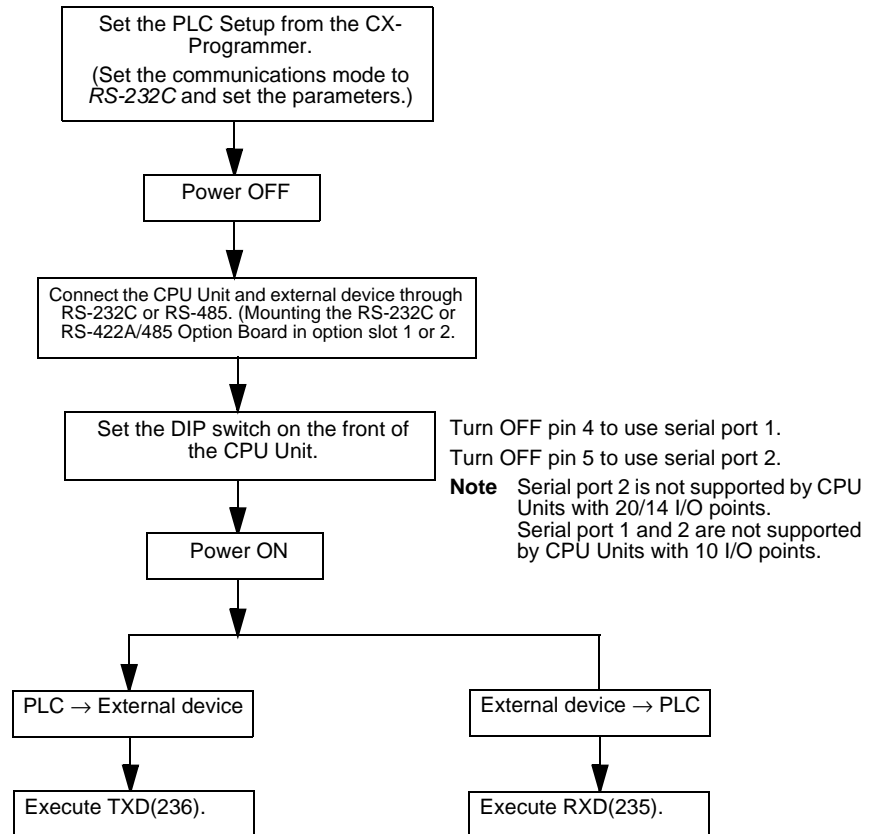


For example, simple (non-protocol) communications can be used to input data from a barcode reader or output data to a printer.

The following table lists the no-protocol communication functions supported by CP1L-EL/EM PLCs.

| Transfer direction                           | Method                               | Max. amount of data | Frame format              |   | Other functions   |
|--|--------------------------------------|---------------------|---------------------------|---|---|
|  |                                      |                     | Start code                | End code  |   |
| Data transmission<br>(PLC → External device) | Execution of TXD(236) in the program | 256 bytes           | Yes: 00 to FF<br>No: None | Yes: 00 to FF or CR+LF<br>No: None<br>(The amount of data to receive is specified between 1 and 256 bytes when no end code is specified.) | <ul style="list-style-type: none"><li>• Send delay time (delay between TXD(236) execution and sending data from specified port): 0 to 99,990 ms (unit: 10 ms)</li><li>• Controlling RS and ER signals</li></ul> |
| Data reception<br>(External device → PLC)    | Execution of RXD(235) in the program | 256 bytes           |                           |   | Monitoring CS and DR signals  |

## Procedure



## Message Frame Formats

Data can be placed between a start code and end code for transmission by TXD(236) and data between a start code and end code can be received by RXD(235). When transmitting with TXD(236), data from I/O memory is transmitted, and when receiving with RXD(235), the data (without start/end codes) is stored in I/O memory. Up to 256 bytes (including the start and end codes) can be transferred in no-protocol mode.

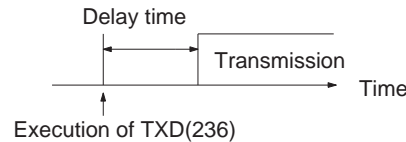
The start and end codes are set in the PLC Setup.

The following table shows the message formats that can be set for transmissions and receptions in no-protocol mode.

| Start code | End code  |  |   |
|------------|---|--|---|
|            | No  | Yes  | CR+LF   |
| No         | <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">data</div><br/>           256 bytes max.         </div>              | <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">data</div> ED<br/>           256 bytes max.         </div>              | <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">data</div> CR+LF<br/>           256 bytes max.         </div>              |
| Yes        | <div style="text-align: center;">           ST <div style="border: 1px solid black; padding: 5px; display: inline-block;">data</div><br/>           256 bytes max.         </div> | <div style="text-align: center;">           ST <div style="border: 1px solid black; padding: 5px; display: inline-block;">data</div> ED<br/>           256 bytes max.         </div> | <div style="text-align: center;">           ST <div style="border: 1px solid black; padding: 5px; display: inline-block;">data</div> CR+LF<br/>           256 bytes max.         </div> |

- When more than one start code is used, the first start code will be effective.
- When more than one end code is used, the first end code will be effective.
- If the data being transferred contains the end code, the data transfer will be stopped midway. In this case, change the end code to CR+LF.

**Note** A setting can be made to delay the transmission of data after the execution of TXD(236).



Refer to the *SYSMAC CP Series CP1L CPU Unit Programming Manual* (W451) for more details on TXD(236) and RXD(235).

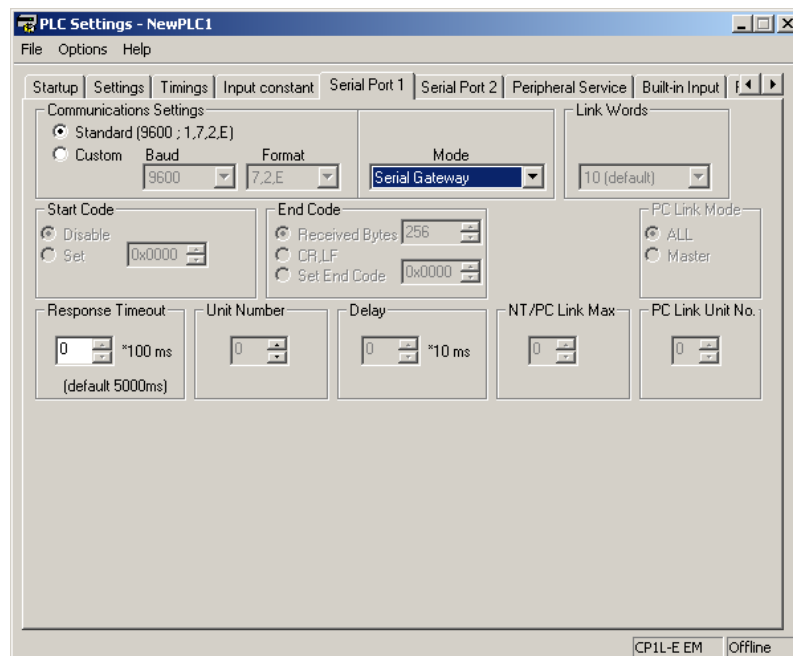
### 8-3-3 Modbus-RTU Easy Master Function

#### Overview

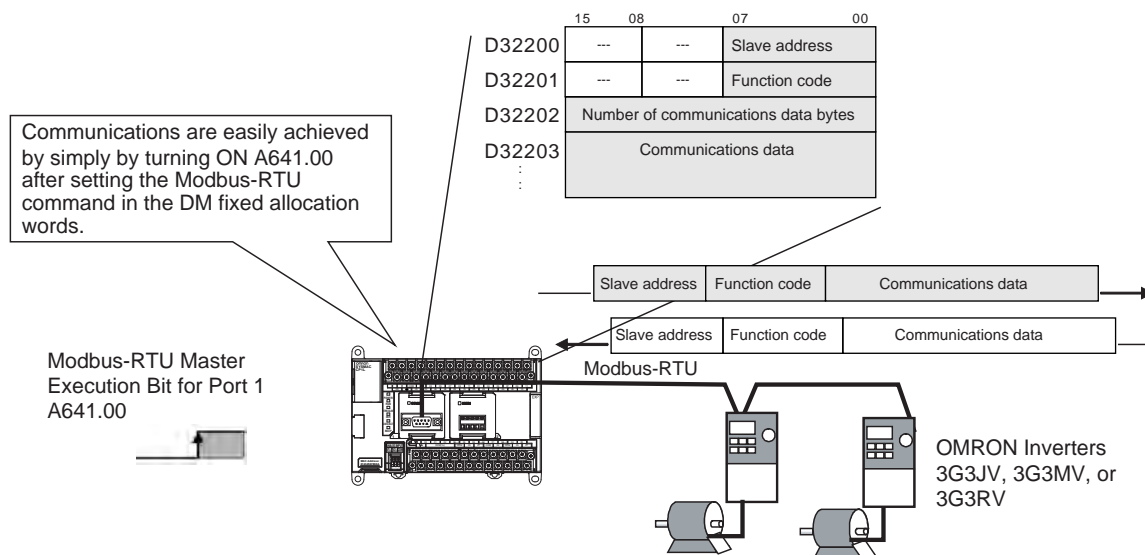
If an RS-232C or RS-422A/485 Option Board is used, the CP1L-EL/EM CPU Unit can function as a Modbus-RTU Master to send Modbus-RTU commands by manipulating software switches. This enables easily controlling Modbus-compliant slaves, such as Inverters, through serial communications.

The following OMRON Inverters support Modbus-RTU slave operation: 3G3JV, 3G3MV, and 3G3RV.

The communications mode in the PLC Setup must be set to the Gateway Mode to enable this functionality.



Modbus-RTU commands can be set simply by turning ON a software switch after setting the Modbus slave address, function, and data in the DM fixed allocation words for the Modbus-RTU Easy Master. The response when received is also store in the DM fixed allocation words for the Modbus-RTU Easy Master.



### DM Fixed Allocation Words for the Modbus-RTU Easy Master

The Modbus-RTU command is stored in the following words in the DM Area.

- EM-type CPU Units  
Serial port 1: D32200 to D32249  
Serial port 2: D32300 to D32349
- EL-type CPU Units  
Serial port 1: D32300 to D32349

When a response is received after turning ON the Modbus-RTU Master Execution Bit, it is sorted in the following words in the DM Area.

- EM-type CPU Units  
Serial port 1: D32250 to D32299  
Serial port 2: D32350 to D32399
- EL-type CPU Units  
Serial port 1: D32350 to D32399

| Words                             |  | Bits     | Contents |  |
|-----------------------------------|--|----------|----------|--|
| Serial port 1 on EM-type CPU Unit | Serial port 2 on EM-type CPU Unit or Serial port 1 on EL-type CPU Unit |          |          |  |
| D32200                            | D32300   | 00 to 07 | Command  | Slave address (00 to F7 hex)                           |
|                                   |  | 08 to 15 |          | Reserved (Always 00.)                                  |
| D32201                            | D32301   | 00 to 07 |          | Function code  |
|                                   |  | 08 to 15 |          | Reserved (Always 00.)                                  |
| D32202                            | D32302   | 00 to 15 |          | Number of communications data bytes (0000 to 005E hex) |
| D32203 to D32249                  | D32303 to D32349   | 00 to 15 |          | Communications data (94 bytes maximum)                 |

| Words                                   |  | Bits     | Contents |  |
|---|--|----------|----------|--|
| Serial port 1<br>on EM-type<br>CPU Unit | Serial port 2<br>on EM-type<br>CPU Unit<br>or<br>Serial port 1<br>on EL-type<br>CPU Unit |          |          |  |
| D32250                                  | D32350   | 00 to 07 | Response | Slave address (00 to F7 hex)                   |
|   |  | 08 to 15 |          | Reserved (Always 00.)                          |
| D32251                                  | D32351   | 00 to 07 |          | Function code                                  |
|   |  | 08 to 15 |          | Reserved                                       |
| D32252                                  | D32352   | 00 to 07 |          | Error code                                     |
|   |  | 08 to 15 |          | Reserved (Always 00.)                          |
| D32253                                  | D32353   | 00 to 15 |          | Number of response bytes<br>(0000 to 03EA hex) |
| D32254 to<br>D32299                     | D32354 to<br>D32399  | 00 to 15 |          | Response data<br>(92 bytes maximum)            |

### Error Codes

The following error codes are stored in an allocated DM Area word when an error occurs in Modbus-RTU Easy Master function execution.

| Code | Name                                 | Description   |
|------|--------------------------------------|---|
| 0x00 | Normal end                           | Not an error.   |
| 0x01 | Illegal address                      | The slave address specified in the parameter is illegal (248 or higher).  |
| 0x02 | Illegal function code                | The function code specified in the parameter is illegal.  |
| 0x03 | Data length overflow                 | There are more than 94 data bytes.  |
| 0x04 | Serial communications mode error     | The Modbus-RTU Easy Master function was executed when the serial communications mode was not the Serial Gateway Mode. |
| 0x80 | Response timeout                     | A response was not received from the Servo.   |
| 0x81 | Parity error                         | A parity error occurred.  |
| 0x82 | Framing error                        | A framing error occurred.   |
| 0x83 | Overrun error                        | An overrun error occurred.  |
| 0x84 | CRC error                            | A CRC error occurred.   |
| 0x85 | Incorrect confirmation address       | The slave address in the response is difference from the one in the request.  |
| 0x86 | Incorrect confirmation function code | The function code in the response is difference from the one in the request.  |
| 0x87 | Response size overflow               | The response frame is larger than the storage area (92 bytes).  |
| 0x88 | Exception response                   | An exception response was received from the slave.  |
| 0x89 | Service being executed               | A service is already being executed (reception traffic congestion).   |
| 0x8A | Execution canceled                   | Executing the service has been canceled.  |
| 0x8F | Other error                          | Other FINS response code was received.  |

**Auxiliary Area Flags and Bits**

The Modbus-RTU command set in the DM fixed allocation words for the Modbus-RTU Easy Master is automatically sent when the Modbus-RTU Master Execution Bit is turned ON. The results (normal or error) will be given in corresponding flags.

| Word | Bit | Port                             | Contents   |
|------|-----|----------------------------------|--|
| A640 | 00  | EM-type CPU Units: Serial port 2 | Modbus-RTU Master Execution Bit<br>Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. |
|      | 01  | EL-type CPU Units: Serial port 1 | Modbus-RTU Master Execution Normal Flag<br>ON: Execution normal.<br>OFF: Execution error or still in progress.                             |
|      | 02  |                                  | Modbus-RTU Master Execution Error Flag<br>ON: Execution error.<br>OFF: Execution normal or still in progress.                              |
| A641 | 00  | EM-type CPU Unit: Serial port 1  | Modbus-RTU Master Execution Bit<br>Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. |
|      | 01  |                                  | Modbus-RTU Master Execution Normal Flag<br>ON: Execution normal.<br>OFF: Execution error or still in progress.                             |
|      | 02  |                                  | Modbus-RTU Master Execution Error Flag<br>ON: Execution error.<br>OFF: Execution normal or still in progress.                              |

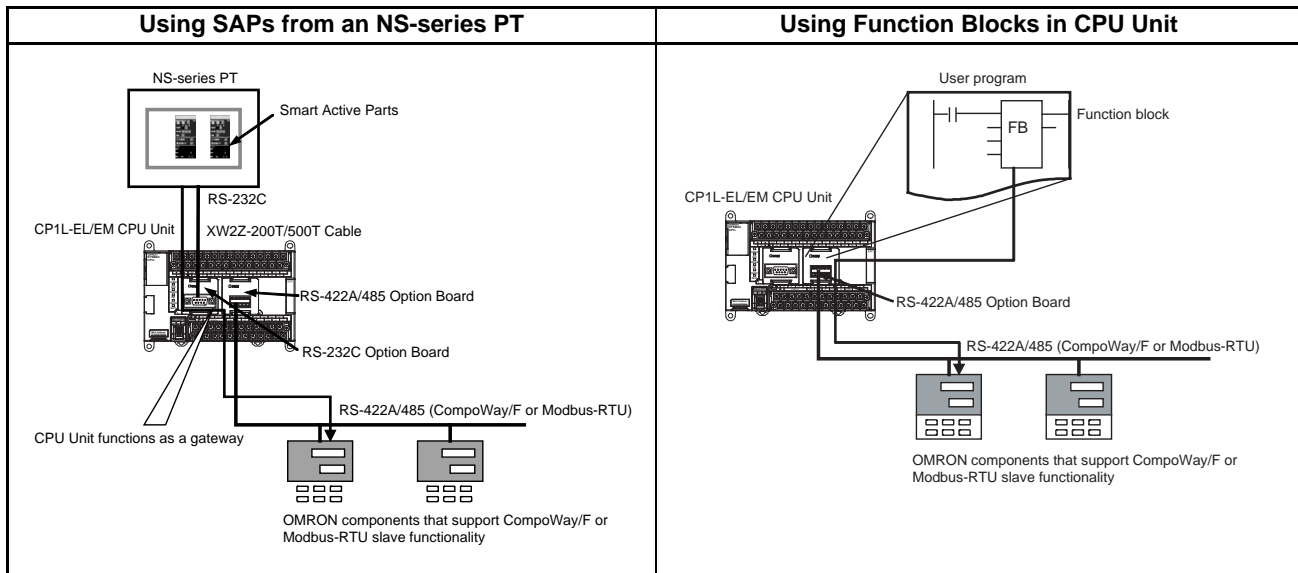
## 8-3-4 Communications: Smart Active Parts and Function Blocks

### Overview

OMRON components that support CompoWay/F communications or Modbus-RTU slave functionality (such as Temperature Controllers) can be easily accessed from a CP1L-EL/EM CPU Unit equipped with an RS-422A/485 or RS-232C Option Board using Smart Active Parts (SAPs) on an NS-series PT or using function blocks in the ladder program in the CP1L-EL/EM CPU Unit.

The communications mode in the PLC Setup must be set to the Gateway Mode to enable this functionality.

### System Configuration



**Note** Refer to OMRON's Smart Library website for the most recent information on using SAPs and function blocks.

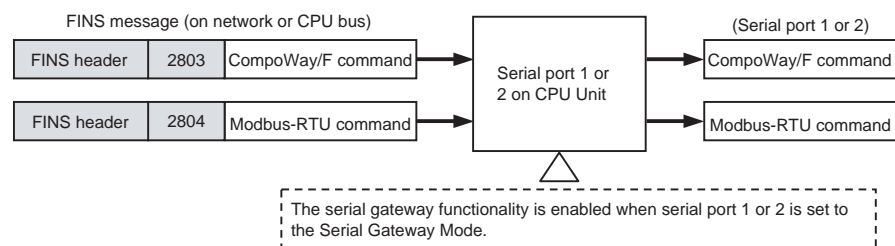
### Serial Gateway Function

When a FINS command is received, it is automatically converted to the protocol corresponding to the message and sent on the serial communications path. Responses are also converted in the same way.

**Note** Serial ports 1 and 2 on the CP1L-EL/EM CPU Unit can be used to convert to the following protocols.

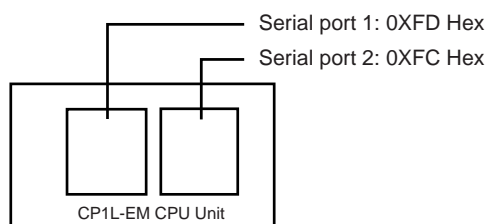
- CompoWay/F
- Modbus-RTU

This functionality is enabled when the serial communications mode is set to *Serial Gateway*.



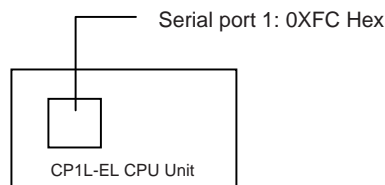
**Contents of FINS Header**

- Destination network address (DNA)
  - a. When the routing table for network control of serial communication channel is developed:  
It is the network address that corresponds to serial communication port according to the routing table.
  - b. When the routing table for networking serial communication channel is not developed:  
It is the network address when actual destination PLC is specified.
- Destination node address (DA1)
  - a. When the routing table for network control of serial communication channel is developed:  
00Hex (means PLC internal communication)
  - b. When the routing table for network control of serial communication channel is not developed:  
It is the node address when actual destination PLC is specified.
- Destination model address (DA2)  
It needs to be the model address of serial communication port.  
CPU Unit with 30 or 40 I/O Points



| Serial communication port of CP1L-EM | Model address of serial communication port |
|--------------------------------------|--|
| Serial port 1                        | FD Hex (decimal 253)                       |
| Serial port 2                        | FC Hex (decimal 252)                       |

CPU Unit with 20 I/O Points



| Serial communication port of CP1L-EL | Model address of serial communication port |
|--------------------------------------|--|
| Serial port 1                        | FC Hex (decimal 252)                       |



## CPU Unit Serial Gateway Function Specifications

| Item                                | Specification  |
|-------------------------------------|--|
| Pre-conversion data                 | FINS (via FINS network, Host Link FINS, toolbus, NT Link, or CPU bus)  |
| Conversion functions                | FINS commands addressed to serial port 1 or 2 on the CPU Unit are converted to CompoWay/F commands (after removing the header) if the FINS command code is 2803 hex and to Modbus-RTU commands (after removing the header) if the FINS command code is 2804 hex.   |
| Post-conversion data                | CompoWay/F command or Modbus-RTU command   |
| Serial communications method        | 1:N half-duplex  |
| Maximum number of nodes             | 31   |
| Enabling serial communications mode | Serial Gateway Mode  |
| Response timeout                    | The time from when a message converted to a different protocol is set until a response is received is monitored by the serial gateway function.<br>Default: 5 s, User setting: 0.1 to 25.5 s<br><b>Note</b> A FINS response code of 0205 hex (response timeout) is sent to the source of the FINS command if a timeout occurs. |
| Send delay function                 | None   |

**Note** If a CJ-series Serial Communications Unit is connected via a CJ Unit Adapter, messages can also be converted to Modbus-ASCII or Host Link FINS. Refer to the *SYSMAC CS/CJ Series Serial Communications Boards/Units Operation Manual (W336)* for details.

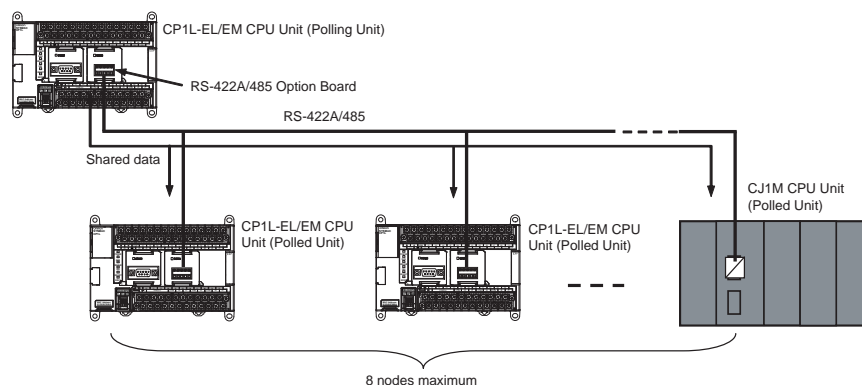
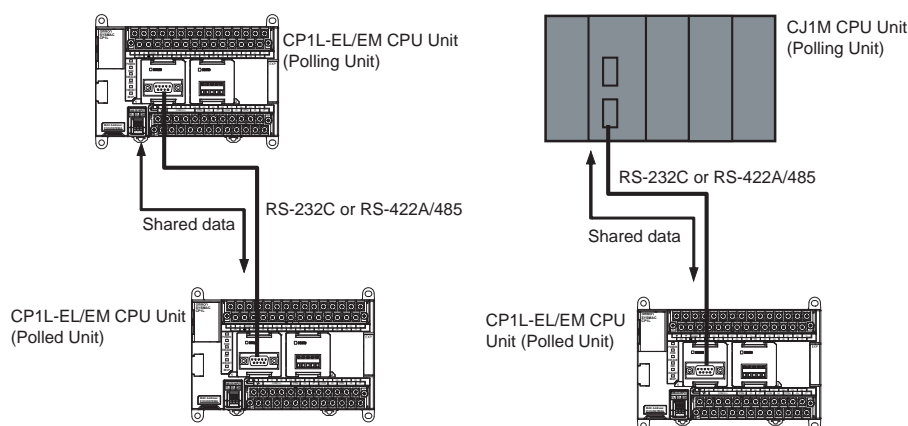
## 8-3-5 Serial PLC Links

### Overview

Serial PLC Links can be used to allow data to be exchanged among CP1L-EL/EM and CJ1M CPU Units via the RS-422A/485 or RS-232C Option Boards mounted to the CPU Units without requiring special programming. The communications mode in the PLC Setup must be set to the Serial PLC Link Mode to enable this functionality.

- Either serial port 1 or 2 can be used. (See note.)
- Words are allocated in memory in the Serial PLC Link Words (CIO 3100 to CIO 3199).
- A maximum of 10 words can be transferred by each CP1L-EL/EM CPU Unit, but the number of linked words can be set to fewer words. (The size must be the same for all CP1L-EL/EM CPU Units.)

**Note** Serial PLC Links cannot be used on serial ports 1 and 2 at the same time. If one port is set as a Serial PLC Link slave or master, it will not be possible to set the other port for a Serial PLC Link. A PLC Setup error will occur if an attempt is made to set both ports for Serial PLC Links.

**Configuration****1:N Connections between CP1L-EL/EM/CJ1M CPU Units (8 Nodes Maximum)****1:1 Connections between CP1L-EL/EM/CJ1M CPU Units****Specifications**

| Item                                | Specifications   |
|-------------------------------------|--|
| Applicable serial ports             | Serial port 1 or 2. Both ports cannot be used for PLC Links at the same time. If both ports are set for PLC Links (either as polling node or polled node), a PLC Setup setting error (non-fatal error) will occur and the PLC Setup Setting Error Flag (A402.10) will turn ON. |
| Connection method                   | RS-422A/485 or RS-232C connection via RS-422A/485 or RS-232C Option Board.   |
| Allocated data area                 | Serial PLC Link Words:<br>CIO 3100 to CIO 3199 (Up to 10 words can be allocated for each CPU Unit.)  |
| Number of Units                     | 9 Units max., comprising 1 Polling Unit and 8 Polled Units (A PT can be placed on the same network in an 1:N NT Link, but it must be counted as one of the 8 Polled Units.)  |
| Link methods (data refresh methods) | Complete link method or Polling Unit link method   |

**Data Refresh Methods**

The following two methods can be used to refresh data.

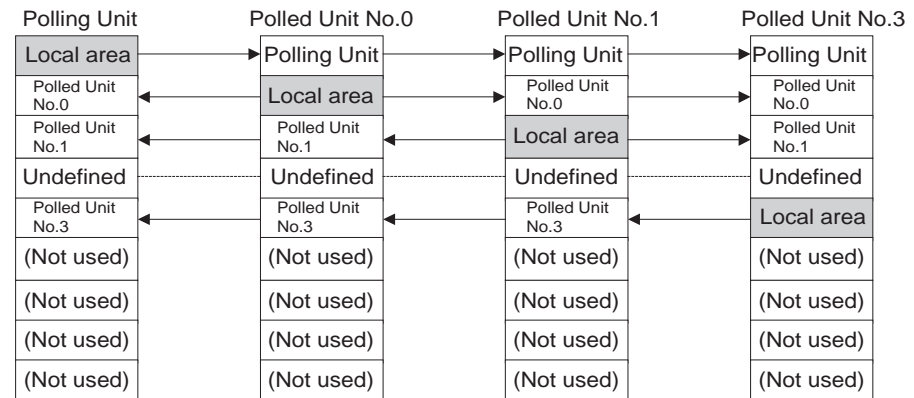
- Complete link method
- Polling Unit link method

### Complete Link Method

The data from all nodes in the Serial PLC Links are reflected in both the Polling Unit and the Polled Units. (The only exceptions are the address allocated to the connected PT's unit number and the addresses of Polled Units that are not present in the network. These data areas are undefined in all nodes.)

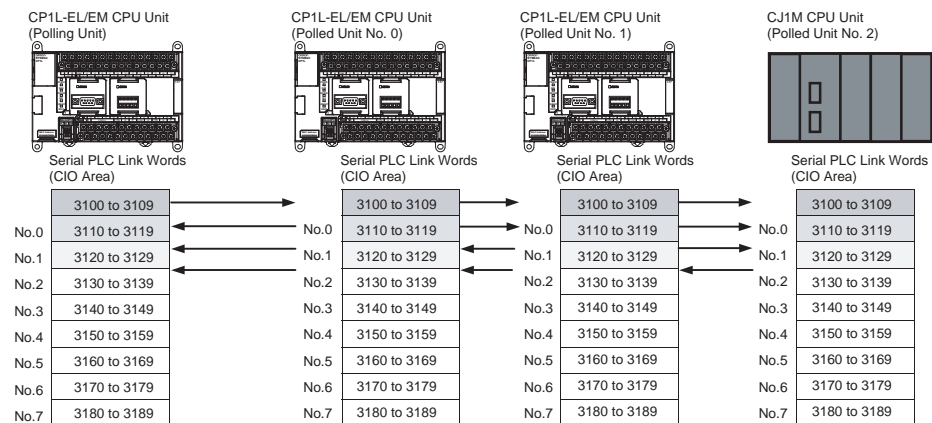
#### Example: Complete Link Method, Highest Unit Number: 3

In the following diagram, Polled Unit No. 2 is either a PT or is a Unit not present in the network, so the area allocated for Polled Unit No. 2 is undefined in all nodes.



#### Example: Complete Link Method, Number of Link Words: 10

Each CPU Unit (either CP1L-EL/EM or CJ1M) sends data to the same words in all other CPU Units for the Polling Unit and all Polled Units. The Polling Unit is a CP1L-EL/EM CPU Unit in the following example, but it could also be a CJ1M CPU Unit.

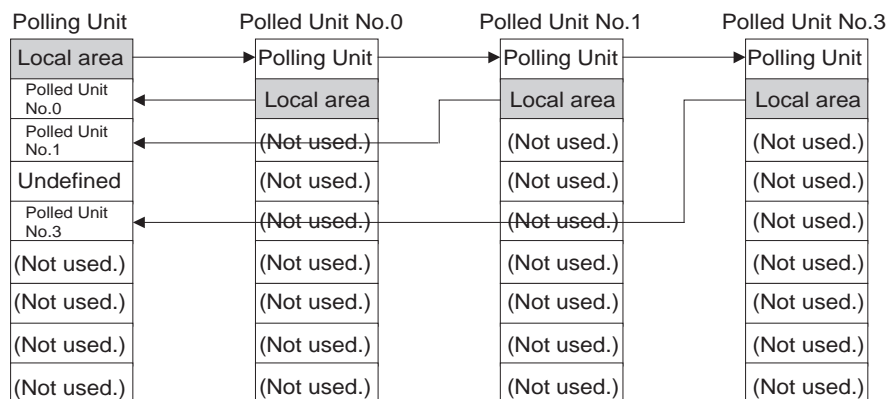


### Polling Unit Link Method

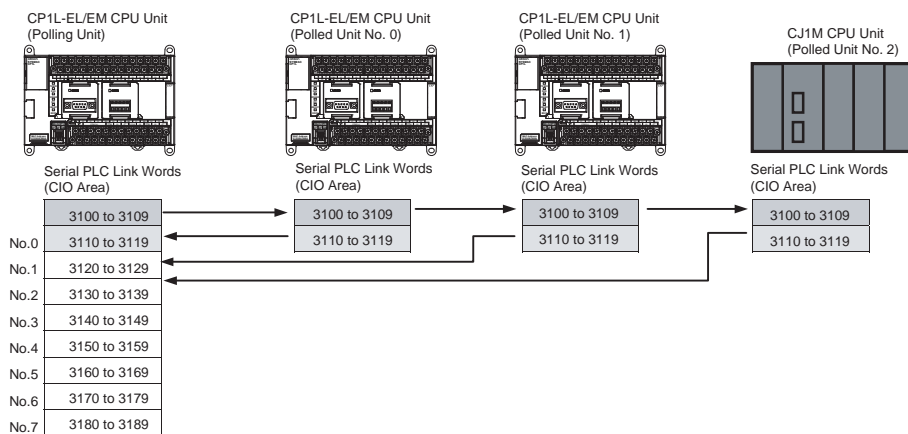
The data for all the Polled Units in the Serial PLC Links are reflected in the Polling Unit only, and each Polled Unit reflects the data of the Polling Unit only. The advantage of the Polling Unit link method is that the addresses allocated for the local Polled Unit data are the same in each Polled Unit, allowing data to be accessed using common ladder programming. The areas allocated for the unit numbers of the PT or Polled Units not present in the network are undefined in the Polling Unit only.

**Example: Polling Unit Link Method, Highest Unit Number: 3**

In the following diagram, Polled Unit No. 2 is a PT or a Unit not participating in the network, so the corresponding area in the Polling Unit is undefined.

**Example: Polling Unit Link Method, Number of Link Words: 10**

The CPU Unit that is the Polling Unit (either CP1L-EL/EM or CJ1M) sends its data (CIO 3100 to CIO 3109) to the same words (CIO 3100 to CIO 3109) in all other CPU Units. The Polled Units send their data (CIO 3110 to CIO 3119) to consecutive sets of 10 words in the Polling Unit. The Polling Units is a CP1L-EL/EM CPU Unit in the following example, but it could also be a CJ1M CPU Unit. (Only the first three Polled Units are shown below.)



**Allocated Words****Complete Link Method**

Address

CIO 3100

Serial PLC  
Link Words

CIO 3199

| Link words        | 1 word                     | 2 words                 | 3 words                 | to | 10 words                |
|-------------------|----------------------------|-------------------------|-------------------------|----|-------------------------|
| Polling Unit      | CIO 3100                   | CIO 3100 to<br>CIO 3101 | CIO 3100 to<br>CIO 3102 |    | CIO 3100 to<br>CIO 3109 |
| Polled Unit No. 0 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 1 | CIO 3102                   | CIO 3104 to<br>CIO 3105 | CIO 3106 to<br>CIO 3108 |    | CIO 3120 to<br>CIO 3129 |
| Polled Unit No. 2 | CIO 3103                   | CIO 3106 to<br>CIO 3107 | CIO 3109 to<br>CIO 3111 |    | CIO 3130 to<br>CIO 3139 |
| Polled Unit No. 3 | CIO 3104                   | CIO 3108 to<br>CIO 3109 | CIO 3112 to<br>CIO 3114 |    | CIO 3140 to<br>CIO 3149 |
| Polled Unit No. 4 | CIO 3105                   | CIO 3110 to<br>CIO 3111 | CIO 3115 to<br>CIO 3117 |    | CIO 3150 to<br>CIO 3159 |
| Polled Unit No. 5 | CIO 3106                   | CIO 3112 to<br>CIO 3113 | CIO 3118 to<br>CIO 3120 |    | CIO 3160 to<br>CIO 3169 |
| Polled Unit No. 6 | CIO 3107                   | CIO 3114 to<br>CIO 3115 | CIO 3121 to<br>CIO 3123 |    | CIO 3170 to<br>CIO 3179 |
| Polled Unit No. 7 | CIO 3108                   | CIO 3116 to<br>CIO 3117 | CIO 3124 to<br>CIO 3126 |    | CIO 3180 to<br>CIO 3189 |
| Not used.         | CIO 3109<br>to<br>CIO 3199 | CIO 3118 to<br>CIO 3199 | CIO 3127 to<br>CIO 3199 |    | CIO 3190 to<br>CIO 3199 |

**Polling Unit Link Method**

Address

CIO 3100

Serial PLC  
Link Words

CIO 3199

| Link words        | 1 word                     | 2 words                 | 3 words                 | to | 10 words                |
|-------------------|----------------------------|-------------------------|-------------------------|----|-------------------------|
| Polling Unit      | CIO 3100                   | CIO 3100 to<br>CIO 3101 | CIO 3100 to<br>CIO 3102 |    | CIO 3100 to<br>CIO 3109 |
| Polled Unit No. 0 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 1 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 2 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 3 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 4 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 5 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 6 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Polled Unit No. 7 | CIO 3101                   | CIO 3102 to<br>CIO 3103 | CIO 3103 to<br>CIO 3105 |    | CIO 3110 to<br>CIO 3119 |
| Not used.         | CIO 3102<br>to<br>CIO 3199 | CIO 3104 to<br>CIO 3199 | CIO 3106 to<br>CIO 3199 |    | CIO 3120 to<br>CIO 3199 |

**Procedure**

The Serial PLC Links operate according to the following settings in the PLC Setup in the Polling Unit and Polled Units.

**Settings at the Polling Unit**

- 1,2,3...**
1. Set the serial communications mode of serial port 1 or 2 to Serial PLC Links (Polling Unit).
  2. Set the link method to the Complete Link Method or Polling Unit Link Method.
  3. Set the number of link words (up to 10 words for each Unit).
  4. Set the maximum unit number in the Serial PLC Links (0 to 7).

**Settings at the Polled Units**

- 1,2,3...**
1. Set the serial communications mode of serial port 1 or 2 to Serial PLC Links (Polled Unit).
  2. Set the unit number of the Serial PLC Link Polled Unit.

**PLC Setup****Settings at the Polling Unit**

| Item                  |                                 | Set value   | Default   | Refresh timing |
|-----------------------|---------------------------------|---|-----------|----------------|
| Serial port<br>1 or 2 | Mode: Communications mode       | PC Link (Master): PLC Link Polling Unit                   | Host Link | Every cycle    |
|                       | Baud: Baud rate                 | 38,400 bps, 115,200 bps                                   | 9,600 bps |                |
|                       | PC link mode: PLC Link method   | ALL: Complete link method<br>Masters: Polling Unit method | ALL       |                |
|                       | Link words: No. of link words   | 1 to 10 words   | 10 words  |                |
|                       | PC Link Unit No.: Max. unit No. | 0 to 7  | 0 hex     |                |

**Settings at the Polled Unit**

| Item                  |                           | Set value                             | Default   | Refresh timing |
|-----------------------|---------------------------|---------------------------------------|-----------|----------------|
| Serial port<br>1 or 2 | Mode: Communications mode | PC Link (Slave): PLC Link Polled Unit | Host Link | Every cycle    |
|                       | Baud: Baud rate           | 38,400 bps, 115,200 bps               | 9,600 bps |                |
|                       | Unit number               | 0 to 7                                | 0         |                |

**Note** Both serial ports cannot be used for PLC Links at the same time. If both ports are set for PLC Links (either as polling node or polled node), a PLC Setup setting error (non-fatal error) will occur and the PLC Setup Setting Error Flag (A402.10) will turn ON. If PLC Links is set for one serial port, set the other serial port to a different mode.

**Related Auxiliary Area Flags for Serial Port 1 of an EM-type CPU Unit**

| Name  | Address            | Details   | Read/write | Refresh timing  |
|---|--------------------|---|------------|---|
| Serial Port 1 Communicating with PT Flags (See note.) | A394.00 to A394.07 | When serial port 1 is being used in NT link mode, the bit corresponding to the Unit performing communications will be ON. Bits 00 to 07 correspond to unit numbers 0 to 7, respectively.<br>ON: Communicating<br>OFF: Not communicating                                 | Read       | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>Turns ON the bit corresponding to the unit number of the PT/Polled Unit that is communicating via serial port 1 in NT link mode or Serial PLC Link mode.</li> <li>Bits 00 to 07 correspond to unit numbers 0 to 7, respectively.</li> </ul>  |
| Serial Port 1 Restart Bit                             | A526.01            | Turn ON this bit to restart serial port 1.  | Read/write | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>Turn ON to restart serial port 1, (except when communicating in peripheral bus mode).</li> </ul> <p>Note: The bit is automatically turned OFF by the system when restart processing has been completed.</p>  |
| Serial Port 1 Error Flags                             | A528.08 to A528.15 | When an error occurs at serial port 1, the corresponding error bit is turned ON.<br>Bit 08: Not used.<br>Bit 09: Not used.<br>Bit 10: Parity error<br>Bit 11: Framing error<br>Bit 12: Overrun error<br>Bit 13: Timeout error<br>Bit 14: Not used.<br>Bit 15: Not used. | Read/write | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>When an error occurs at serial port 1, the corresponding error bit is turned ON.</li> <li>The flag is automatically turned OFF by the system when serial port 1 is restarted.</li> <li>In NT link mode, only bit 05 (timeout error) is enabled.</li> </ul> <p>In Serial PLC Link mode, only the following bits are enabled.</p> <ul style="list-style-type: none"> <li>Errors at the Polling Unit:<br/>Bit 05: Timeout error</li> <li>Errors at Polled Units:<br/>Bit 05: Timeout error<br/>Bit 04: Overrun error<br/>Bit 03: Framing error</li> </ul> <p>Note: If the error occurred in Serial PLC link mode, the console will retry before communication establish. Rehabilitation of the communications is no need for port restart. If user eliminates error, the communication will automatically establish between console and servo.<br/>However, error flag will be saved as the record. If you want to clear the error flag, please restart port.</p> |
| Serial Port 1 Settings Changed Flag                   | A619.01            | Turns ON when the communications conditions of serial port 1 are being changed.<br>ON: Changed<br>OFF: No change  | Read/write | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>Turns ON while communications conditions settings for serial port 1 are being changed.</li> <li>Turns ON when the CHANGE SERIAL PORT SETUP instruction (STUP(237)) is executed.</li> <li>Turns OFF when the changes to settings are completed.</li> </ul>  |

**Note** In the same way as for the existing 1:N NT Link, the status (communicating/not communicating) of PTs in Serial PLC Links can be checked from the Polling Unit (CPU Unit) by reading the Serial Port 1 Communicating with PT Flag (A394 bits 00 to 07 for unit numbers 0 to 7).

**Related Auxiliary Area Flags for Serial Port 2 of an EM-type CPU Unit**

| Name  | Address            | Details   | Read/write | Refresh timing  |
|---|--------------------|---|------------|---|
| Serial Port 2 Communicating with PT Flags (See note.) | A393.00 to A393.07 | When Serial Port 2 is being used in NT link mode, the bit corresponding to the Unit performing communications will be ON. Bits 00 to 07 correspond to unit numbers 0 to 7, respectively.<br>ON: Communicating<br>OFF: Not communicating                                 | Read       | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>Turns ON the bit corresponding to the unit number of the PT/Polled Unit that is communicating via Serial Port 2 in NT link mode or Serial PLC Link mode.</li> <li>Bits 00 to 07 correspond to unit numbers 0 to 7, respectively.</li> </ul>  |
| Serial Port 2 Restart Bit                             | A526.00            | Turn ON this bit to restart Serial Port 2.  | Read/write | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>Turn ON to restart Serial Port 2, (except when communicating in peripheral bus mode).</li> </ul> <p>Note: The bit is automatically turned OFF by the system when restart processing has been completed.</p>  |
| Serial Port 2 Error Flags                             | A528.00 to A528.07 | When an error occurs at Serial Port 2, the corresponding error bit is turned ON.<br>Bit 00: Not used.<br>Bit 01: Not used.<br>Bit 02: Parity error<br>Bit 03: Framing error<br>Bit 04: Overrun error<br>Bit 05: Timeout error<br>Bit 06: Not used.<br>Bit 07: Not used. | Read/write | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>When an error occurs at Serial Port 2, the corresponding error bit is turned ON.</li> <li>The flag is automatically turned OFF by the system when Serial Port 2 is restarted.</li> <li>In NT link mode, only bit 05 (timeout error) is enabled.</li> </ul> <p>In Serial PLC Link mode, only the following bits are enabled.</p> <ul style="list-style-type: none"> <li>Errors at the Polling Unit:<br/>Bit 05: Timeout error</li> <li>Errors at Polled Units:<br/>Bit 05: Timeout error<br/>Bit 04: Overrun error<br/>Bit 03: Framing error</li> </ul> <p>Note: If the error occurred in Serial PLC link mode, the console will retry before communication establish. Rehabilitation of the communications is no need for port restart. If user eliminates error, the communication will automatically establish between console and servo.<br/>However, error flag will be saved as the record. If you want to clear the error flag, please restart port.</p> |
| Serial Port 2 Settings Changed Flag                   | A619.02            | Turns ON when the communications conditions of Serial Port 2 are being changed.<br>ON: Changed<br>OFF: No change  | Read/write | <ul style="list-style-type: none"> <li>Cleared when power is turned ON.</li> <li>Turns ON while communications conditions settings for Serial Port 2 are being changed.</li> <li>Turns ON when the CHANGE SERIAL PORT SETUP instruction (STUP(237)) is executed.</li> <li>Turns OFF when the changes to settings are completed.</li> </ul>  |

**Note** In the same way as for the existing 1:N NT Link, the status (communicating/not communicating) of PTs in Serial PLC Links can be checked from the Polling Unit (CPU Unit) by reading the Serial Port 2 Communicating with PT Flag (A393 bits 00 to 07 for unit numbers 0 to 7).



**Related Auxiliary Area Flags for Serial Port 1 of an EL-type CPU Unit**

| Name  | Address            | Details   | Read/write | Refresh timing  |
|---|--------------------|---|------------|---|
| Serial Port 1 Communications Error Flag               | A392.04            | Turns ON when a communications error occurs at Serial Port 1.<br>ON: Error<br>OFF: Normal   | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Turns ON when a communications error occurs at Serial Port 1.</li> <li>• Turns OFF when the port is restarted.</li> <li>• Disabled in peripheral bus mode and NT link mode.</li> </ul>   |
| Serial Port 1 Communicating with PT Flags (See note.) | A393.00 to A393.07 | When Serial Port 1 is being used in NT link mode, the bit corresponding to the Unit performing communications will be ON. Bits 00 to 07 correspond to unit numbers 0 to 7, respectively.<br>ON: Communicating<br>OFF: Not communicating                                 | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Turns ON the bit corresponding to the unit number of the PT/Polled Unit that is communicating via Serial Port 1 in NT link mode or Serial PLC Link mode.</li> <li>• Bits 00 to 07 correspond to unit numbers 0 to 7, respectively.</li> </ul>  |
| Serial Port 1 Restart Bit                             | A526.00            | Turn ON this bit to restart Serial Port 1.  | Read/write | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Turn ON to restart Serial Port 1, (except when communicating in peripheral bus mode).</li> </ul> <p>Note: The bit is automatically turned OFF by the system when restart processing has been completed.</p>  |
| Serial Port 1 Error Flags                             | A528.00 to A528.07 | When an error occurs at Serial Port 1, the corresponding error bit is turned ON.<br>Bit 00: Not used.<br>Bit 01: Not used.<br>Bit 02: Parity error<br>Bit 03: Framing error<br>Bit 04: Overrun error<br>Bit 05: Timeout error<br>Bit 06: Not used.<br>Bit 07: Not used. | Read/write | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• When an error occurs at Serial Port 1, the corresponding error bit is turned ON.</li> <li>• The flag is automatically turned OFF by the system when Serial Port 1 is restarted.</li> <li>• Disabled during peripheral bus mode.</li> <li>• In NT link mode, only bit 05 (timeout error) is enabled.</li> </ul> <p>In Serial PLC Link mode, only the following bits are enabled.</p> <ul style="list-style-type: none"> <li>• Errors at the Polling Unit:<br/>Bit 05: Timeout error</li> <li>• Errors at Polled Units:<br/>Bit 05: Timeout error<br/>Bit 04: Overrun error<br/>Bit 03: Framing error</li> </ul> |
| Serial Port 1 Settings Changed Flag                   | A619.02            | Turns ON when the communications conditions of Serial Port 1 are being changed.<br>ON: Changed<br>OFF: No change  | Read/write | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Turns ON while communications conditions settings for Serial Port 1 are being changed.</li> <li>• Turns ON when the CHANGE SERIAL PORT SETUP instruction (STUP(237)) is executed.</li> <li>• Turns OFF when the changes to settings are completed.</li> </ul>  |

**Note** In the same way as for the existing 1:N NT Link, the status (communicating/not communicating) of PTs in Serial PLC Links can be checked from the Polling Unit (CPU Unit) by reading the Serial Port 1 Communicating with PT Flag (A393 bits 00 to 07 for unit numbers 0 to 7).

### 8-3-6 1:1 Links

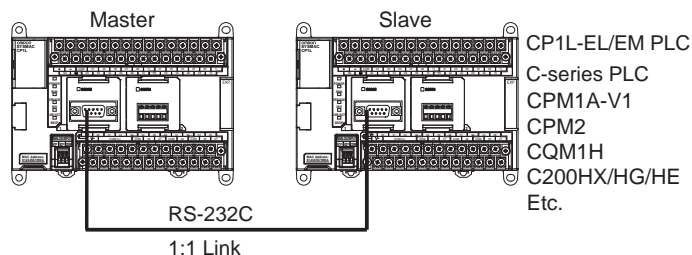
Two PLCs can be connected through their RS-232C ports to create Link Areas.

#### Applicable PLCs

A 1:1 Link can be created between any of the following SYSMAC PLCs:  
CP1L-EL/EM, CQM1H, C200HX/HG/HE(-Z), CPM1A-V1, CPM2A, CPM2B, CPM2C, and SRM1(-V2)

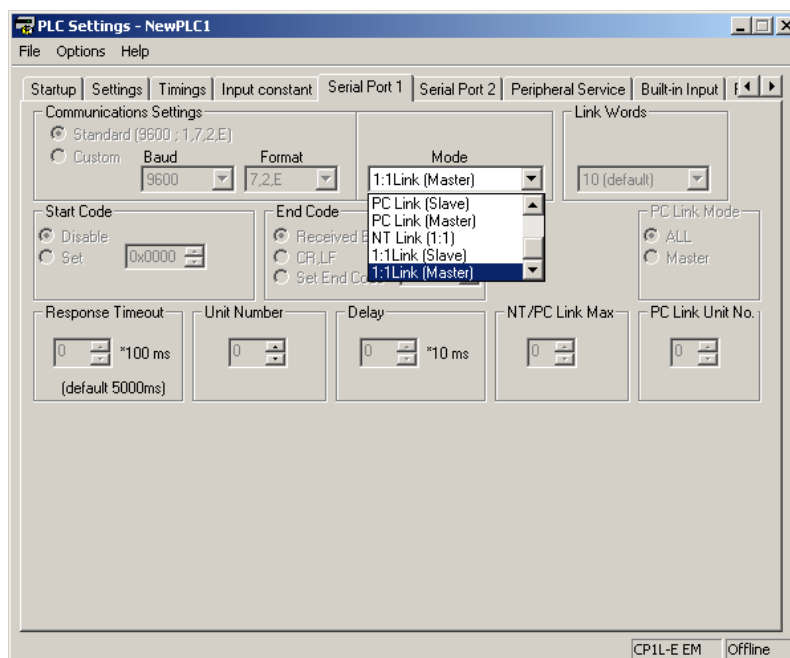
#### Connections

To create a 1:1 Link, connect the RS-232C ports on the two PLCs.



#### PLC Setup

Set the PLC to a 1:1 Link Master or a 1:1 Link Slave in the PLC Setup. Set the other PLC to the opposite setting.

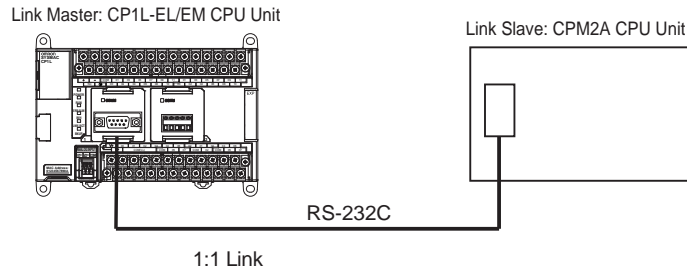


#### Link Area Size

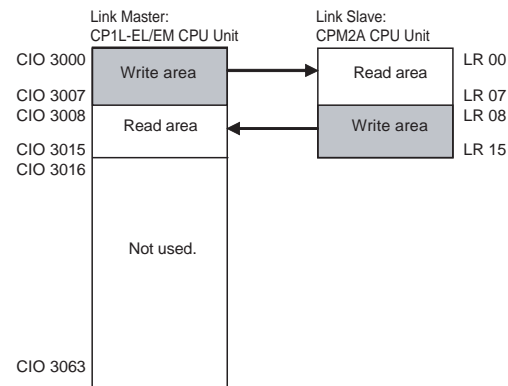
The 1:1 Link Area in the CP1L-EL/EM is from CIO 3000 to CIO 3015 (16 words). Even if a 1:1 Link is created with a CQM1H or C200HX/HG/HE(-Z) PLC, the 1:1 Link Area will be only 16 words on both sides of the link, and only LR 00 to LR 15 will be used in the CQM1H or C200HX/HG/HE(-Z) PLC. LR 16 to LR 63 cannot be used for 1:1 Links

#### Operation

Here, operation is described assuming that the master is the CP1L-EL/EM and the slave is the CPM2A.



### 1:1 Link Area

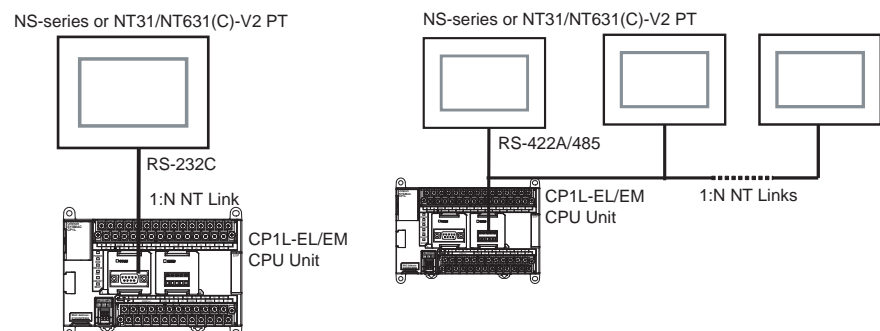


CP1L-EL/EM is set as the link master, so CIO 3000 to CIO 3007 are its write area. Any data written to these words with the OUT or MOV instructions will be automatically transferred to LR 00 to LR 07 in the CPM2A. The CPM2A will use these words as its read area.

CIO 3008 to 3015 are the read area of the CP1L-EL/EM. The contents of LR 08 to LR 15 in the CPM2A will automatically be transferred to CIO 3008 to 3015 in the CP1L-EL/EM. The words in the PLC's read area cannot be written using the OUT, MOV, or any other write instructions.

## 8-3-7 1:N NT Links

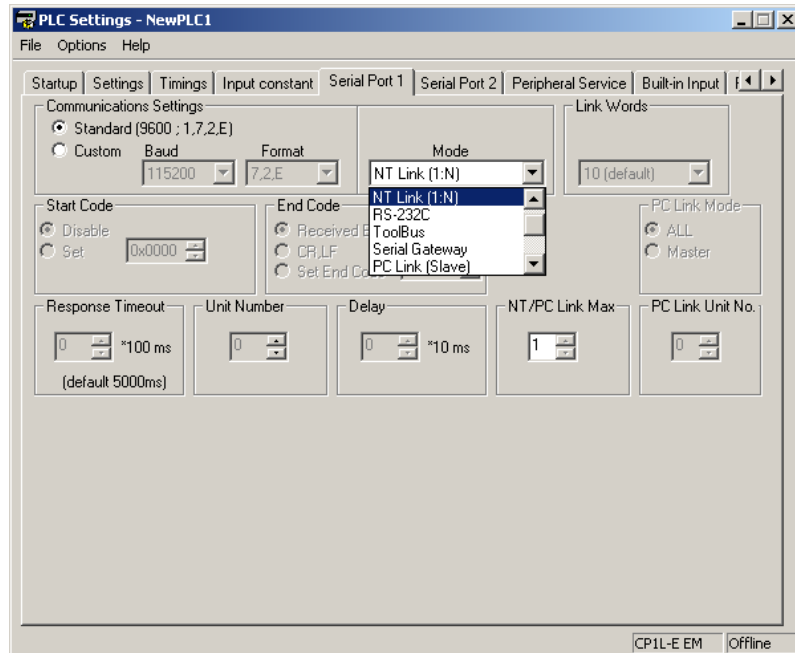
In the CP Series, communications are possible with PTs (Programmable Terminals) using NT Links in 1:N mode.



**Note** Communications are not possible using the 1:1-mode NT Link protocol.

High-speed NT Links are possible in addition to the previous standard NT Links by using the PT system menu and the following PLC Setup. High-speed NT Links are possible, however, only with NS-series PTs or with the NT31(C)-V2 or NT631(C)-V2 PTs.

## PLC Setup



| Port               | Name                                | Settings contents                         | Default values      | Other conditions  |
|--------------------|-------------------------------------|---|---------------------|---|
| Serial port 1 or 2 | Mode: Communications mode           | NT Link (1:N): 1:N NT Links               | Host Link           | Turn OFF pin 4 on the CPU Unit DIP switch when using serial port 1 and turn OFF pin 5 when using serial port 2. |
|                    | Baud: Baud rate                     | 38,400 (standard)<br>115,200 (high speed) | 9,600<br>(disabled) |   |
|                    | NT/PC Link Max: Highest unit number | 0 to 7                                    | 0                   |   |

## PT System Menu

Set the PT as follows:

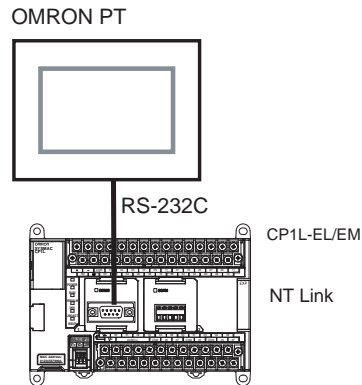
**1,2,3...**

1. Select NT Link (1:N) from Comm. A Method or Comm. B Method on the Memory Switch Menu under the System Menu on the PT Unit.
2. Press the SET Touch Switch to set the Comm. Speed to High Speed.

### 8-3-8 1:1 NT Links

The NT Link communications protocol was developed to enable high-speed communications between PLC and Programmable Terminals (PTs). There are two communications modes supported by the NT Link protocol: 1:1 NT Links, in which one PLC is connected to one PT, and 1:N NT Links, in which one PLC is connected to more than one PT.

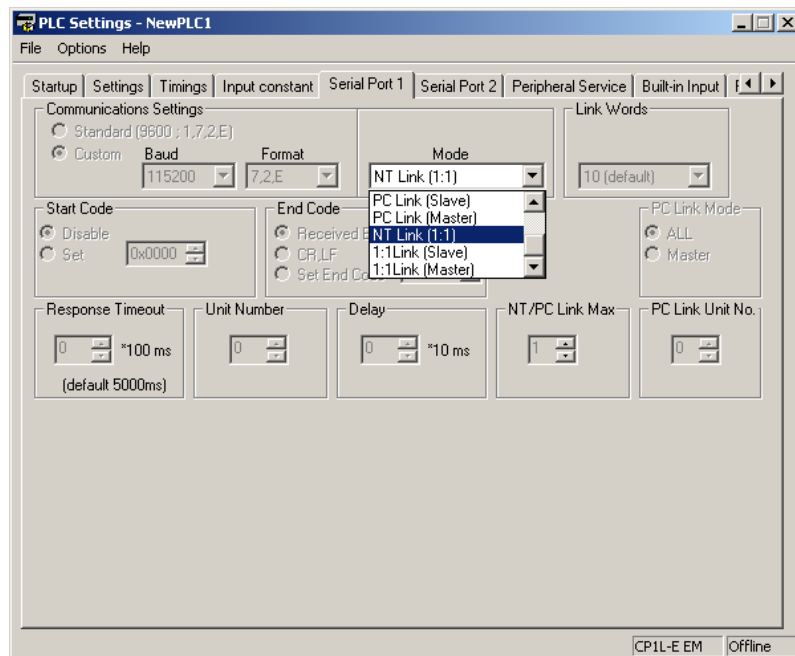
#### Connections



With the NT Link protocol, the PLC automatically responds to commands sent from the PT, so no communications programming is required in the CP1L-EL/EM.

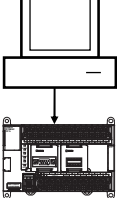
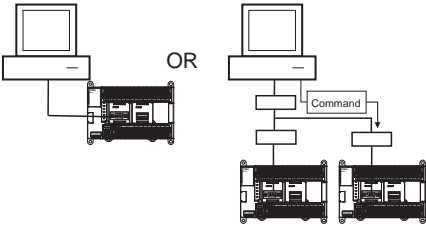
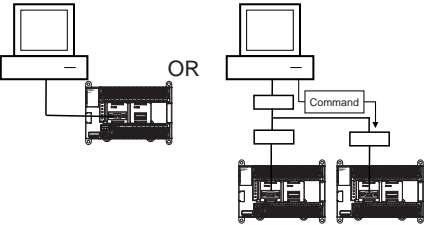
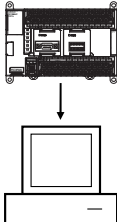
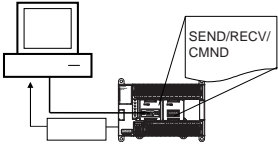
#### PLC Setup

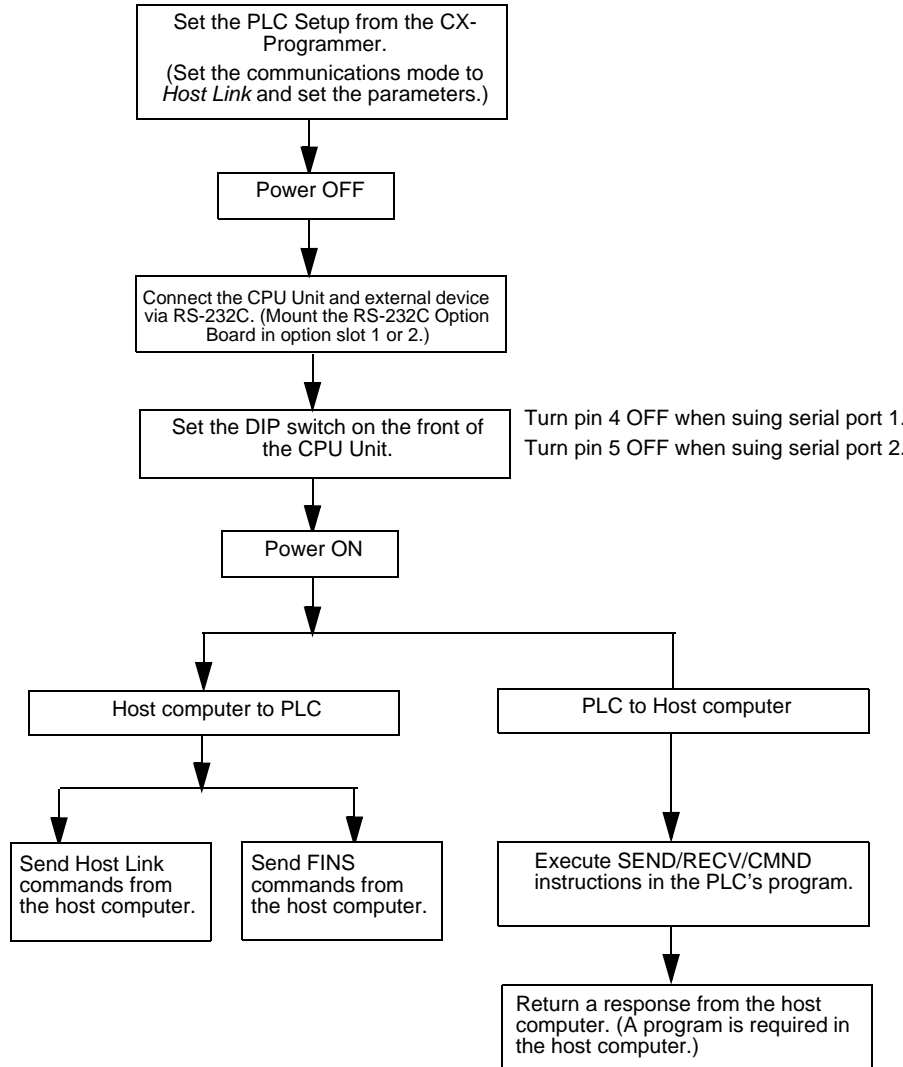
Select "NT Link (1:1)" as the serial communications mode.



### 8-3-9 Host Link Communications

The following table shows the host link communication functions available in CP1L-EL/EM PLCs. Select the method that best suits your application.

| Command flow   | Command type   | Communications method   | Configuration  |
|--|--|---|--|
| <p>Host computer</p>    | <p>Host link command (C Mode)</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;">Host link command</div>  | <p>Create frame in the host computer and send the command to the PLC. Receive the response from the PLC.</p> <p>Application:<br/>Use this method when communicating primarily from the host computer to the PLC.</p>  | <p>Directly connect the host computer in a 1:1 or 1:N system.</p>  |
|  | <p>FINS command (with Host Link header and terminator) sent.</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;"> <div style="display: inline-block; width: 20px; height: 10px; border: 1px solid black;"></div> <div style="display: inline-block; width: 40px; height: 10px; border: 1px solid black; text-align: center;">FINS</div> <div style="display: inline-block; width: 20px; height: 10px; border: 1px solid black;"></div> </div> <div style="display: flex; justify-content: space-around; width: 100px; margin-top: 5px;"> <span>Header</span> <span>Terminator</span> </div>    | <p>Create frame in the host computer and send the command to the PLC. Receive the response from the PLC.</p> <p>Application:<br/>Use these methods when communicating primarily from the host computer to PLCs in the network.</p> <p>Remarks:<br/>The FINS command must be placed between a Host Link header and terminator and then sent by the host computer.</p>  | <p>Directly connect the host computer in a 1:1 or 1:N system.</p>  |
|  <p>Host computer</p> | <p>FINS command (with Host Link header and terminator) is sent.</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;"> <div style="display: inline-block; width: 20px; height: 10px; border: 1px solid black;"></div> <div style="display: inline-block; width: 40px; height: 10px; border: 1px solid black; text-align: center;">FINS</div> <div style="display: inline-block; width: 20px; height: 10px; border: 1px solid black;"></div> </div> <div style="display: flex; justify-content: space-around; width: 100px; margin-top: 5px;"> <span>Header</span> <span>Terminator</span> </div> | <p>Send the command frame with the CPU Unit's SEND, RECV, or CMND instruction. Receive response from the host computer.</p> <p>Application:<br/>Use this method when communicating primarily from the PLC to the host computer to transmit status information, such as error information.</p> <p>Remarks:<br/>The FINS command will be placed between a Host Link header and terminator when it is sent. The FINS command must be interpreted at the host computer and then the host computer must return a response.</p> | <p>Directly connect the host computer in a 1:1 system.</p>       |

**Procedure****Host Link Commands**

The following table lists the host link commands. Refer to the *SYSMAC CS/CJ-series Communications Commands Reference Manual (W342)* for more details.

| Type                     | Header code | Name            | Function   |
|--------------------------|-------------|-----------------|--|
| I/O memory read commands | RR          | CIO AREA READ   | Reads the contents of the specified number of CIO Area words starting from the specified word.                                 |
|                          | RL          | LINK AREA READ  | Reads the contents of the specified number of Link Area words starting from the specified word.                                |
|                          | RH          | HR AREA READ    | Reads the contents of the specified number of Holding Area words starting from the specified word.                             |
|                          | RC          | PV READ         | Reads the contents of the specified number of timer/counter PVs (present values) starting from the specified timer/counter.    |
|                          | RG          | T/C STATUS READ | Reads the status of the Completion Flags of the specified number of timers/counters starting from the specified timer/counter. |
|                          | RD          | DM AREA READ    | Reads the contents of the specified number of DM Area words starting from the specified word.                                  |
|                          | RJ          | AR AREA READ    | Reads the contents of the specified number of Auxiliary Area words starting from the specified word.                           |

| Type                              | Header code | Name                     | Function  |
|-----------------------------------|-------------|--------------------------|---|
| I/O memory write commands         | WR          | CIO AREA WRITE           | Writes the specified data (word units only) to the CIO Area, starting from the specified word.  |
|                                   | WL          | LINK AREA WRITE          | Writes the specified data (word units only) to the Link Area, starting from the specified word.   |
|                                   | WH          | HR AREA WRITE            | Writes the specified data (word units only) to the Holding Area, starting from the specified word.  |
|                                   | WC          | PV WRITE                 | Writes the PVs (present values) of the specified number of timers/counters, starting from the specified timer/counter.  |
|                                   | WD          | DM AREA WRITE            | Writes the specified data (word units only) to the DM Area, starting from the specified word.   |
|                                   | WJ          | AR AREA WRITE            | Writes the specified data (word units only) to the Auxiliary Area, starting from the specified word.  |
| Timer/counter SV read commands    | R#          | SV READ 1                | Reads the 4-digit BCD constant or word address in the SV of the specified timer/counter instruction.  |
|                                   | R\$         | SV READ 2                | Searches for the specified timer/counter instruction beginning at the specified program address and reads the 4-digit constant or word address in the SV.     |
|                                   | R%          | SV READ 3                | Searches for the specified timer/counter instruction beginning at the specified program address and reads the 4-digit BCD constant or word address in the SV. |
| Timer/counter SV write commands   | W#          | SV CHANGE 1              | Changes the 4-digit BCD constant or word address in the SV of the specified timer/counter instruction.  |
|                                   | W\$         | SV CHANGE 2              | Searches for the specified timer/counter instruction beginning at the specified program address and changes the 4-digit constant or word address in the SV.   |
|                                   | W%          | SV CHANGE 3              | Searches for the specified timer/counter instruction beginning at the specified program address and changes the 4-digit constant or word address in the SV.   |
| CPU Unit status commands          | MS          | STATUS READ              | Reads the operating status of the CPU Unit (operating mode, force-set/reset status, fatal error status).  |
|                                   | SC          | STATUS CHANGE            | Changes the CPU Unit's operating mode.  |
|                                   | MF          | ERROR READ               | Reads and clears errors in the CPU Unit (non-fatal and fatal).  |
| Force-set/force-reset commands    | KS          | FORCE SET                | Force-sets the specified bit.   |
|                                   | KR          | FORCE RESET              | Force-resets the specified bit.   |
|                                   | FK          | MULTIPLE FORCE SET/RESET | Force-sets, force-resets, or clears the forced status of the specified bits.  |
|                                   | KC          | FORCE SET/RESET CANCEL   | Cancels the forced status of all force-set and force-reset bits.  |
| Model read command                | MM          | PLC MODEL READ           | Reads the model type of the PLC.  |
| Test command                      | TS          | TEST                     | Returns, unaltered, one block of data transmitted from the host computer.   |
| Program area access commands      | RP          | PROGRAM READ             | Reads the contents of the CPU Unit's user program area in machine language (object code).   |
|                                   | WP          | PROGRAM WRITE            | Writes the machine language (object code) program transmitted from the host computer into the CPU Unit's user program area.                                   |
| I/O memory compound read commands | QQMR        | COMPOUND COMMAND         | Registers the desired bits and words in a table.  |
|                                   | QQIR        | COMPOUND READ            | Reads the registered words and bits from I/O memory.  |



| Type   | Header code | Name                              | Function   |
|--|-------------|-----------------------------------|--|
| Host Link communications processing commands | XZ          | ABORT (command only)              | Aborts the host link command that is currently being processed.                            |
|  | **          | INITIALIZE (command only)         | Initializes the transmission control procedure of all PLCs connected to the host computer. |
|  | IC          | Undefined command (response only) | This response is returned if the header code of a command was not recognized.              |

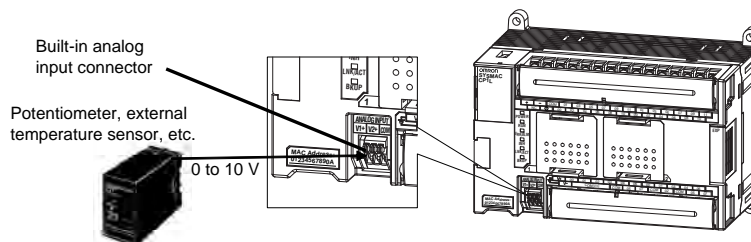
**FINS Commands**

The following table lists the FINS commands. Refer to the *FINS Commands Reference Manual (W227)* for more details.

| Type                            | Command code |    | Name                        | Function   |
|---------------------------------|--------------|----|-----------------------------|--|
| I/O Memory Area Access Commands | 01           | 01 | MEMORY AREA READ            | Reads consecutive data from the I/O memory area.                                       |
|                                 | 01           | 02 | MEMORY AREA WRITE           | Writes consecutive data to the I/O memory area.  |
|                                 | 01           | 03 | MEMORY AREA FILL            | Fills the specified range of I/O memory with the same data.                            |
|                                 | 01           | 04 | MULTIPLE MEMORY AREA READ   | Reads non-consecutive data from the I/O memory area.                                   |
|                                 | 01           | 05 | MEMORY AREA TRANSFER        | Copies and transfers consecutive data from one part of the I/O memory area to another. |
| Parameter Area Access Commands  | 02           | 01 | PARAMETER AREA READ         | Reads consecutive data from the parameter area.  |
|                                 | 02           | 02 | PARAMETER AREA WRITE        | Writes consecutive data to the parameter area.   |
|                                 | 02           | 03 | PARAMETER AREA FILL         | Fills the specified range of the parameter area with the same data.                    |
| Program Area Access Commands    | 03           | 06 | PROGRAM AREA READ           | Reads data from the user program area.   |
|                                 | 03           | 07 | PROGRAM AREA WRITE          | Writes data to the user program area.  |
|                                 | 03           | 08 | PROGRAM AREA CLEAR          | Clears the specified range of the user program area.                                   |
| Execution Control Commands      | 04           | 01 | RUN                         | Switches the CPU Unit to RUN or MONITOR mode.  |
|                                 | 04           | 02 | STOP                        | Switches the CPU Unit to PROGRAM mode.   |
| Configuration Read Commands     | 05           | 01 | CONTROLLER DATA READ        | Reads CPU Unit information.  |
|                                 | 05           | 02 | CONNECTION DATA READ        | Reads the model numbers of the specified Units.  |
| Status Read Commands            | 06           | 01 | CONTROLLER STATUS READ      | Reads the CPU Unit's status information.   |
|                                 | 06           | 20 | CYCLE TIME READ             | Reads the average, maximum, and minimum cycle times.                                   |
| Clock Access Commands           | 07           | 01 | CLOCK READ                  | Reads the clock.   |
|                                 | 07           | 02 | CLOCK WRITE                 | Sets the clock.  |
| Message Access Commands         | 09           | 20 | MESSAGE READ/CLEAR          | Reads/clears messages and FAL (FALS) messages.   |
| Access Right Commands           | 0C           | 01 | ACCESS RIGHT ACQUIRE        | Acquires the access right if no other device holds it.                                 |
|                                 | 0C           | 02 | ACCESS RIGHT FORCED ACQUIRE | Acquires the access right even if another device currently holds it.                   |
|                                 | 0C           | 03 | ACCESS RIGHT RELEASE        | Releases the access right regardless of what device holds it.                          |
| Error Access Commands           | 21           | 01 | ERROR CLEAR                 | Clears errors and error messages.  |
|                                 | 21           | 02 | ERROR LOG READ              | Reads the error log.   |
|                                 | 21           | 03 | ERROR LOG CLEAR             | Clears the error log pointer to zero.  |
| Forced Status Commands          | 23           | 01 | FORCED SET/RESET            | Force-sets, force-resets, or clears the forced status of the specified bits.           |
|                                 | 23           | 02 | FORCED SET/RESET CANCEL     | Cancels the forced status of all force-set and force-reset bits.                       |

## 8-4 Built-in Analog Input

The CP1L-EL/EM CPU Units are equipped with 2 built-in analog inputs. When a voltage of 0 to 10 V is applied to the built-in analog input terminal, the voltage is converted from analog to digital and the PV in A642 and A643 can be changed to any value within a range of 0 to 1000 (0000 to 03E8 hex).



### Analog Input Specifications

| Item                     | Specification   |
|--------------------------|---|
| Number of inputs         | 2 inputs (2 words allocated in the AR Area)               |
| Input signal range       | Voltage input: 0 V to 10 V                                |
| Max. rated input         | 0 V to 15 V   |
| External input impedance | 100 kΩ min.   |
| Resolution               | 1/1000 (full scale)                                       |
| Overall accuracy         | 25°C: ±2.0% (full scale)<br>0 to 55°C: ±3.0% (full scale) |
| A/D conversion data      | 0000 to 03E8 hex  |
| Averaging function       | Not supported   |
| Conversion time          | Same as PLC cycle time                                    |
| Isolation method         | None  |

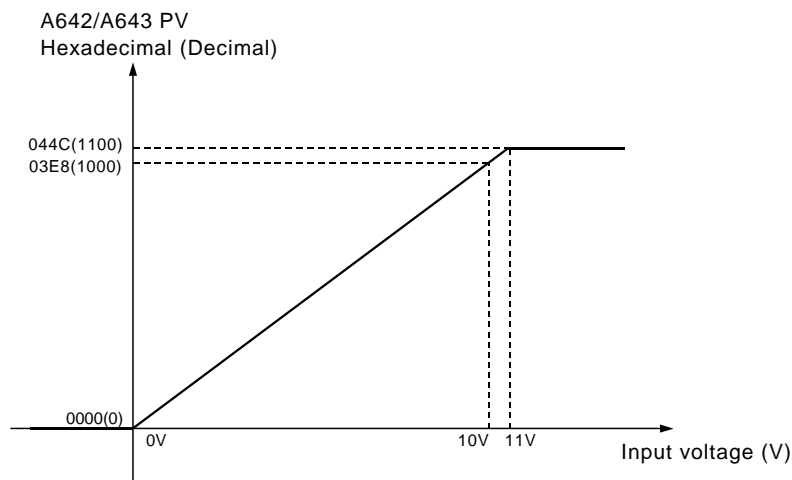
### Analog Input Signal Ranges

Analog input data is digitally converted according to the input signal range as shown below.

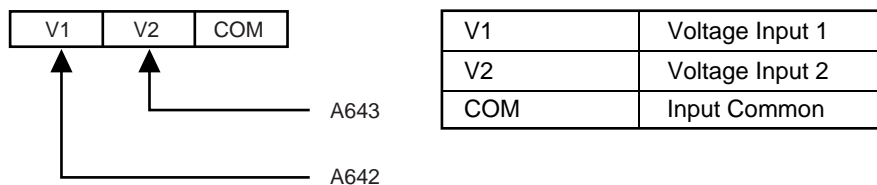
**Note** When the input exceeds the specified range, the A/D conversion data will be fixed at either the lower limit or upper limit.

#### ■ 0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 03E8 (0 to 1000). The entire data range is 0000 to 044C (0 to 1100).



## Analog Input Terminal Arrangement



**Note** The PV in the Auxiliary Area (A642) is for analog input 1.  
The PV in the Auxiliary Area (A643) is for analog input 2.

## Applicable Cables and Terminal Wiring

## ■ Applicable Cables

Solid wire or ferrules can be used.

- Recommended solid wire

| Wire type  | Wire size   |
|------------|---|
| Solid Wire | 0.2mm <sup>2</sup> to 0.5mm <sup>2</sup> (AWG24 to AWG20) |

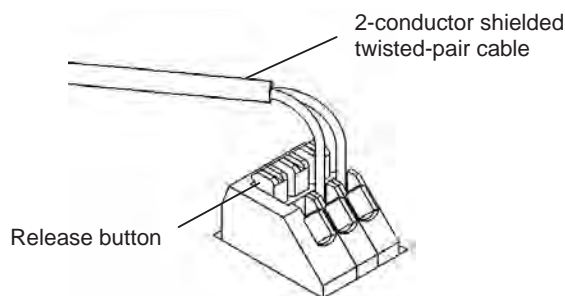
- Recommended ferrules

| Manufacturer    | Model     | Applicable wire            |
|-----------------|-----------|----------------------------|
| Phoenix Contact | AI-0.5-10 | 0.5mm <sup>2</sup> (AWG20) |

**Note** Do not connect bare stranded wires directly to terminals.

## ■ Terminal Wiring

When wiring the analog I/O terminal block, treat either solid or stranded wires directly.

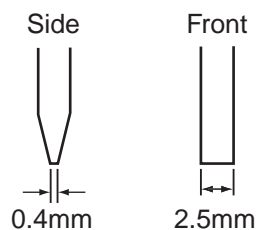


- To make the connection, press the release button in with a small flat blade screwdriver and push the line in while the lock is released. Remove the screwdriver and lock it inside.
- To disconnect the wiring, press the release button in with a small flat blade screwdriver and pull the line out while the lock is released.

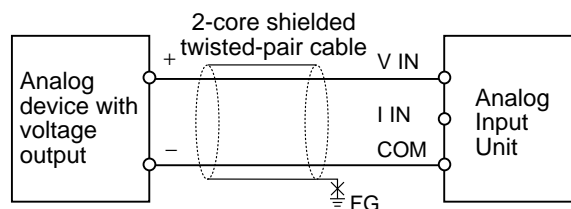
**Note** (1) Ferrules with/without plastic sleeve cannot be used.  
(2) When using stranded wire, twist the core so that the barbed wires cannot protrude.  
(3) Do not solder-plate the end of cable.

The screwdriver shown below is recommended for wiring.

| Model       | Manufacturer    |
|-------------|-----------------|
| SZS 0.4×2.5 | Phoenix Contact |

**Wiring for Analog Inputs**

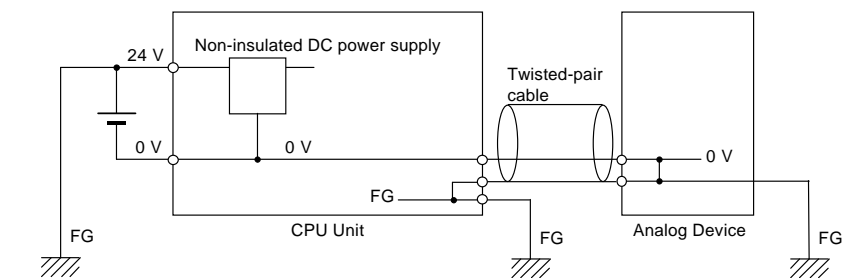
To prevent noise, 2-core shielded twisted-pair cable should be used. And the shield can be connected to the FG terminal if necessary.

**Note**

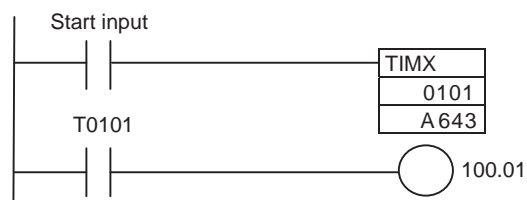
- (1) If necessary, connect the shield to the FG terminal to prevent noise.
- (2) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- (3) When there is noise in the power supply line, install a noise filter on the input section and the power supply.



**Caution** When connecting the analog option board to an outside analog device, either ground the 0 V side of the PLC's external power supply or do not ground the PLC's external power supply at all. Otherwise the PLC's external power supply may be shorted depending on the connection methods of the outside analog device. DO NOT ground the 24 V side of the PLC's external power supply, as shown in the following diagram.

**Application Example**

Setting the value for timer T101 in A643 makes it possible to use T101 as a variable timer with a range of 0 to 100.0 s (0 to 1000). A change in the set value is reflected with the next scan.

**Note**

External analog setting input values may vary with changes in the ambient temperature. Do not use the external analog setting input for applications that require highly precise set values.

## 8-5 Battery-free Operation

### 8-5-1 Overview

With the CP1L-EL/EM CPU Unit, saving backup data in the built-in flash memory (non-volatile memory) enables operation with no battery mounted (i.e., battery-free operation).

I/O memory (such as CIO), however, is constantly refreshed during operation, so backup data is not saved in the built-in flash memory. When battery-free operation is used, therefore, programs must be created assuming that I/O memory data will not be saved.

For example, if a battery is mounted, then HR, CNT, and DM data is saved during power interruptions if a battery is mounted but not when battery-free operation is used.

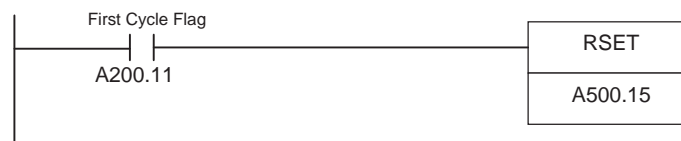
In that case it is necessary to set the required values in the ladder program. It is also possible to save to the built-in flash memory in advance the DM initial values that are to be set for the DM on RAM at startup.

### 8-5-2 Using Battery-free Operation

#### Precautions when Creating Programs for Battery-free Operation

Be careful of the following points, and create programs for which it will not be a problem even if the correct I/O memory values are not held.

- For unstable parts of I/O memory, include programming at the start of operation to set required data.
- When battery-free operation is used, the Output OFF Flag (A500.15) in the Auxiliary Area becomes unstable. When the Output OFF Flag turns ON, all outputs turn OFF, so include the following program for clearing the Output OFF Flag at the start of operation.



- Do not reference the clock function, (the clock data in words A351 to A354 of the Auxiliary Area, or the various kinds of time data).

#### Saving DM Initial Values (Only when Required)

Use the following procedure to save to the built-in flash memory the DM initial values that are to be set at startup.

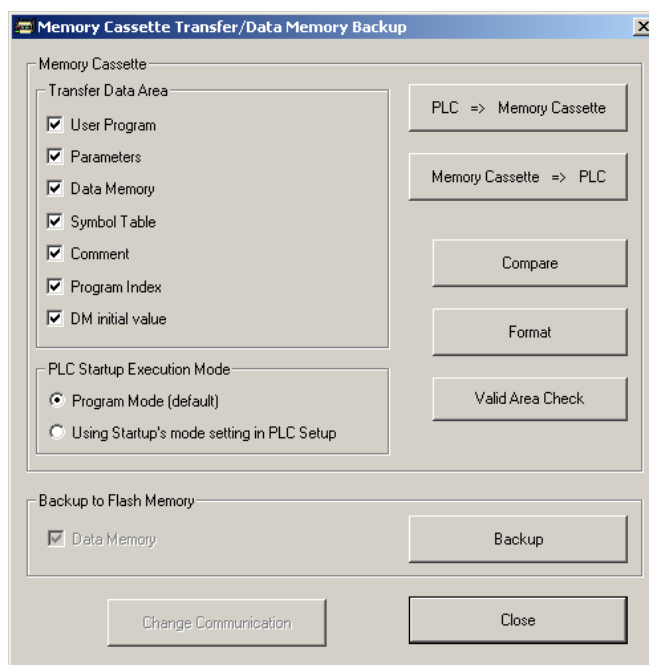
1,2,3...

1. First set in the DM Area the data that is to be set as initial values at startup.
2. Execute a backup to flash memory from the CX-Programmer's Memory Cassette Transfer/Data Memory Backup Dialog Box.

The procedure is as follows:

- a. Select **PLC - Edit - Memory Cassette/DM**.

The following Memory Cassette Transfer/DM Backup Dialog Box will be displayed.



- b. Select the *Data Memory* Option in the *Backup to Flash Memory* Area and click the **Backup** Button.  
The DM data will be written to the built-in flash memory.

**Note** The DM data that is saved and written at startup is the entire DM Area (D0 to D32767).

## PLC Setup

- 1,2,3... 1. Set *Do not detect Low Battery (run without battery)* to *Do not detect*.
2. Set *IOM Hold Bit Status at Startup* and *Forced Status Hold Bit Status at Startup* to *Clear (OFF)*.
3. Set *Read DM from flash memory* to *Read*. (Only when DM initial values have been saved as described above.)

**Caution** The CP1L-EL/EM CPU Units automatically back up the user program and parameter data to flash memory when these are written to the CPU Unit. Also, the CX-Programmer can be used to save all of the data in the DM Area to the flash memory for use as initial values when the power supply is turned ON. Neither of these functions saves the I/O memory data (including HR Area data, counter PVs and Completion Flags, and DM Area data other than initial values). The HR Area data, counter PVs and Completion Flags, and DM Area data other than initial values are held during power interruptions with a battery. If there is a battery error, the contents of these areas may not be accurate after a power interruption. If HR Area data, counter PVs and Completion Flags, and DM Area data other than initial values are used to control external outputs, prevent inappropriate outputs from being made whenever the Battery Error Flag (A402.04) is ON.

## 8-6 Memory Cassette Functions

### 8-6-1 Overview

CP1L-EL/EM CPU Units have Memory Cassette functions that enable data in the CPU Unit to be stored on and read from a special CP1W-ME05M Memory Cassette. These functions can be used for the following applications.

- Copying data to other CPU Units to produce duplicate devices.
- Backing up data in case the CPU Unit needs to be replaced due to any malfunction.
- Writing and updating data when existing device versions are upgraded.

### Memory Cassette Specifications

Use the following Memory Cassette.

| Model      | Specifications   |
|------------|--|
| CP1W-ME05M | <ul style="list-style-type: none"> <li>• Memory size 512 Kwords</li> <li>• Storage capacity The following CPU Unit data (for each Unit) <ul style="list-style-type: none"> <li>• User programs</li> <li>• Parameters</li> <li>• Comment memory</li> <li>• Function Block (FB) sources</li> <li>• DM initial values in the built-in flash memory</li> <li>• DM in RAM</li> </ul> </li> <li>• Write method Operations from the CX-Programmer</li> <li>• Read method Powering up with DIP switch pin SW2 set to ON, or operations from the CX-Programmer</li> </ul> |

### Data that Can be Stored on a Memory Cassette

The following data can be stored on a Memory Cassette.

| Data stored on Memory Cassette |   | Location in CPU Unit                                    |
|--------------------------------|---|---|
| User programs                  |   | Built-in RAM, built-in flash memory (User Program Area) |
| Parameters                     | PLC Setup, CPU Bus Unit settings, routing tables                    | Built-in RAM, built-in flash memory (Parameter Area)    |
| Comment data for user programs | Variable tables   | Built-in flash memory (Comment Memory Area)             |
|                                | (I/O comments, rung comments, program comments)                     | Built-in flash memory (Comment Memory Area)             |
|                                | Program indexes (section names, section comments, program comments) | Built-in flash memory (Comment Memory Area)             |
| Function Block (FB) sources    |   | Built-in flash memory (FB Source Memory Area)           |
| DM                             |   | Built-in RAM (D0 to D32767 in DM Area)                  |
| DM initial values (See note.)  |   | Built-in flash memory (DM Initial Values Area)          |

The areas for storing various types of data have fixed allocations in the Memory Cassette, and a single Memory Cassette corresponds to a single CPU Unit.

Therefore it is not possible to simultaneously store multiple items of the same type of data (e.g., two user programs).

Also, the data can only be read to a CPU Unit. It cannot be directly managed from a personal computer like files.

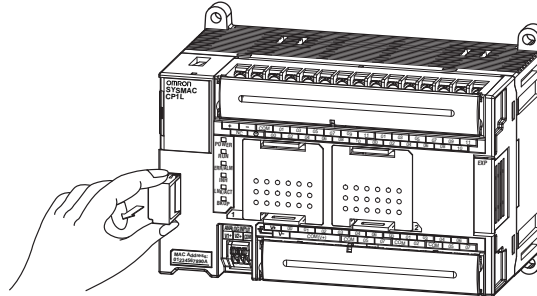
The only data that can be stored on a Memory Cassette is the data from a CPU Unit.

- Note** The CX-Programmer's function for saving DM initial values is used for saving the values in the DM Area (D0 to D32767) to the built-in flash memory as initial values. By means of a setting in the PLC Setup, these initial values can then be automatically written to the DM Area (D0 to D32767) when the power is turned ON.

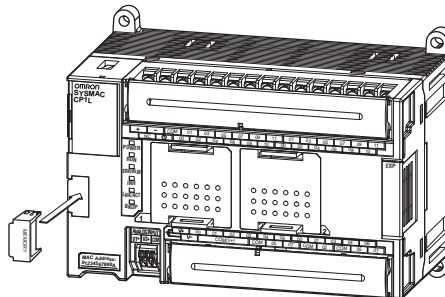
## 8-6-2 Mounting and Removing a Memory Cassette

### Mounting

- 1,2,3...** 1. Turn OFF the power supply to the PLC and removed the cover to the Memory Cassette socket.

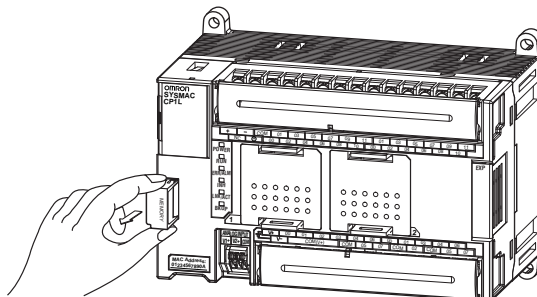


2. Holding the Memory Cassette with the side with the nameplate facing upwards, insert the Memory Cassette all the way into the slot.



### Removal

- 1,2,3...** 1. Turn OFF the power supply to the PLC.  
2. Grasp the end of the Memory Cassette between the thumbnail and index finger, and slide it upwards to remove it.



- Note** (1) Turn OFF the power supply before mounting or removing the Memory Cassette.



- (2) Absolutely do not remove the Memory Cassette while the BKUP indicator is flashing (i.e., during a data transfer or verification). Doing so could make the Memory Cassette unusable.
- (3) The Memory Cassette is small, so be careful to not let it be dropped or lost when it is removed.

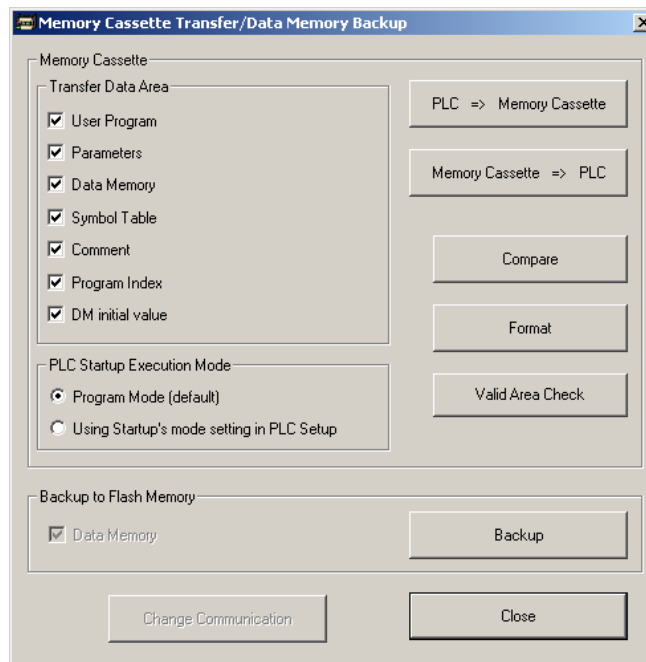
### 8-6-3 Operation Using the CX-Programmer

Use the following procedure for the Memory Cassette function.

1,2,3...

1. Select **PLC - Edit - Memory Cassette/DM**.

The following Memory Cassette Transfer/Data Memory Backup Dialog Box will be displayed.



2. Under *Transfer Data Area*, check whatever types of data are to be transferred.

Click the **Valid Area Check** Button to check the valid areas in the Memory Cassette mounted in the CPU Unit and the operating mode after automatic transfer at startup. If the user program is specified to be written, select the operating mode after automatic transfer at startup.

- PROGRAM mode (default): Used, e.g., to copy the system.
- Use PLC Setup: Used, e.g., for operation with the Memory Cassette.

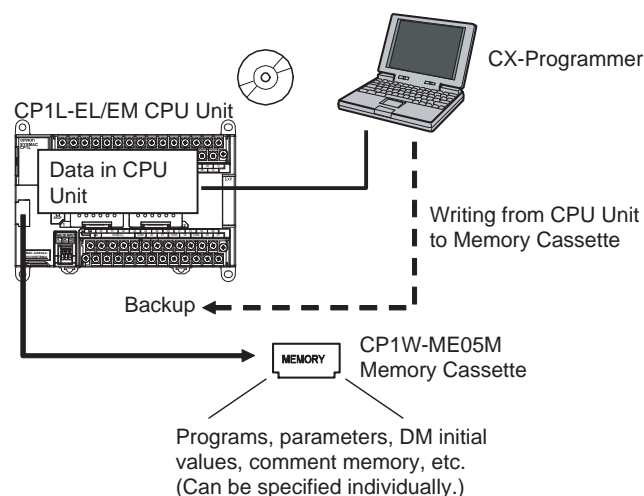
3. Execute any of the following operations.

- To write data from the CPU Unit to the Memory Cassette:  
Click the **PLC ⇒ Memory Cassette** Button.
- To read data from the Memory Cassette to the CPU Unit:  
Click the **Memory Cassette ⇒ PLC** Button.
- To verify data transferred between the CPU Unit and the Memory Cassette:  
Click the **Compare** Button. This will cause all areas to be verified regardless of the items checked under Transfer Area.
- To format the Memory Cassette:  
Click the **Format** Button. This will cause all areas to be formatted regardless of the items checked under Transfer Area.

### 8-6-4 Memory Cassette Data Transfer Function

#### Writing from the CPU Unit to the Memory Cassette

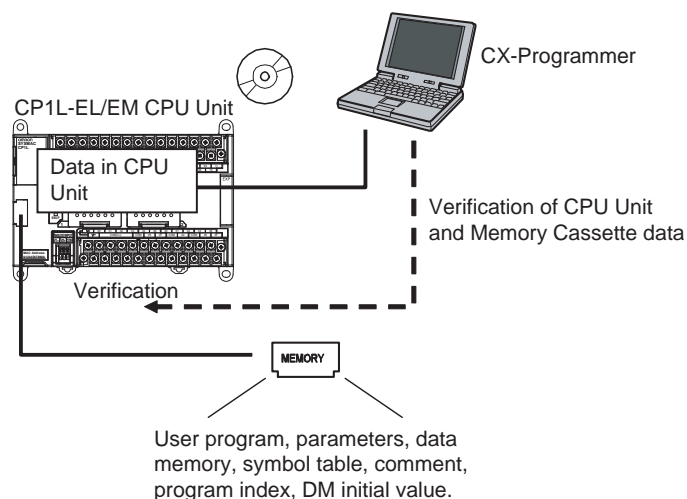
The CX-Programmer's Memory Cassette function can be used to write data from the CPU Unit to the Memory Cassette. The data to be written can be individually specified.



- When creating a Memory Cassette for a device version upgrade, select and save only the required data (such as the user program and DM).
- When creating a Memory Cassette for backup or duplication, save all of the data to the Memory Cassette.

#### CPU Unit and Memory Cassette Verification

When using the CX-Programmer's Memory Cassette function to store data in the Memory Cassette, verify that data by comparing it to the data in the CPU Unit.



This function can be used for operations such as confirmation after data has been written to the Memory Cassette, or confirming that the data in the backup matches the data in the CPU Unit.

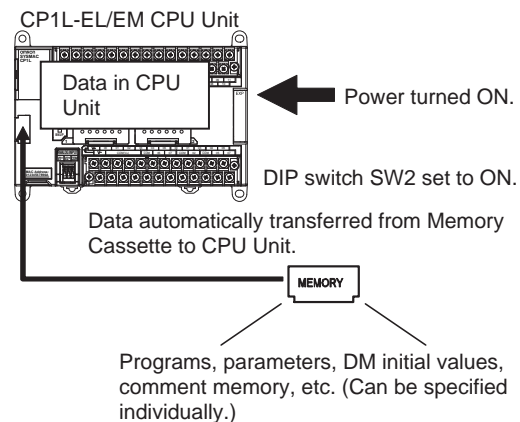
### Automatic Transfer from the Memory Cassette at Startup

With just a simple DIP switch setting, data stored in advance in the Memory Cassette can be automatically read when the power is turned ON, and written to the corresponding areas in the CPU Unit.

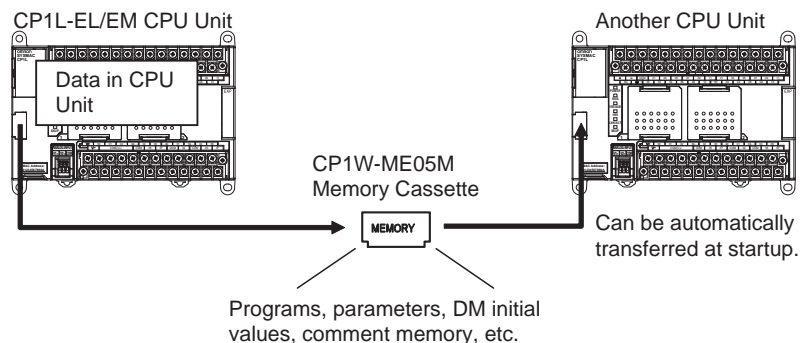
Mount a Memory Card and set DIP switch pin SW2 to ON, and then turn the power OFF and back ON.

All valid data in the Memory Card will be automatically transferred to the CPU Unit.

**Note** When this function is executed, at least the user program must be stored on the Memory Cassette.



This function can be used to copy data to another CPU Unit without using the CX-Programmer.

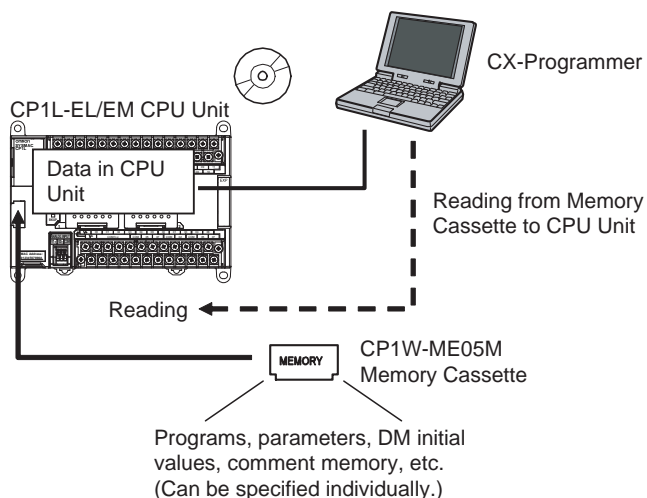


User programs can be overwritten to upgrade equipment versions without using the CX-Programmer.

If writing data from the CPU Unit to the Memory Cassette and the CPU Unit is set to use the operating mode specified in the PLC Setup as the operating mode after automatic transfer at startup, operation can be started without cycling the power, enabling operation from the Memory Cassette.

### Reading Data from the Memory Cassette to the CPU Unit

The CX-Programmer's Memory Cassette function can be used to read data stored on the Memory Cassette, and transfer it to the corresponding areas in the CPU Unit. The data to be read can be individually specified.



This function can be used for operations such as writing the required backup data to the CPU Unit for maintenance.

### Precautions when Using the Memory Cassette Data Transfer Function

- In order for Memory Cassette data to be transferred, the Memory Cassette must be mounted in the CPU Unit.
- The BKUP indicator will light while data is being transferred to or verified in a Memory Cassette. Never turn OFF the power to the PLC or remove the Memory Cassette while the BKUP indicator is lit. Doing either may make it impossible to use the Memory Cassette.
- Memory Cassette data transfers and verification are possible only when the CPU Unit operating mode is PROGRAM mode. The Memory Cassette transfer function cannot be used in either RUN or MONITOR mode.
- When using automatic transfer from a Memory Cassette at startup, be sure to transfer the data to the Memory Cassette if any changes are made using online editing.
- The operating mode cannot be switched from PROGRAM mode to RUN or MONITOR mode while a Memory Cassette data transfer or verification is in progress.
- The following table shows whether data transfers are enabled when the CPU Unit is protected in various ways.

| Type of protection   | Transfer from CPU Unit to Memory Cassette | Transfer from Memory Cassette to CPU Unit |
|--|---|---|
| Not protected.   | Yes                                       | Yes                                       |
| System protected by DIP switch pin SW1 set to ON.                        | Yes                                       | No  |
| Protected by password. Overwriting and duplication both permitted.       | Yes                                       | Yes                                       |
| Protected by password. Overwriting prohibited and duplication permitted. | Yes                                       | Transfer enabled only at startup.         |

| Type of protection   | Transfer from CPU Unit to Memory Cassette | Transfer from Memory Cassette to CPU Unit |
|--|---|---|
| Protected by password. Overwriting permitted and duplication prohibited. | No  | Yes                                       |
| Protected by password. Overwriting and duplication both prohibited.      | No  | Transfer enabled only at startup.         |

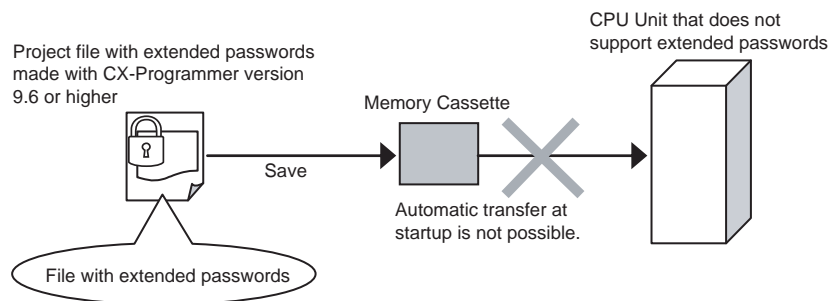
- If a Memory Cassette is not mounted, data will be read from the flash memory built into the CPU Unit to start operation regardless of the setting of DIP switch pin SW2.
- CP1L-EL/EM CPU Units with 20 I/O points do not have D10000 to D31999. These words will be treated as follows when data from a CPU Unit with 20 I/O points is transferred to a CPU Unit with 30 or 40 I/O points or visa versa.

|  |  |
|--|--|
| Transferring data from a CPU Unit with 20 I/O points to one with 30 or 40 I/O points | "0000" will be written to D10000 to D31999 in the CPU Unit with 30 or 40 I/O points. |
| Transferring data from a CPU Unit with 30 or 40 I/O points to one with 20 I/O points | D10000 to D31999 in the CPU Unit with 30 or 40 I/O points will be ignored.           |

**Note** A program file that has extended passwords cannot be automatically transferred at startup to a CPU Unit that does not support extended passwords.

(1) CPU Units That Do Not Support Extended Passwords

- CJ1L-EM CPU Units, unit version 1.0
- CJ1L-EL CPU Units, unit version 1.0



## 8-6-5 Procedures for Automatic Transfer from the Memory Cassette at Startup

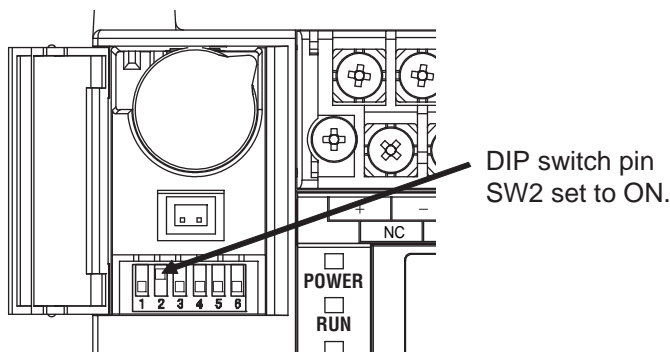
### Copying the System

Use the following procedure to enable automatic transfer at startup.

1,2,3...

1. Prepare a Memory Cassette containing the required data. When transferring the data to the Memory Cassette, set the operating mode after automatic transfer at startup to PROGRAM mode (default).
2. With the power supply turned OFF to the CPU Unit, remove the cover from the Memory Cassette slot and insert the Memory Cassette.

3. Open the cover for the CPU Unit's battery and set DIP switch pin SW2 to ON.



4. Turn ON the power supply to the CPU Unit.
5. The automatic transfer from the Memory Cassette will begin. The rest of the procedure assumes that the operating mode after automatic transfer at startup to PROGRAM mode (default).
6. After the automatic transfer has been completed, turn OFF the power supply to the CPU Unit.
7. Remove the Memory Cassette, and replace the Memory Cassette slot cover.
8. Return the setting of DIP switch pin SW2 to OFF, and close the cover.
9. Turn the power supply to the CPU Unit back ON.

**Note** After the automatic transfer from the Memory Cassette at startup has been completed with the operating mode after automatic transfer at startup set to PROGRAM mode (default), the transfer will not start again automatically (regardless of the Startup Mode setting in the PLC Setup). As described in the procedure above, to start operation turn the power supply OFF, return the setting of DIP switch SW2 to OFF, and then turn the power supply back ON. If the the operating mode specified in the PLC Setup is set as the operating mode after automatic transfer at startup, operation will start without changing the DIP switch SW2 or Memory Cassette.

### Operating from a Memory Cassette

- 1,2,3... 1. Prepare a Memory Cassette containing the required data.  
When transferring the data to the Memory Cassette, set the operating mode after automatic transfer at startup to PROGRAM mode (default).
2. With the power supply turned OFF to the CPU Unit, remove the cover from the Memory Cassette slot and insert the Memory Cassette.
3. Open the cover for the CPU Unit's PERIPHERAL section and set DIP switch pin SW2 to ON.
4. Turn ON the power supply to the CPU Unit.

**Note** If, when the data is transferred to the Memory Cassette, the operating mode specified in the PLC Setup is set as the operating mode after automatic transfer at startup, operation will start automatically after data transfer, even if the power is not cycled. Be sure that starting operation will cause no problems before using automatic transfer at startup.

## 8-7 Program Protection

The following protection functions are supported by the CP1L-EL/EM CPU Units.

- Read protection from the CX-Programmer
- Write protection using a DIP switch setting
- Write protection setting from the CX-Programmer
- Write protection against FINS commands sent to the CPU Unit via networks
- Prohibiting creating a program file for file memory

### 8-7-1 Read Protection

#### Overview

It is possible to read-protect individual program tasks (called task read protection) or the entire user program (called UM read protection).

Read protection prevents anyone from displaying or editing the read-protected set of tasks or entire user program from CX-Programmer without inputting the correct password. If the password is input incorrectly five times consecutively, password input will be disabled for two hours, providing even better security for PLC data.

#### **Read Protection Using Extended Passwords**

With unit version 1.1 or later and CX-Programmer version 9.6 or higher, you can extend protection with UM read protection and task read protection to ensure better protection for your design assets.

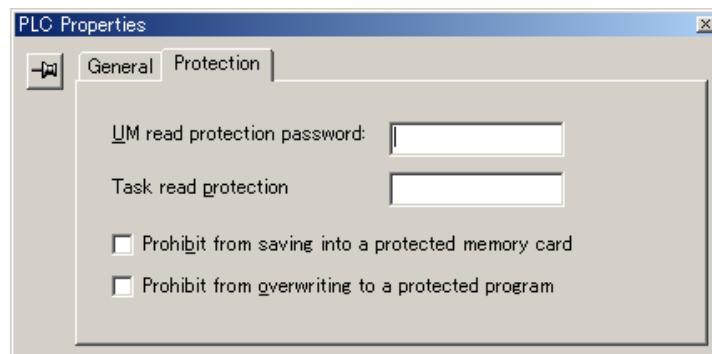
#### Operating Procedure

##### **Setting Protection**

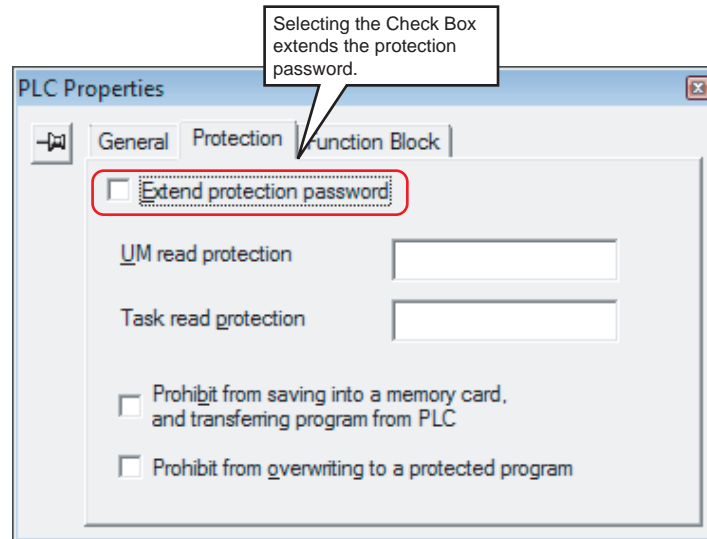
Register a password either online or offline.

1,2,3...

1. Select the PLC name, then select **View - Properties**.
2. Click the *Protection* Tab in the PLC Properties Dialog Box and enter the passwords.



With unit version 1.1 or later and CX-Programmer version 9.6 or higher, you can use longer passwords for UM read protection and task read protection. Click the *Protection* Tab in the PLC Properties Dialog Box and enter the passwords.

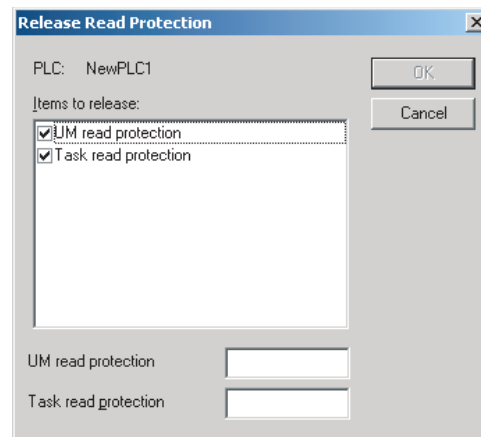


The limits to the password text string lengths are given in the following table.

| Unit version                | Number of input characters | Type of input characters |
|-----------------------------|----------------------------|--------------------------|
| Unit version 1.0 or earlier | 8 characters max.          | Alphanumeric characters  |
| Unit version 1.1 or later   | 16 characters max.         |                          |

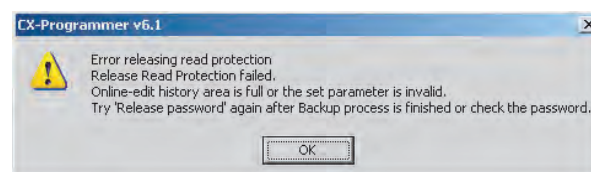
### Protection Release Procedure

- 1,2,3... 1. Go online and select **PLC - Protection - Release Password**. The following Release Read Protection Dialog Box will be displayed.



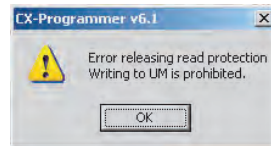
2. Input the password. If the password is incorrect, one of the following messages will be displayed and protection will not be released.

### UM Read Protection





### Task Read Protection



3. If an incorrect password is input five times consecutively, read protection will not be released even if the correct password is input on the sixth attempt and displaying and editing the entire user program or the specified tasks will be disabled for two hours.

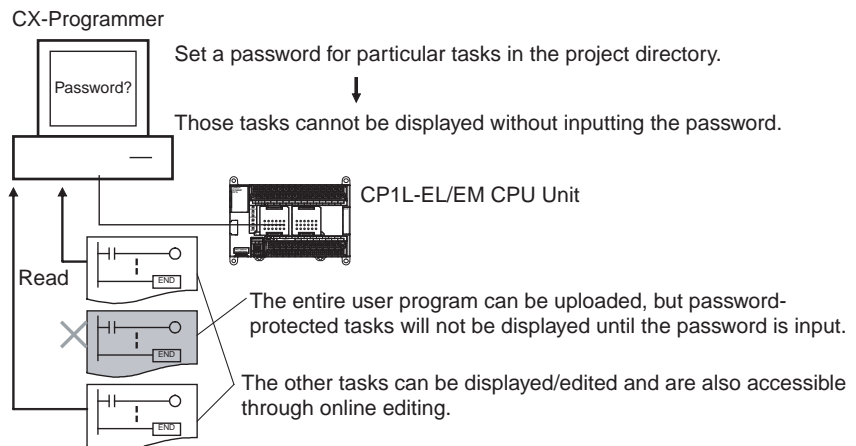
## Read Protection for Individual Tasks Using Passwords

### Overview

It is possible to read-protect individual program tasks (referred to as “task read protection” below) or the entire PLC. The same password controls access to all of the read-protected tasks.

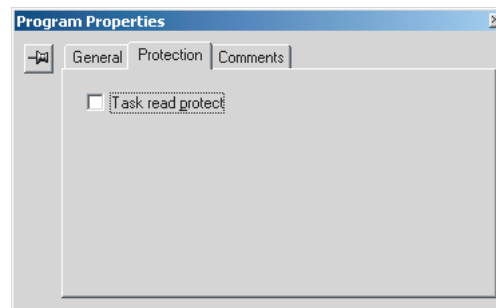
Task read protection prevents anyone from displaying or editing the read-protected set of tasks from CX-Programmer without inputting the correct password. In this case, the entire program can be uploaded, but the read-protected tasks cannot be displayed or edited without inputting the correct password. Tasks that are not read-protected can be displayed, edited, or modified with online editing.

**Note** Task read protection cannot be set if UM read protection is already set. However, it is possible to set UM read protection after task read protection has been set.

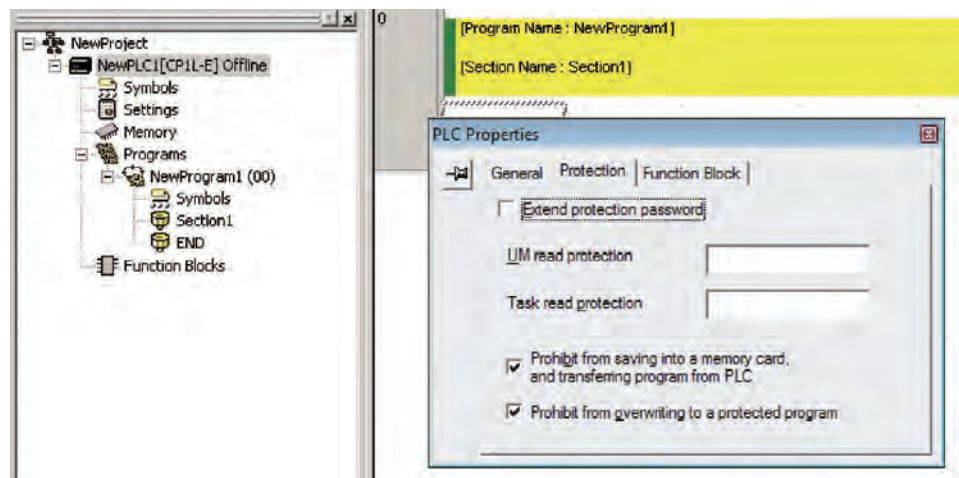


## Operating Procedure

- 1,2,3... 1. Right-click the tasks that will be password-protected, select **Properties** from the pop-up menu, and select the *Task read protect* Option on the *Protection* Tab Page.



2. Display the *Protection* Tab of the PLC Properties Dialog Box and register a password in the *Task read protection* Box.

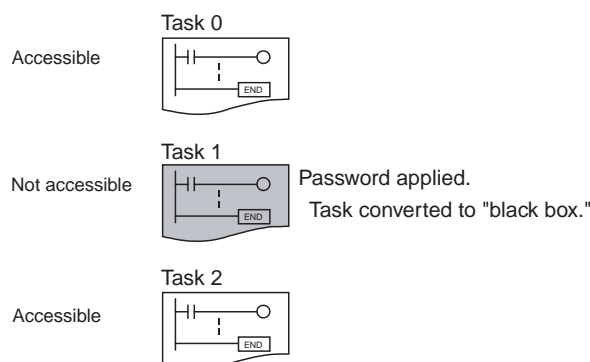


3. Connect online and select **PLC - Transfer - To PLC** to transfer the program. The tasks registered in step 2 will be password-protected.

**Note** The program can be transferred after step 1, above, and then password protection be set by selecting **PLC - Protection - Set Password**. The tasks registered in step 1 will be password-protected.

## Usage

Apply read protection to tasks when you want to convert those task programs to "black box" programs.



- Note**
1. If the CX-Programmer is used to read a task with task read protection applied, an error will occur and the task will not be read. Likewise, if the PT Ladder Monitor function is used to read a password protected task, an error will occur and the task will not be read.
  2. The entire program can be transferred to another CPU Unit even if individual tasks in the program are read-protected. The task read protection will remain in effective for the password-protected tasks.
  3. When the CX-Programmer is used to compare a user program in the computer's memory with a user program in the CPU Unit, password-protected tasks will be compared too.

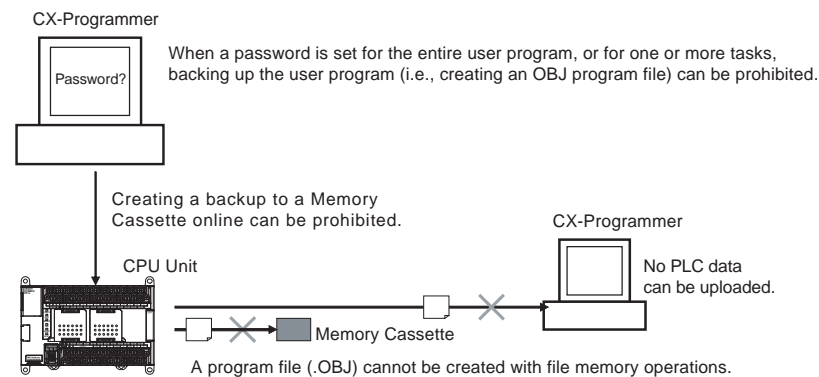
### Restrictions to Function Block Use

Function block definitions can be read even if the entire program or individual tasks in a program containing function blocks are read-protected. If required, set read protection individually for each function block.

### Prohibiting Backing Up the Programs to a Memory Cassette

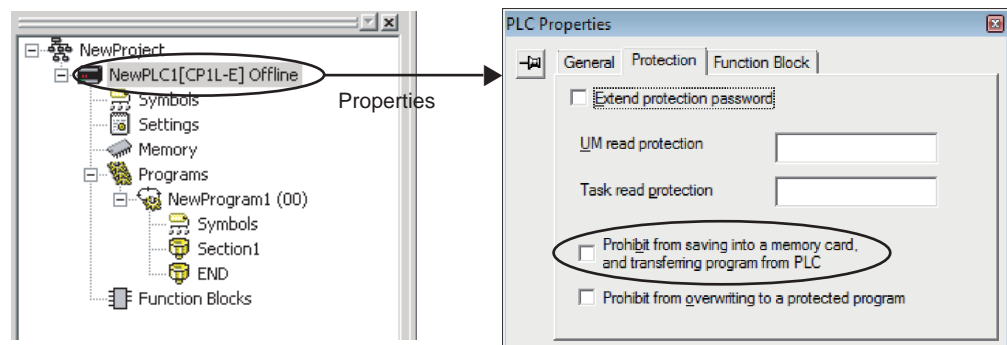
#### Overview

When a password is set for the entire user program or for a task from the CX-Programmer, prohibiting backing up the user program can be set as an option. Doing so will make it impossible to upload PLC data to the CX-Programmer and make it impossible to save PLC data offline to a storage device.



#### Operating Procedure

- 1,2,3...**
1. When registering a password in the *UM read protection password* Box or *Task read protection* Box, select the *Prohibit from saving to a memory card, and transferring program from PLC* Option.



2. Go online and then either select **PLC - Transfer - To PLC** to transfer the program or select **PLC - Protection - Set Password** and click the **OK** button.

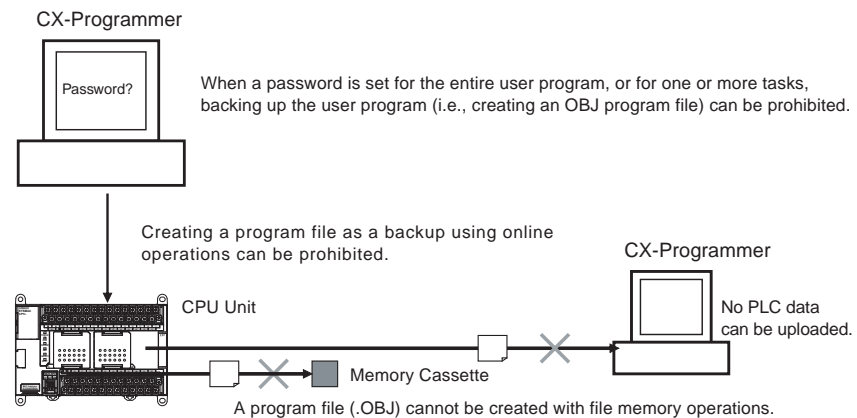
#### Application

The above procedure enables using a password to protect against disclosure of the program to unauthorized persons.

- Note**
- (1) Copying the program is possible if read protection is not set.
  - (2) The setting to prohibit backing up the program is not effective until the program is transferred to the PLC. Always transfer the program after changing the setting.

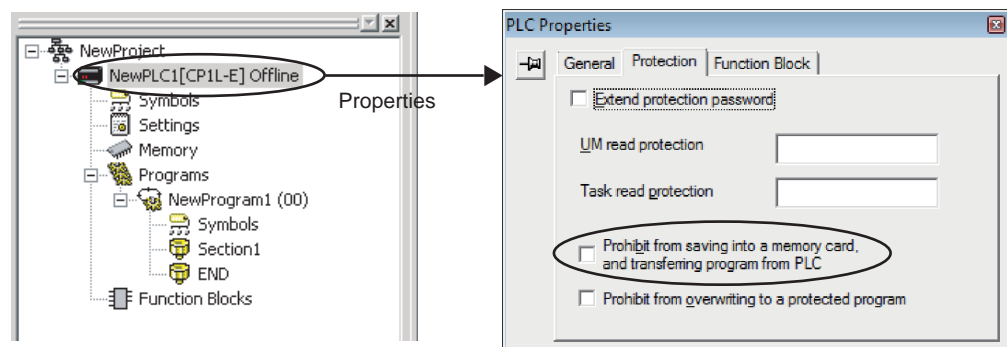
### Prohibiting Creating Program Files in File Memory

When a password is set for the entire user program or for a task from the CX-Programmer, prohibiting creating a program file (.OBJ) as a backup can be set as an option. Doing so will make it impossible to create a program file in file memory using the file memory operations. (This setting will also prohibit uploading PLC data to the CX-Programmer and saving PLC data to a storage device.)



### Operating Procedure

- 1,2,3...**
1. When registering a password in the *UM read protection password* Box or *Task read protection* Box, select the *Prohibit from saving to a memory card, and transferring program from PLC* Option.



2. Go online and then either select **PLC - Transfer - To PLC** to transfer the program or select **PLC - Protection - Set Password** and click the **OK** button.

### Application

The above procedure enables using a password to protect against disclosure of the program to unauthorized persons.

- Note**
- (1) Copying the program is possible if read protection is not set.
  - (2) The setting to prohibit backing up the program is not effective until the program is transferred to the PLC. Always transfer the program after changing the setting.

## Auxiliary Area Flags and Bits Related to Password Protection

| Name   | Bit address | Description   |
|--|-------------|---|
| UM Read Protection Flag                      | A99.00      | Indicates whether or not the PLC (the entire user program) is read-protected.<br>OFF: UM read protection is not set.<br>ON: UM read protection is set.  |
| Task Read Protection Flag                    | A99.01      | Indicates whether or not selected program tasks are read-protected.<br>OFF: Task read protection is not set.<br>ON: Task read protection is set.  |
| Program Write Protection for Read Protection | A99.02      | Indicates whether or not the write protection option has been selected to prevent overwriting of password-protected tasks or programs.<br>OFF: Overwriting allowed<br>ON: Overwriting prohibited (write-protected)                  |
| Enable/Disable Bit for Program Backup        | A99.03      | Indicates whether or not a backup program file (.OBJ file) can be created when UM read protection or task read protection is set.<br>OFF: Creation of backup program file allowed<br>ON: Creation of backup program file prohibited |

### 8-7-2 Write Protection

#### Write-protection Using the DIP Switch

The user program can be write-protected by turning ON pin 1 of the CPU Unit's DIP switch. When this pin is ON, it won't be possible to change the user program or parameter area (e.g., PLC Setup and routing tables) from the CX-Programmer. This function can prevent the program from being overwritten inadvertently at the work site.

It is still possible to read and display the program from the CX-Programmer when it is write-protected.

#### CPU Unit DIP Switch

| Pin | Name                                 | Settings                            |
|-----|--------------------------------------|-------------------------------------|
| SW1 | User Program Memory Write Protection | ON: Protected<br>OFF: Not protected |

#### Confirming the User Program Date

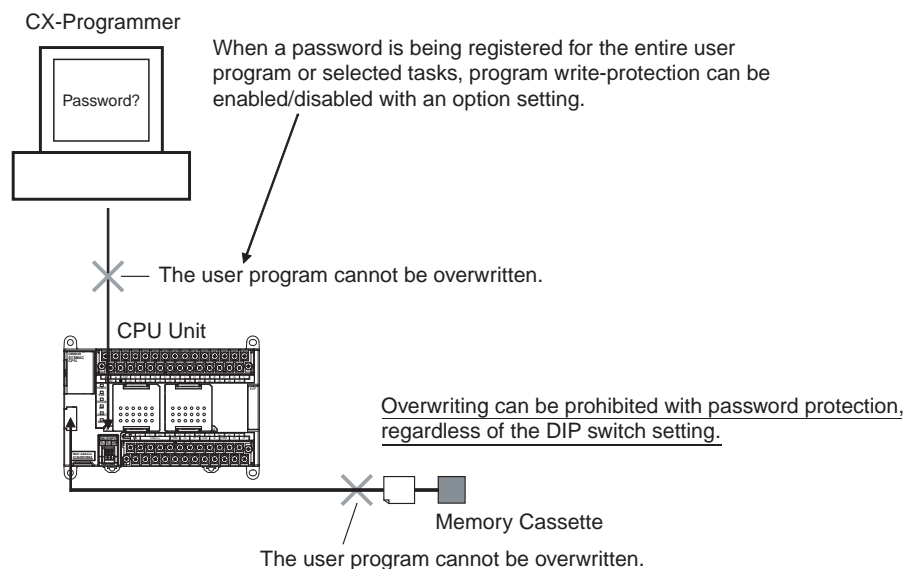
The dates the program and parameters were created can be confirmed by checking the contents of A90 to A97.

## Auxiliary Area Words

| Name              | Address    | Description   |
|-------------------|------------|---|
| User Program Date | A90 to A93 | The time and date the user program was last overwritten in memory is given in BCD.  |
|                   |            | A90.00 to A90.07      Seconds (00 to 59 BCD)  |
|                   |            | A90.08 to A90.15      Minutes (00 to 59 BCD)  |
|                   |            | A91.00 to A91.07      Hour (00 to 23 BCD)   |
|                   |            | A91.08 to A91.15      Day of month (01 to 31 BCD)   |
|                   |            | A92.00 to A92.07      Month (01 to 12 BCD)  |
|                   |            | A92.08 to A92.15      Year (00 to 99 BCD)   |
|                   |            | A93.00 to A93.07      Day (00 to 06 BCD)<br>Day of the week:<br>00: Sunday, 01: Monday,<br>02: Tuesday, 03: Wednesday,<br>04: Thursday, 05: Friday,<br>06: Saturday |
| Parameter Date    | A94 to A97 | The time and date the parameters were last overwritten in memory is given in BCD. The format is the same as that for the User Program Date given above.             |

### Write-protection Using Passwords

The program (or selected tasks) can also be write-protected if the write protection option is selected from the CX-Programmer when a password is being registered for the entire program or those selected tasks. The write protection setting can prevent unauthorized or accidental overwriting of the program.

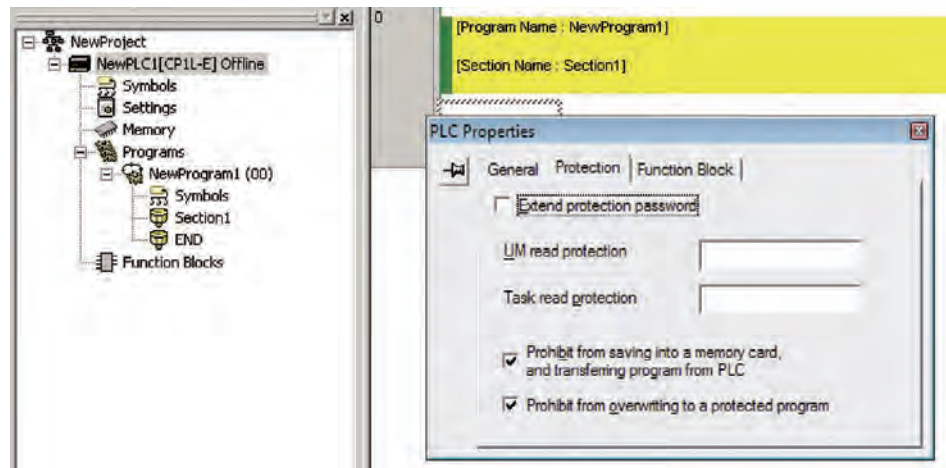


- Note**
1. If the selected tasks are write-protected by selecting this option when registering a password, only the tasks (program) that are password-protected will be protected from overwriting. It will still be possible to overwrite other tasks with operations such as online editing and task downloading.
  2. All tasks (programs) can be overwritten when program read protection is not enabled.

## Operating Procedure

1,2,3...

**Table 1** When registering a password in the *UM read protection password Box* or *Task read protection Box*, select the *Prohibit from overwriting to a protected program Option*.



3. Either select **PLC - Transfer - To PLC** to transfer the program or select **PLC - Protection - Set Password** and click the **OK** button.

**Note**

The setting to enable/disable creating file memory program files will not take effect unless the program is transferred to the CPU Unit. Always transfer the program after changing this setting.

### Write Protection against FINS Commands Sent to the CPU Unit via Networks

It is possible to prohibit write operations and other editing operations sent to the PLC's CPU Unit as FINS commands through a network (including write operations from CX-Programmer, CX-Protocol, CX-Process, and other applications using Fins Gateway). Read processes are not prohibited.

FINS write protection can disable write processes such as downloading the user program, PLC Setup, or I/O memory, changing the operating mode, and performing online editing.

It is possible to exclude selected nodes from write protection so that data can be written from those nodes.

An event log in the CPU Unit automatically records all write processes sent through the network and that log can be read with a FINS command.

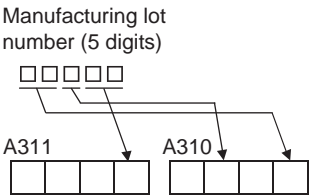
## 8-7-3 Protecting Program Execution Using the Lot Number

The lot number is stored in A310 and A311 and can be used to prevent the program from being executed on a CPU Unit with the wrong lot number.

The following instructions can be added to the program to create a fatal error and thus prevent program execution if an attempt is made to execute the program on a CPU Unit with the incorrect lot number. A password can also be set to read-protect the program so that it cannot be copied, e.g., using a Memory Cassette.

The lot number stored in A310 and A311 cannot be changed by the user.

The upper digits of the lot number are stored in A311 and the lower digits are stored in A310, as shown below.

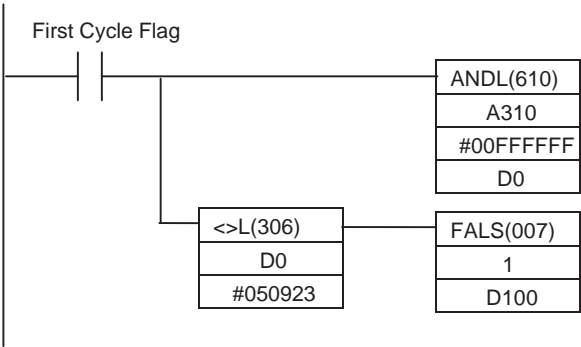


X, Y, and Z in the lot number are converted to 10, 11, and 12, respectively, in A310 and A311. Some examples are given below.

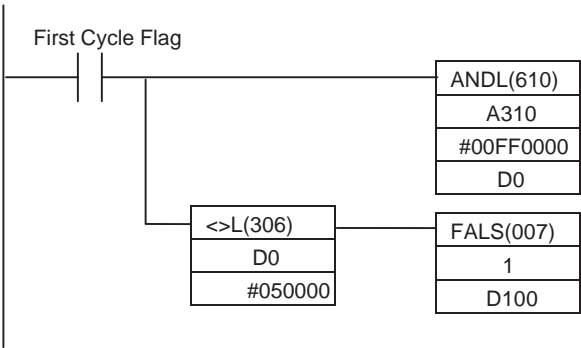
| Lot number | A311 | A310 |
|------------|------|------|
| 01805      | 0005 | 0801 |
| 30Y05      | 0005 | 1130 |

Ladder Programming Example

- The following instructions will create a fatal error to prevent the program from being executed when the lot number is not 23905.

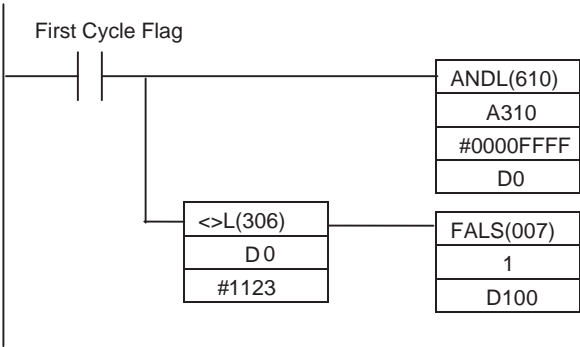


- The following instructions will create a fatal error to prevent the program from being executed when the lot number does not end in 05.





- The following instructions will create a fatal error to prevent the program from being executed when the lot number does not begin with 23Y.



8-8 Failure Diagnosis Functions

This section introduces the following functions.

- Failure Alarm Instructions: FAL(006) and FALS(007)
- Failure Point Detection: FPD(269)
- Output OFF Bit

8-8-1 Failure Alarm Instructions: FAL(006) and FALS(007)

The FAL(006) and FALS(007) instructions generate user-defined errors. FAL(006) generates a non-fatal error that allows program execution to continue and FALS(007) generates a fatal error that stops program execution. When the user-defined error conditions (i.e., the execution conditions for FAL(006) or FALS(007)) are met, the instruction will be executed and the following processing will be performed.

- 1,2,3...
1.

The FAL Error Flag (A402.15) or FALS Error Flag (A401.06) is turned ON.
2.

The corresponding error code is written to A400.
3.

The error code and time of occurrence are stored in the Error Log.
4.

The error indicator on the front of the CPU Unit will flash or light.
5.

If FAL(006) has been executed, the CPU Unit will continue operating.  
If FALS(007) has been executed, the CPU Unit will stop operating. (Program execution will stop.)

Operation of FAL(006)



When execution condition A goes ON, an error with FAL number 002 is generated, A402.15 (FAL Error Flag) is turned ON, and A360.02 (FAL Number 002 Flag) is turned ON. Program execution continues.

Errors generated by FAL(006) can be cleared by executing FAL(006) with FAL number 00 or performing the error read/clear operation from the CX-Programmer.

#### Operation of FALS(007)



When execution condition B goes ON, an error with FALS number 003 is generated, and A401.06 (FALS Error Flag) is turned ON. Program execution is stopped.

Errors generated by FAL(006) can be cleared by eliminating the cause of the error and performing the error read/clear operation from the CX-Programmer.

## 8-8-2 Failure Point Detection: FPD(269)

FPD(269) performs time monitoring and logic diagnosis. The time monitoring function generates a non-fatal error if the diagnostic output isn't turned ON within the specified monitoring time. The logic diagnosis function indicates which input is preventing the diagnostic output from being turned ON.

### Time Monitoring Function

FPD(269) starts timing when it is executed and turns ON the Carry Flag if the diagnostic output isn't turned ON within the specified monitoring time. The Carry Flag can be programmed as the execution condition for an error processing block. Also, FPD(269) can be programmed to generate a non-fatal FAL error with the desired FAL number.

When an FAL error is generated, a preset message will be registered and can be displayed on the CX-Programmer. FPD(269) can be set to output the results of logic diagnosis (the address of the bit preventing the diagnostic output from being turned ON) just before the message.

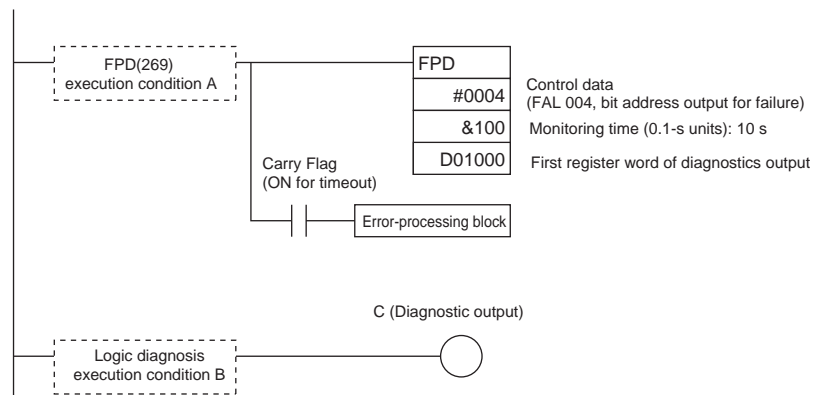
The teaching function can be used to automatically determine the actual time required for the diagnostic output to go ON and set the monitoring time.

### Logic Diagnosis Function

FPD(269) determines which input bit is causing the diagnostic output to remain OFF and outputs the result. The output can be set to bit address output (PLC memory address) or message output (ASCII).

If bit address output is selected, the PLC memory address of the bit can be transferred to an Index Register and the Index Register can be indirectly addressed in later processing.

If the message output is selected, an error message can be displayed on the CX-Programmer at the same time as a FAL error is generated for time monitoring.



### Time Monitoring

Monitors whether output C goes ON with 10 seconds after input A. If C doesn't go ON within 10 seconds, a failure is detected and the Carry Flag is turned ON. The Carry Flag executes the error-processing block. Also, an FAL error (non-fatal error) with FAL number 004 is generated.

### Logic Diagnosis

FPD(269) determines which input bit in block B is preventing output C from going ON. That bit address is output to D1000 and D1001.

### Auxiliary Area Flags and Words

| Name                        | Address      | Operation  |
|-----------------------------|--------------|--|
| Error Code                  | A400         | When an error occurs, the error code is stored in A400.  |
| FAL Error Flag              | A402.15      | Turns ON when FAL(006) is executed.  |
| FALS Error Flag             | A401.06      | Turns ON when FALS(007) is executed.   |
| Executed FAL Number Flags   | A360 to A391 | The corresponding flag turns ON when an FAL(006) error occurs.   |
| Error Log Area              | A100 to A199 | The Error Log Area contains information on the most recent 20 errors.  |
| Error Log Pointer           | A300         | When an error occurs, the Error Log Pointer is incremented by 1 to indicate where the next error record will be recorded as an offset from the beginning of the Error Log Area (A100). |
| Error Log Pointer Reset Bit | A500.14      | Turn this bit ON to reset the Error Log Pointer (A300) to 00.  |
| FPD Teaching Bit            | A598.00      | Turn this bit ON when you want the monitoring time to be set automatically when FPD(269) is executed.  |

### 8-8-3 Simulating System Errors

FAL(006) and FALS(007) can be used to intentionally create fatal and non-fatal system errors. This can be used in system debugging to test display messages on Programmable Terminals (PTs) or other operator interfaces.

Use the following procedure.

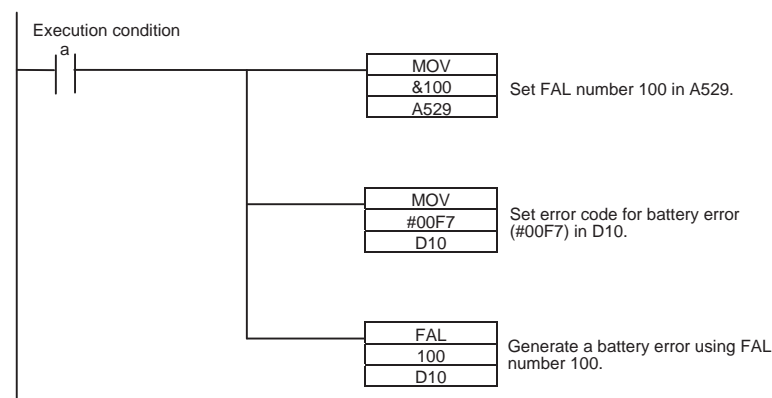
- 1,2,3...**
1. Set the FAL or FALS number to use for simulation in A529. A529 is used when simulating errors for both FAL(006) and FALS(007).
  2. Set the FAL or FALS number to use for simulation as the first operand of FAL(006) or FALS(007).
  3. Set the error code and error to be simulated as the second operand (two words) of FAL(006) or FALS(007). Indicate a nonfatal error for FAL(006) and a fatal error for FALS(007).

To simulate more than one system error, use more than one FAL(006) or FALS(007) instruction with the same value in A529 and different values for the second operand.

#### Auxiliary Area Flags and Words

| Name  | Address | Operation  |
|---|---------|--|
| FAL/FALS Number for System Error Simulation | A529    | Set a dummy FAL/FALS number to use to simulate a system error.<br>0001 to 01FF hex: FAL/FALS numbers 1 to 511<br>0000 or 0200 to FFFF hex: No FAL/FALS number for system error simulation. |

#### Example for a Battery Error



**Note** Use the same methods as for actual system errors to clear the simulated system errors. Refer to the 12-2 *Troubleshooting* for details. All system errors simulated with FAL(006) and FALS(007) can be cleared by cycling the power supply.

### 8-8-4 Output OFF Bit

As an emergency measure when an error occurs, all outputs from Output Units can be turned OFF by turning ON the Output OFF Bit (A500.15). The operating mode will remain in RUN or MONITOR mode, but all outputs will be turned OFF.

**Note** Normally (when IOM Hold Bit = OFF), all outputs from Output Units are turned OFF when the operating mode is changed from RUN/MONITOR mode to PROGRAM mode. The Output OFF Bit can be used to turn OFF all outputs without switching to PROGRAM mode.

## 8-9 Clock

A clock is built into the CP1L-EL/EM CPU Unit and is backed up by a battery. The current data is stored in the following words and refreshed each cycle.

| Name                        | Addresses          | Function   |
|-----------------------------|--------------------|--|
| Clock data:<br>A351 to A354 | A351.00 to A351.07 | Second: 00 to 59 (BCD)   |
|                             | A351.08 to A351.15 | Minute: 00 to 59 (BCD)   |
|                             | A352.00 to A352.07 | Hour: 00 to 23 (BCD)   |
|                             | A352.08 to A352.15 | Day of the month: 00 to 31 (BCD)   |
|                             | A353.00 to A353.07 | Month: 00 to 12 (BCD)  |
|                             | A353.08 to A353.15 | Year: 00 to 99 (BCD)   |
|                             | A354.00 to A354.07 | Day of the week:<br>00: Sunday, 01: Monday,<br>02: Tuesday, 03: Wednesday,<br>04: Thursday, 05: Friday, 06: Saturday |

**Note** The clock cannot be used if a battery is not installed or the battery voltage is low.

### Auxiliary Area Flags and Words

| Name                    | Addresses     | Contents  |
|-------------------------|---------------|---|
| Start-up Time           | A510 and A511 | The time at which the power was turned ON (year, month, day of month, hour, minutes, and seconds).  |
| Power Interruption Time | A512 and A513 | The time at which the power was last interrupted (year, month, day of month, hour, minutes, and seconds).   |
| Power ON Clock Data 1   | A720 to A722  | Consecutive times at which the power was turned ON (year, month, day of month, hour, minutes, and seconds). The times are progressively older from number 1 to number 10. |
| Power ON Clock Data 2   | A723 to A725  |   |
| Power ON Clock Data 3   | A726 to A728  |   |
| Power ON Clock Data 4   | A729 to A731  |   |
| Power ON Clock Data 5   | A732 to A734  |   |
| Power ON Clock Data 6   | A735 to A737  |   |
| Power ON Clock Data 7   | A738 to A740  |   |
| Power ON Clock Data 8   | A741 to A743  |   |
| Power ON Clock Data 9   | A744 to A746  |   |
| Power ON Clock Data 10  | A747 to A749  |   |
| Operation Start Time    | A515 to A517  | The time that operation started (year, month, day of month, hour, minutes, and seconds).  |
| Operation End Time      | A518 to A520  | The time that operation stopped (year, month, day of month, hour, minutes, and seconds).  |
| User Program Date       | A90 to A93    | The time when the user program was last overwritten (year, month, day of month, hour, minutes, and seconds).  |
| Parameter Date          | A94 to A97    | The time when the parameters were last overwritten (year, month, day of month, hour, minutes, and seconds).   |

**Time-related Instructions**

| <b>Name</b>       | <b>Mnemonic</b> | <b>Function</b>   |
|-------------------|-----------------|---|
| HOURS TO SECONDS  | SEC(065)        | Converts time data in hours/minutes/seconds format to an equivalent time in seconds only. |
| SECONDS TO HOURS  | HMS(066)        | Converts seconds data to an equivalent time in hours/minutes/seconds format.              |
| CALENDAR ADD      | CADD(730)       | Adds time to the calendar data in the specified words.                                    |
| CALENDAR SUBTRACT | CSUB(731)       | Subtracts time from the calendar data in the specified words.                             |
| CLOCK ADJUSTMENT  | DATE(735)       | Changes the internal clock setting to the setting in the specified source words.          |

## SECTION 9

# Using Expansion Units and Expansion I/O Units

This section describes how to use CP-series Expansion Units and Expansion I/O Units.

|       |  |     |
|-------|--|-----|
| 9-1   | Connecting Expansion Units and Expansion I/O Units . . . . . | 458 |
| 9-2   | Analog Input Units . . . . .                                 | 459 |
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| 9-4-1 | CP1W-MAD11 Analog I/O Units . . . . .                        | 483 |
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| 9-5   | Temperature Sensor Units . . . . .                           | 513 |
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| 9-6   | CompoBus/S I/O Link Units . . . . .                          | 548 |

## 9-1 Connecting Expansion Units and Expansion I/O Units

CP-series Expansion Units and Expansion I/O Units can be connected to the CP1L-EL/EM. Up to three Expansion Units or Expansion I/O Units can be connected to a CPU Unit with 30 or 40 I/O points and one Expansion Unit or Expansion I/O Unit can be connected to a CPU Unit with 20 I/O points.

### Number of I/O Words

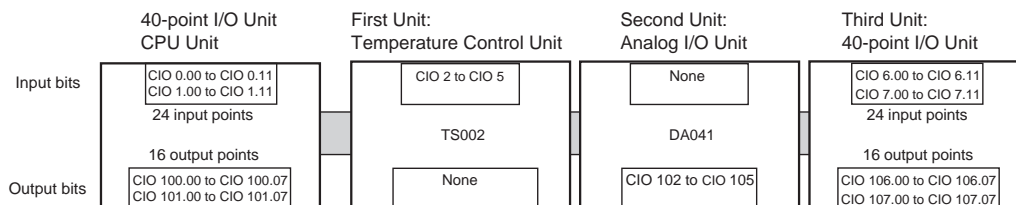
| Unit name           |                          | Model       | Current consumption (mA) |        | I/O words |        |
|---------------------|--------------------------|-------------|--------------------------|--------|-----------|--------|
|                     |                          |             | 5 VDC                    | 24 VDC | Input     | Output |
| Expansion Units     | Analog Input Unit        | CP1W-AD041  | 100                      | 90     | 4         | 2      |
|                     |                          | CP1W-AD042  | 100                      | 50     | 4         | 2      |
|                     | Analog Output Unit       | CP1W-DA021  | 40                       | 95     | ---       | 2      |
|                     |                          | CP1W-DA041  | 80                       | 124    | ---       | 4      |
|                     |                          | CP1W-DA042  | 70                       | 160    | ---       | 4      |
|                     | Analog I/O Unit          | CP1W-MAD11  | 83                       | 110    | 2         | 1      |
|                     |                          | CP1W-MAD42  | 120                      | 120    | 4         | 2      |
|                     |                          | CP1W-MAD44  | 120                      | 170    | 4         | 4      |
|                     | Temperature Control Unit | CP1W-TS001  | 40                       | 59     | 2         | ---    |
|                     |                          | CP1W-TS101  | 54                       | 73     | 4         | ---    |
|                     |                          | CP1W-TS002  | 40                       | 59     |           |        |
|                     |                          | CP1W-TS102  | 54                       | 73     |           |        |
|                     |                          | CP1W-TS003  | 70                       | 30     | 4         | ---    |
|                     |                          | CP1W-TS004  | 80                       | 50     | 2         | 1      |
|                     | CompoBus/S I/O Link Unit | CP1W-SRT21  | 29                       | ---    | 1         | 1      |
| Expansion I/O Units | 40-point I/O Unit        | CP1W-40EDR  | 80                       | 90     | 2         | 2      |
|                     |                          | CP1W-40EDT  | 160                      | ---    |           |        |
|                     |                          | CP1W-40EDT1 | 160                      | ---    |           |        |
|                     | 32-point Output Unit     | CP1W-32ER   | 49                       | 131    | ---       | 2      |
|                     |                          | CP1W-32ET   | 113                      | ---    |           |        |
|                     |                          | CP1W-32ET1  | 113                      | ---    |           |        |
|                     | 20-point I/O Unit        | CP1W-20EDR1 | 103                      | 44     | 1         | 1      |
|                     |                          | CP1W-20EDT  | 130                      | ---    |           |        |
|                     |                          | CP1W-20EDT1 | 130                      | ---    |           |        |
|                     | 16-point Output Unit     | CP1W-16ER   | 42                       | 90     | ---       | 2      |
|                     |                          | CP1W-16ET   | 76                       | ---    |           |        |
|                     |                          | CP1W-16ET1  | 76                       | ---    |           |        |
|                     | 8-point Input Unit       | CP1W-8ED    | 18                       | ---    | 1         | ---    |
|                     | 8-point Output Unit      | CP1W-8ER    | 26                       | 44     | ---       | 1      |
|                     |                          | CP1W-8ET    | 75                       | ---    |           |        |
|                     |                          | CP1W-8ET1   | 75                       | ---    |           |        |

**Note** CP1W-32ER/32ET/32ET1's maximum number of simultaneously ON points is 24 (75%).



**Allocation of I/O Words**

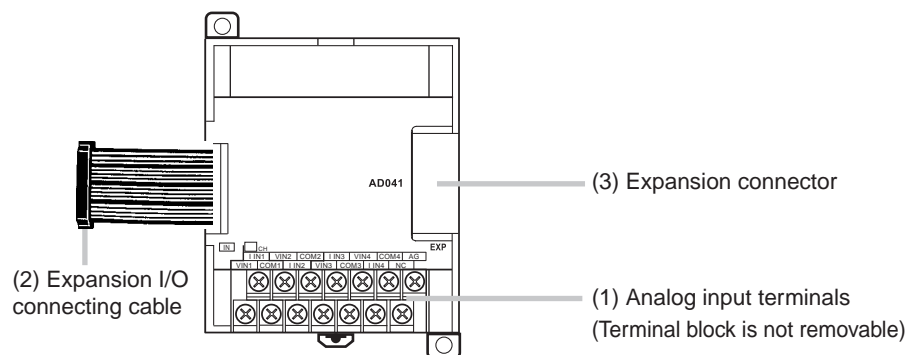
Expansion Units and Expansion I/O Units are allocated I/O bits in the order the Units are connected starting from the CPU Unit. When the power to the CPU Unit is turned ON, the CPU Unit checks for any Expansion Units and Expansion I/O Units connected to it and automatically allocates I/O bits.



## 9-2 Analog Input Units

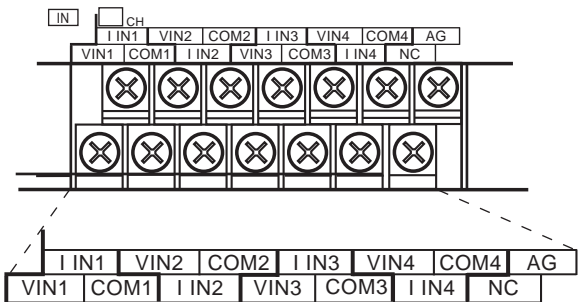
Each CP1W-AD041/CP1W-AD042 Analog Input Unit provides four analog inputs.

- The analog input signal ranges are 0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, and 4 to 20 mA.  
The resolution of CP1W-AD041 is 1/6,000.  
The resolution of CP1W-AD042 is 1/12,000.  
The open-circuit detection function is activated in the ranges of 1 to 5 V and 4 to 20 mA.
- The Analog Input Unit uses four input words and two output words, so a maximum of three Units can be connected.

**Part Names****CP1W-AD041/CP1W-AD042**

1. Analog Input Terminals  
Connected to analog output devices.

■ Input Terminal Arrangement



|       |                 |
|-------|-----------------|
| V IN1 | Voltage input 1 |
| I IN1 | Current input 1 |
| COM1  | Input common 1  |
| V IN2 | Voltage input 2 |
| I IN2 | Current input 2 |
| COM2  | Input common 2  |
| V IN3 | Voltage input 3 |
| I IN3 | Current input 3 |
| COM3  | Input common 3  |
| V IN4 | Voltage input 4 |
| I IN4 | Current input 4 |
| COM4  | Input common 4  |

**Note** When using current inputs, voltage input terminals must be short-circuited with current input terminals.

- Expansion I/O Connecting Cable  
Connected to the CPU Unit or Expansion Unit expansion connector. The cable is attached to the Analog Input Unit and cannot be removed.

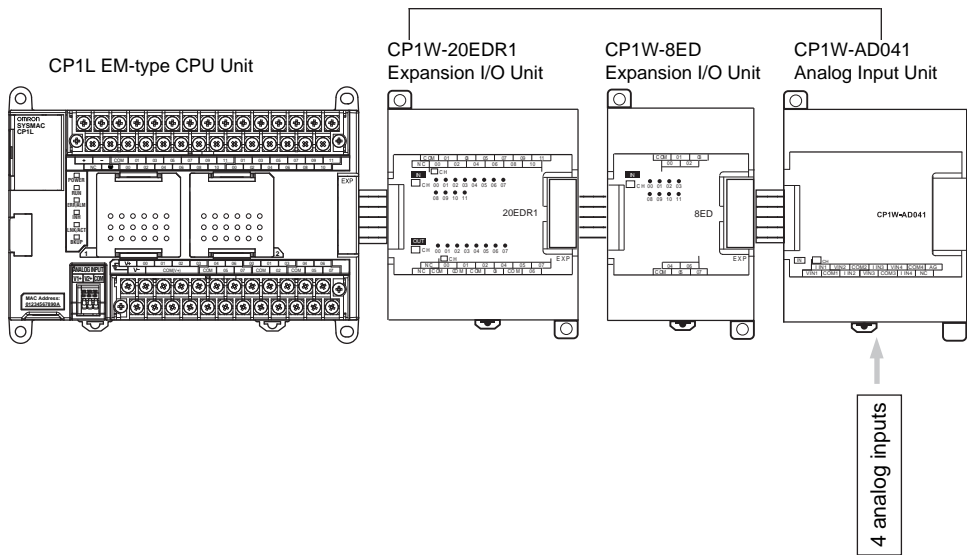
**Note** Do not touch the cables during operation. Static electricity may cause operating errors.

- Expansion Connector  
Connected to the next Expansion Unit or Expansion I/O Unit to enable expansion.

**Main Analog Input Unit Specifications**

Analog Input Units are connected to a CP1L-EL/EM CPU Unit. For CP1L EM-type CPU Units, a maximum of three Units can be connected, including other Expansion Units and Expansion I/O Units. For CP1L EL-type CPU Units, a maximum of one Unit can be connected.

For CP1L EM-type CPU Units, a maximum of 3 Expansion Units or Expansion I/O Units can be connected.



| Item                            |           | CP1W-AD041   |                             | CP1W-AD042   |                             |
|---------------------------------|-----------|--|-----------------------------|--|-----------------------------|
|                                 |           | Voltage Input  | Current Input               | Voltage Input  | Current Input               |
| Number of inputs                |           | 4 inputs (4 words allocated)   |                             |  |                             |
| Input signal range              |           | 0 to 5 VDC,<br>1 to 5 VDC,<br>0 to 10 VDC,<br>or -10 to 10 VDC   | 0 to 20 mA<br>or 4 to 20 mA | 0 to 5 VDC,<br>1 to 5 VDC,<br>0 to 10 VDC,<br>or -10 to 10 VDC   | 0 to 20 mA<br>or 4 to 20 mA |
| Max. rated input                |           | ±15 V  | ±30 mA                      | ±15 V  | ±30 mA                      |
| External input impedance        |           | 1 MΩ min.  | Approx. 250 Ω               | 1 MΩ min.  | Approx. 250 Ω               |
| Resolution                      |           | 1/6000 (full scale)  |                             | 1/12000 (full scale)   |                             |
| Overall accuracy                | 25°C      | 0.3% full scale  | 0.4% full scale             | 0.2% full scale  | 0.3% full scale             |
|                                 | 0 to 55°C | 0.6% full scale  | 0.8% full scale             | 0.5% full scale  | 0.7% full scale             |
| A/D conversion data             |           | 16-bit binary (4-digit hexadecimal)<br>Full scale for -10 to 10 V: F448 to 0BB8 Hex<br>Full scale for other ranges: 0000 to 1770 Hex |                             | 16-bit binary (4-digit hexadecimal)<br>Full scale for -10 to 10 V: E890 to 1770 Hex<br>Full scale for other ranges: 0000 to 2EE0 Hex |                             |
| Averaging function              |           | Supported (Set in output words n+1 and n+2.)   |                             |  |                             |
| Open-circuit detection function |           | Supported  |                             |  |                             |
| Conversion time                 |           | 2 ms/point (8 ms/all points)   |                             | 1 ms/point (4 ms/all points)   |                             |
| Isolation method                |           | Photocoupler isolation between analog I/O terminals and internal circuits. No isolation between analog I/O signals.                  |                             |  |                             |
| Current consumption             |           | 5 VDC: 100 mA max.; 24 VDC: 90 mA max.   |                             | 5 VDC: 100 mA max.; 24 VDC: 50 mA max.   |                             |

### Analog Input Signal Ranges

Analog input data is digitally converted according to the input signal range as shown below.

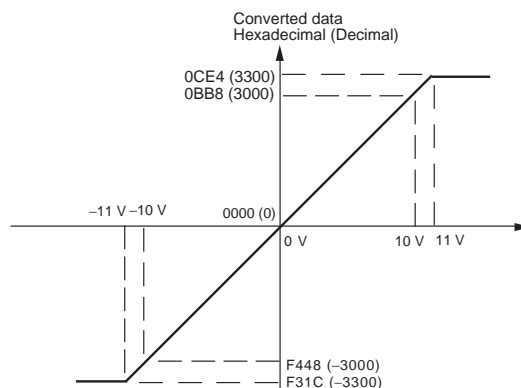
**Note** When the input exceeds the specified range, the A/D conversion data will be fixed at either the lower limit or upper limit.

### Analog Input Signal Ranges

#### ■ -10 to 10 V Inputs

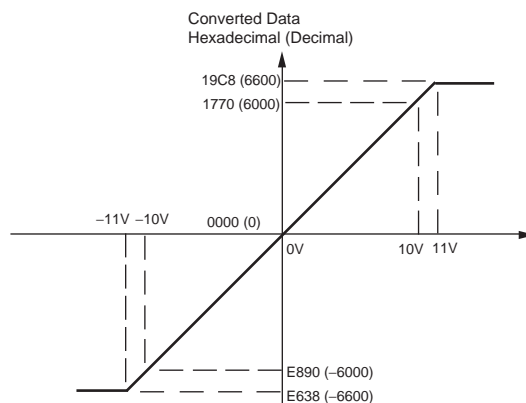
When the resolution is 1/6,000, the -10 to 10 V range corresponds to hexadecimal values F448 to 0BB8 (-3,000 to 3,000). The range of data that can be converted is F31C to 0CE4 hex (-3,300 to 3,300).

A negative voltage is expressed as two's complement.



When the resolution is 1/12,000, the -10 to 10 V range corresponds to hexadecimal values E890 to 1770 (-6,000 to 6,000). The entire data range is E638 to 19C8 hex (-6,600 to 6,600).

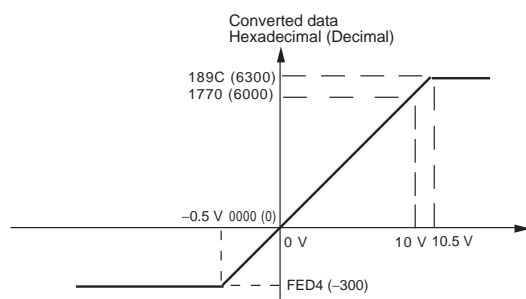
A negative voltage is expressed as a two's complement.



### ■ 0 to 10 V Inputs

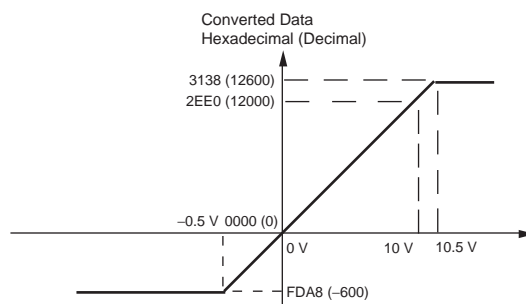
When the resolution is 1/6,000, the 0 to 10 V range corresponds to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (–300 to 6,300).

A negative voltage is expressed as two's complement.



When the resolution is 1/12,000, the 0 to 10 V range corresponds to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (–600 to 12,600).

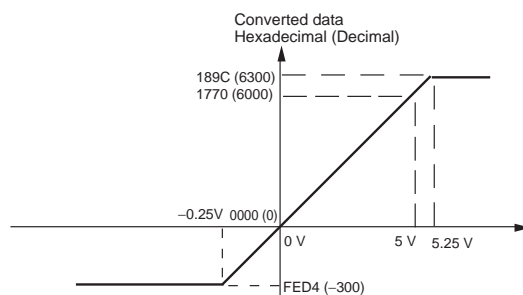
A negative voltage is expressed as a two's complement.



### ■ 0 to 5 V Inputs

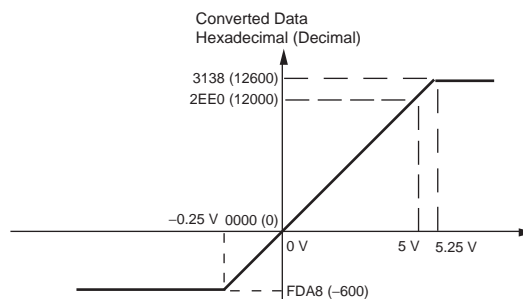
When the resolution is 1/6,000, the 0 to 5 V range corresponds to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (–300 to 6,300).

A negative voltage is expressed as two's complement.



When the resolution is 1/12,000, the 0 to 5 V range corresponds to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600).

A negative voltage is expressed as a two's complement.

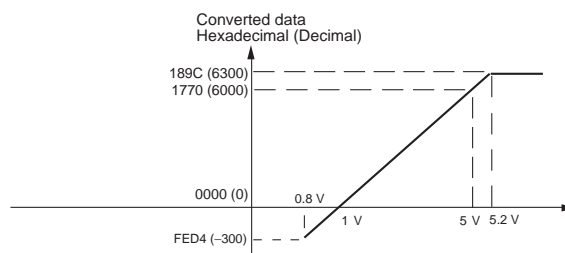


### ■ 1 to 5 V Inputs

When the resolution is 1/6,000, the 1 to 5 V range corresponds to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (-300 to 6,300).

Voltage in the range of 0.8 to 1 V is expressed as two's complement.

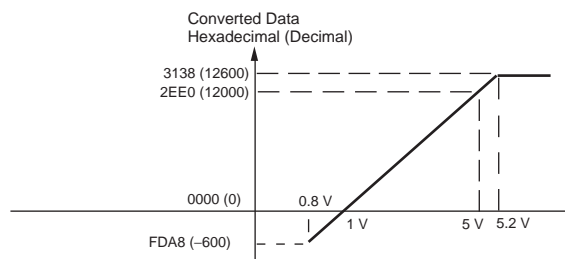
If an input is below the range (i.e., less than 0.8 V), the open-circuit detection function is activated and the data becomes 8,000.



When the resolution is 1/12,000, the 1 to 5 V range corresponds to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (-600 to 12,600).

Voltage in the range of 0.8 to 1 V is expressed as two's complement.

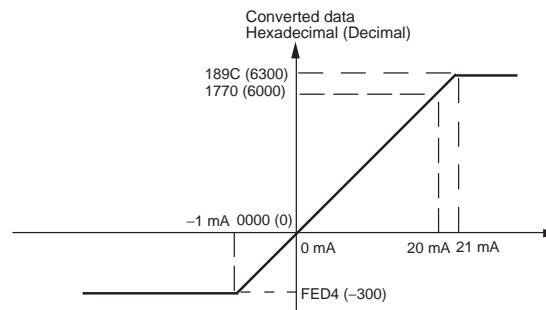
If an input is below the range (i.e., less than 0.8 V), the open-circuit detection function is activated and the data becomes 8,000.



### ■ 0 to 20 mA Inputs

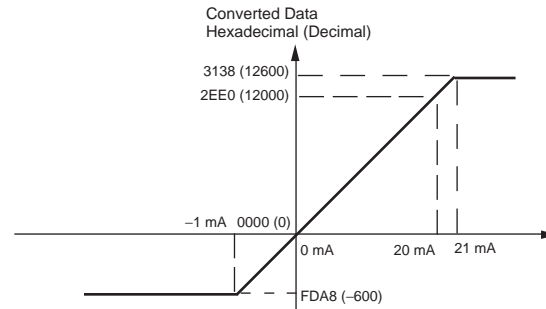
When the resolution is 1/6,000, the 0 to 20 mA range corresponds to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (–300 to 6,300).

A negative current is expressed as two's complement.



When the resolution is 1/12,000, the 0 to 20 mA range corresponds to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (–600 to 12,600).

A negative current is expressed as a two's complement.

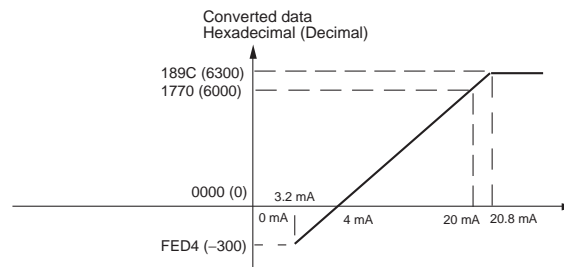


### ■ 4 to 20 mA Inputs

When the resolution is 1/6,000, the 4 to 20 mA range corresponds to hexadecimal values 0000 to 1770 (0 to 6,000). The range of data that can be converted is FED4 to 189C hex (–300 to 6,300).

Current in the range of 3.2 to 4 mA is expressed as two's complement.

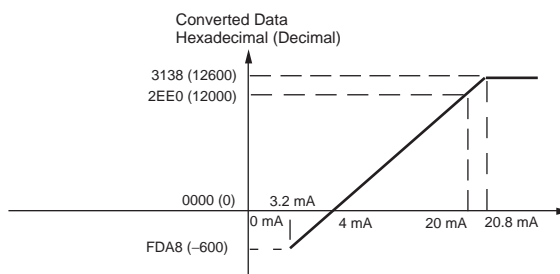
If an input is below the range (i.e., less than 3.2 mA), the open-circuit detection function is activated and the data becomes 8,000.



When the resolution is 1/12,000, the 4 to 20 mA range corresponds to hexadecimal values 0000 to 2EE0 (0 to 12,000). The entire data range is FDA8 to 3138 hex (–600 to 12,600).

Current in the range of 3.2 to 4 mA is expressed as two's complement.

If an input is below the range (i.e., less than 3.2 mA), the open-circuit detection function is activated and the data becomes 8,000.



### Averaging Function

For analog inputs, the averaging function operates when the averaging bit is set to 1. The averaging function outputs the average (a moving average) of the last eight input values as the converted value. If there is only a slight variation in inputs, it is handled by the averaging function as a smooth input.

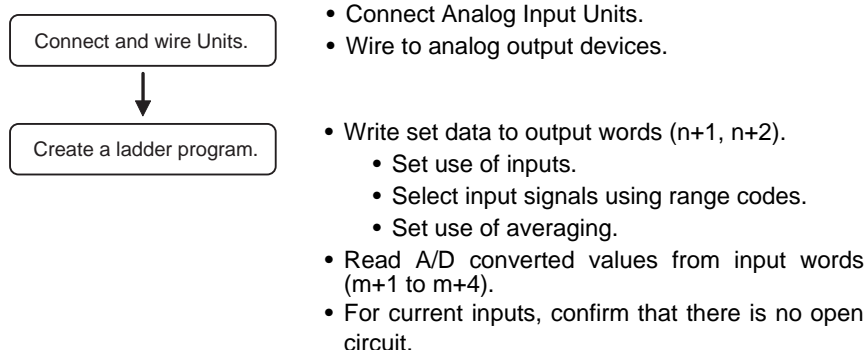
The averaging function stores the average (a moving average) of the last eight input values as the converted value. Use this function to smooth inputs that vary at a short interval.

### Open-circuit Detection Function

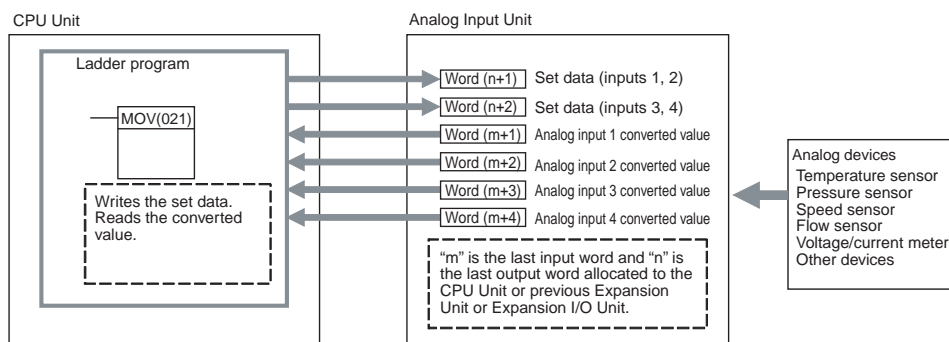
The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA. When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

### Procedure

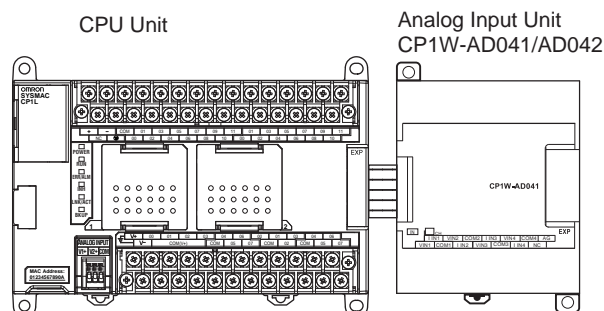


### Writing Set Data and Reading A/D Converted Values



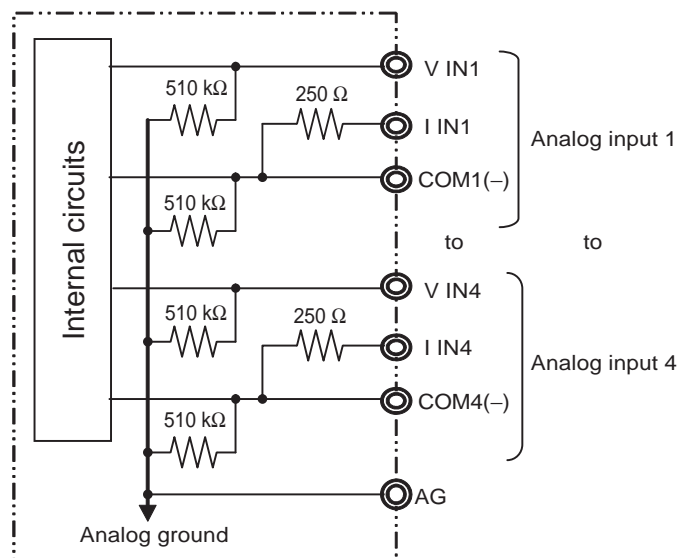
## 1. Connecting the Analog Input Unit

Connect the Analog Input Unit to the CPU Unit.

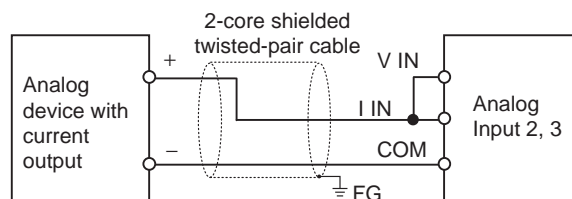
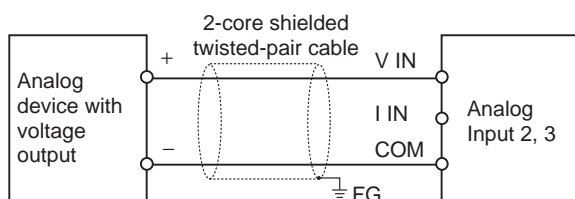


## 2. Wiring Analog Inputs

### Internal Circuits



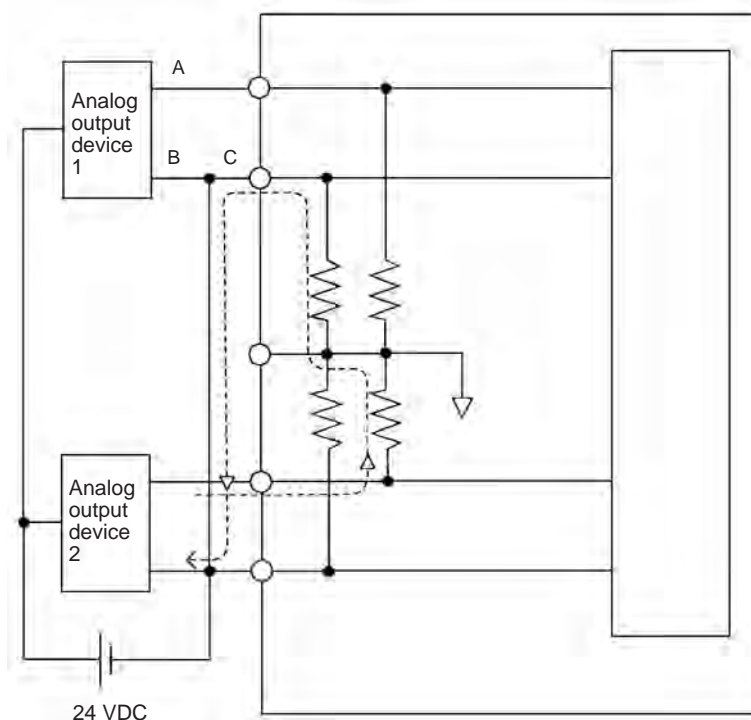
### ■ Wiring for Analog Inputs



#### Note

- (1) Connect the shield to the FG terminal to prevent noise.
- (2) When an input is not being used, short the + and – terminals.
- (3) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- (4) When there is noise in the power supply line, install a noise filter on the input section and the power supply.
- (5) Refer to the following information on open circuits when using voltage inputs.





For example, if analog input device 2 is outputting 5 V and the same power supply is being used as shown above, about 1/3, or 1.6 V, will be applied at the input for input device 1.

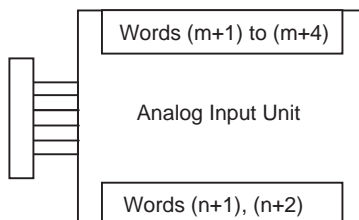
Consider the following information on open input circuits when using voltage inputs. Either use separate power supplies, or install an isolator at each input.

If the same power supply is used as shown in the following diagram and an open circuit occurs at point A or B, an unwanted current flow will occur as shown by the dotted lines in the diagram, creating a voltage at the other input of about 1/3 to 1/2. If the 1 to 5 V range is being used, the open-circuit detection function will not operate. Also, if there is an open circuit at C, the open-circuit detection function will not operate because the negative sides are the same.

### 3. Creating the Ladder Program

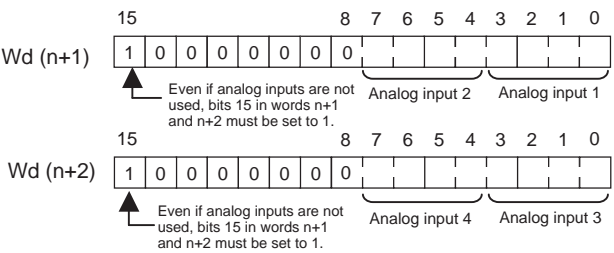
#### Allocating I/O Words

Four input words and two output words are allocated from the next words following the last I/O words allocated to the CPU Unit or an existing Expansion Unit or Expansion I/O Unit.

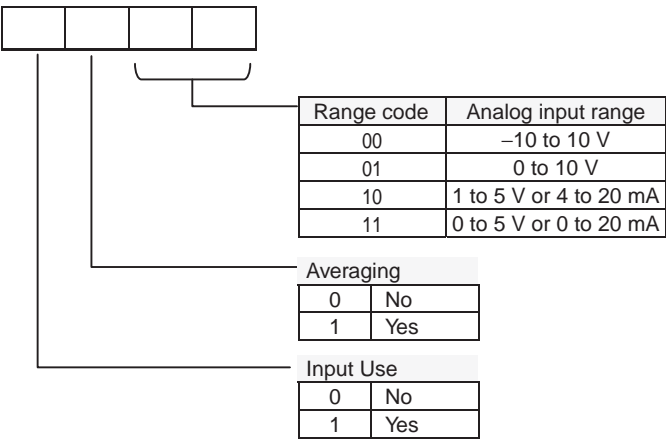


#### Writing Set Data

Write the settings for input use, averaging use, and range codes for words  $n+1$  and  $n+2$ . When the set data is transferred from the CPU Unit to the Analog I/O Unit, the A/D conversion will be started.



■ Set Data



- The Analog Input Unit will not start converting analog input values until the set data has been written.
- Once the range code has been set, it is not possible to be changed while power is being supplied to the CPU Unit. To change the range code, turn the CPU Unit OFF then ON again.

Averaging

Set whether averaging is to be used for set data. When the averaging bit is set to 1, the average (moving average) for the past eight inputs is output as conversion data.

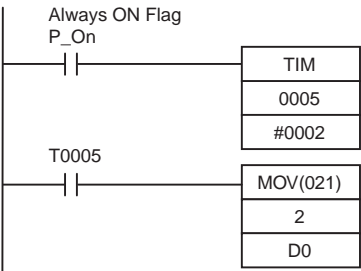
Reading Analog Input Conversion Values

Read the conversion value storage area with the ladder program. With word m as the last input word allocated to the CPU Unit or an already-connected Expansion Unit, the A/D conversion data will be output to the following words m+1 to m+4.

Startup Operation

After the power is turned ON, it will require two cycle times plus approximately 50 ms before the first conversion data is stored in the input words. Therefore, create a program as shown below, so that the ladder can start to operate with valid conversion data in input words.

The analog input data will be 0000 until the first conversion data is stored in the input words.



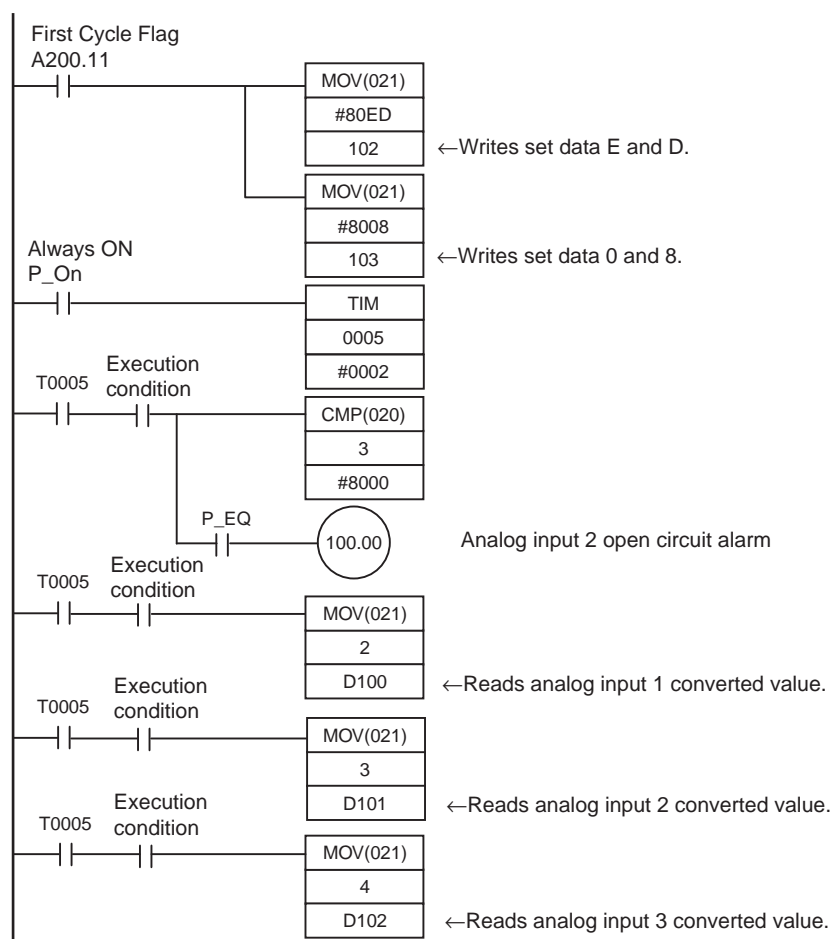
TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON and the analog input 1 conversion data stored in word 2 is transferred to D0.

## Handling Unit Errors

- When an error occurs in an Analog Input Unit, the analog input conversion data becomes 0000.
- CP-series Expansion Unit errors are output to bits 0 to 5 of word A436. The bits are allocated from A436.00 in order starting with the Unit nearest the CPU Unit. Use these flags in the program when it is necessary to detect errors.

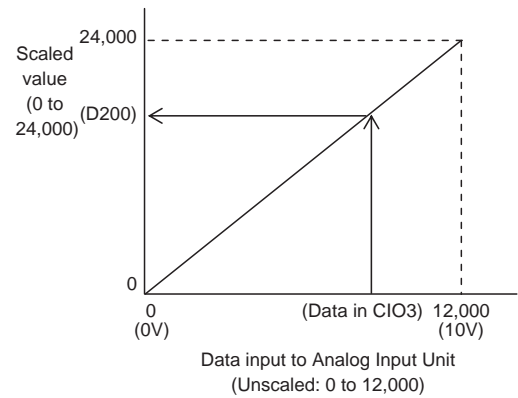
## Ladder Program Example

| Analog input | Input range  | Range code | Averaging | Set data     | Destination word |
|--------------|--------------|------------|-----------|--------------|------------------|
| Input 1      | 0 to 10 V    | 01         | Yes       | 1101 (D hex) | n+1              |
| Input 2      | 4 to 20 mA   | 10         | Yes       | 1110 (E hex) | n+1              |
| Input 3      | −10 to +10 V | 00         | No        | 1000 (8 hex) | n+2              |
| Input 4      | Not used.    | −(00)      | ---       | 0000 (0 hex) | n+2              |



■ **Example: Scaling analog input values**

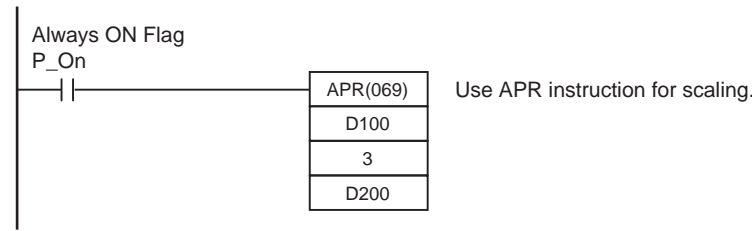
When a 0 to 10V voltage is input to the analog input word (CIO 3) of CP1W-AD042 as 0 to 12,000, convert the value into a value between 0 and 24,000 and output the result to D200.



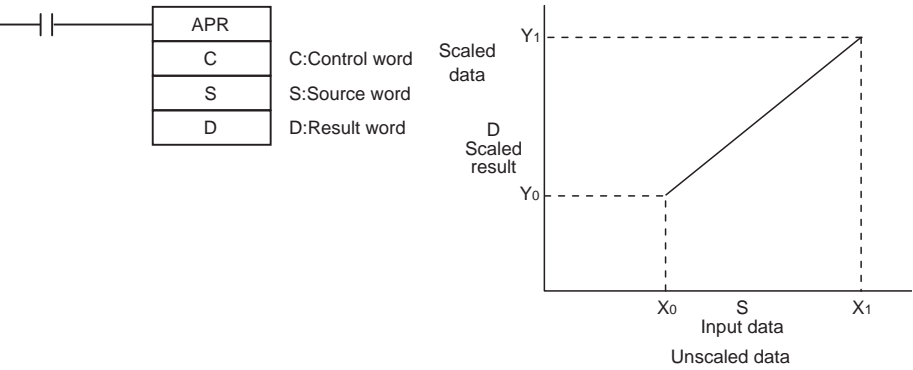
**Data Memory Settings**

| Setting                         | Address | Data    |
|---------------------------------|---------|---------|
| Control word                    | D100    | #0800   |
| Unscaled minimum value (0)      | D101    | &0      |
| Scaled minimum value (0)        | D102    | &0      |
| Unscaled maximum value (12,000) | D103    | &12,000 |
| Scaled maximum value (24,000)   | D104    | &24,000 |

**Ladder Program**

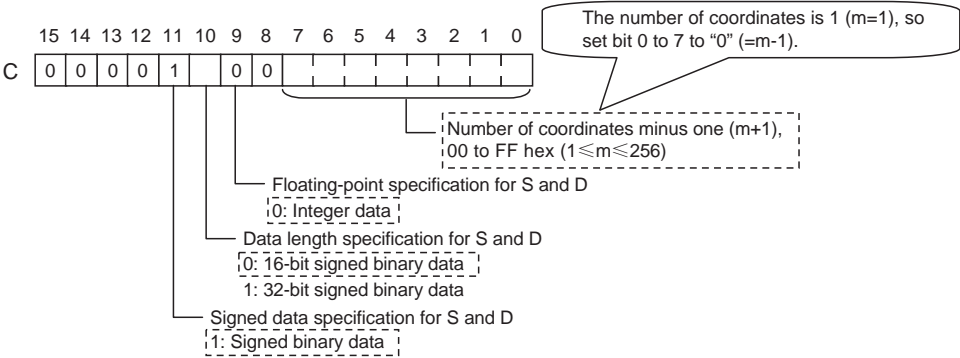


**Descriptions of APR Instruction**



C: Control word  
Set for "Signed Integer Data (Binary)".

Control word setting  
#0800: Binary numeral (0000 1000 0000 0000)



| Setting                                | Address | Data  |
|--|---------|-------|
| Control word                           | C       | #0800 |
| Unscaled minimum value ( $X_0$ )       | C+1     | $X_0$ |
| Scaled minimum value ( $Y_0$ )         | C+2     | $Y_0$ |
| Unscaled maximum value ( $X_m = X_1$ ) | C+3     | $X_1$ |
| Scaled maximum value ( $Y_m = Y_1$ )   | C+4     | $Y_1$ |

S: Source data  
Specify the word address of the input data before scaling.

R: Result word  
Specify the word address where the data will be output after scaling.

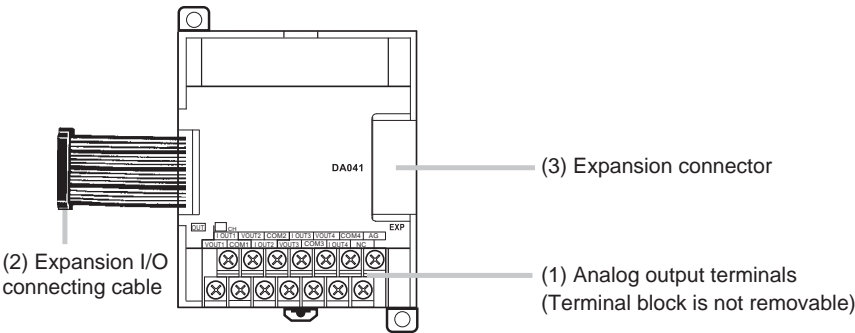
# 9-3 Analog Output Units

Each CP1W-DA021 Analog Output Unit provides two analog outputs.  
Each CP1W-DA041/CP1W-DA042 Analog Output Unit provides four analog outputs.

- The analog output signal ranges are 1 to 5 V, 0 to 10 V, –10 to +10 V, 0 to 20 mA, and 4 to 20 mA.  
The resolution of CP1W-DA041 is 1/6,000.  
The resolution of CP1W-DA042 is 1/12,000.
- The CP1W-DA021 uses two output words, so a maximum of seven Units can be connected.
- The CP1W-DA041/CP1W-DA042 uses four output words, so a maximum of three Units can be connected.

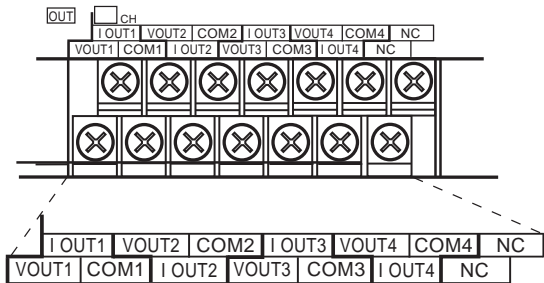
## Part Names

### CP1W-DA021/CP1W-DA041/CP1W-DA042



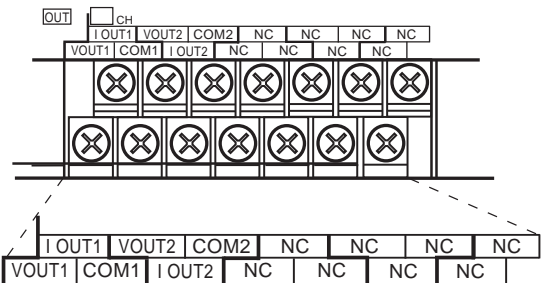
1. Analog Output Terminals  
Connected to analog input devices.

#### ■ Output Terminal Arrangement for CP1W-DA041/CP1W-DA042



|        |                  |
|--------|------------------|
| V OUT1 | Voltage output 1 |
| I OUT1 | Current output 1 |
| COM1   | Output common 1  |
| V OUT2 | Voltage output 2 |
| I OUT2 | Current output 2 |
| COM2   | Output common 2  |
| V OUT3 | Voltage output 3 |
| I OUT3 | Current output 3 |
| COM3   | Output common 3  |
| V OUT4 | Voltage output 4 |
| I OUT4 | Current output 4 |
| COM4   | Output common 4  |

#### ■ Output Terminal Arrangement for CP1W-DA021



|        |                  |
|--------|------------------|
| V OUT1 | Voltage output 1 |
| I OUT1 | Current output 1 |
| COM1   | Output common 1  |
| V OUT2 | Voltage output 2 |
| I OUT2 | Current output 2 |
| COM2   | Output common 2  |

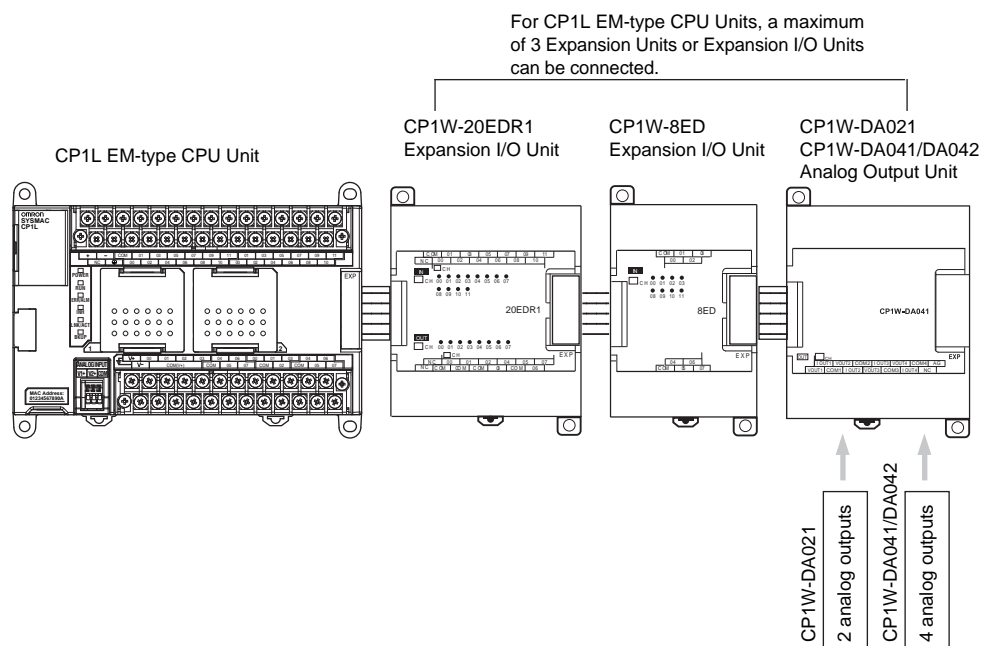
2. Expansion I/O Connecting Cable  
Connected to the CPU Unit or previous Expansion Unit. The cable is provided with the Unit and cannot be removed.

**Note** Do not touch the cables during operation. Static electricity may cause operating errors.

3. Expansion Connector  
Connected to the next Expansion Unit or Expansion I/O Unit.

### **Main Analog Output Unit Specifications**

Analog Output Units are connected to a CP1L-EL/EM CPU Unit. For CP1L EM-type CPU Units, a maximum of three Units can be connected, including other Expansion Units and Expansion I/O Units. For CP1L EL-type CPU Units, a maximum of one Unit can be connected.



| Item                                      |           | CP1W-DA021/CP1W-DA041  |                             | CP1W-DA042   |                             |
|---|-----------|--|-----------------------------|--|-----------------------------|
|   |           | Voltage Output   | Current Output              | Voltage Output   | Current Output              |
| Number of outputs                         |           | CP1W-DA021: 2 outputs (2 words allocated)<br>CP1W-DA041: 4 outputs (4 words allocated)   |                             | 4 outputs (4 words allocated)  |                             |
| Output signal range                       |           | 1 to 5 VDC,<br>0 to 10 VDC,<br>or -10 to 10 VDC  | 0 to 20 mA<br>or 4 to 20 mA | 1 to 5 VDC,<br>0 to 10 VDC,<br>or -10 to 10 VDC  | 0 to 20 mA<br>or 4 to 20 mA |
| External output allowable load resistance |           | 2 kΩ min.  | 350 Ω max.                  | 2 kΩ min.  | 350 Ω max.                  |
| External output impedance                 |           | 0.5 Ω max.   | ---                         | 0.5 Ω max.   | ---                         |
| Resolution                                |           | 1/6000 (full scale)  |                             | 1/12000 (full scale)   |                             |
| Overall accuracy                          | 25°C      | 0.4% full scale  |                             | 0.3% full scale  |                             |
|   | 0 to 55°C | 0.8% full scale  |                             | 0.7% full scale  |                             |
| D/A conversion data                       |           | 16-bit binary (4-digit hexadecimal)<br>Full scale for -10 to 10 V: F448 to 0BB8 Hex<br>Full scale for other ranges: 0000 to 1770 Hex |                             | 16-bit binary (4-digit hexadecimal)<br>Full scale for -10 to 10 V: E890 to 1770 Hex<br>Full scale for other ranges: 0000 to 2EE0 Hex |                             |
| Conversion time                           |           | CP1W-DA021: 2 ms/point (4 ms/all points)<br>CP1W-DA041: 2 ms/point (8 ms/all points)   |                             | 1 ms/point (4 ms/all points)   |                             |
| Isolation method                          |           | Photocoupler isolation between analog I/O terminals and internal circuits. No isolation between analog I/O signals.                  |                             |  |                             |
| Current consumption                       |           | CP1W-DA021: 5 VDC 40 mA max.; 24 VDC 95 mA max.<br>CP1W-DA041: 5 VDC 80 mA max.; 24 VDC 124 mA max.                                  |                             | 5 VDC: 70 mA max.; 24 VDC: 160 mA max.   |                             |

### Analog Output Signal Ranges

The analog values depend on the output signal ranges, as shown in the following diagrams.

**Note** When the output exceeds the specified range, the output signal will be fixed at either the lower limit or upper limit.

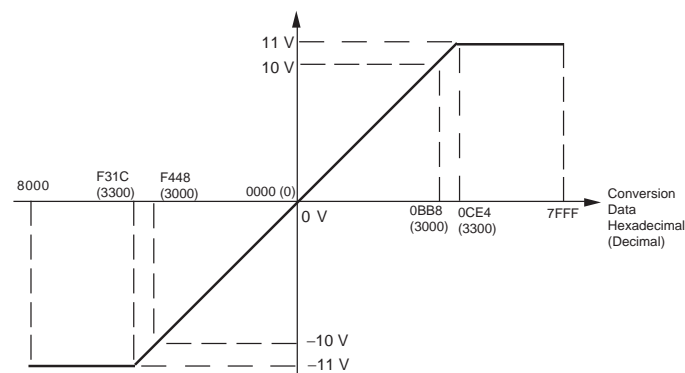
### Analog Output Signal Ranges

#### ■ -10 to 10 V

When the resolution is 1/6,000, the hexadecimal values F448 to 0BB8 (-3000 to 3000) correspond to an analog voltage range of -10 to 10 V.

The entire output range is -11 to 11 V.

Specify a negative voltage as a two's complement.

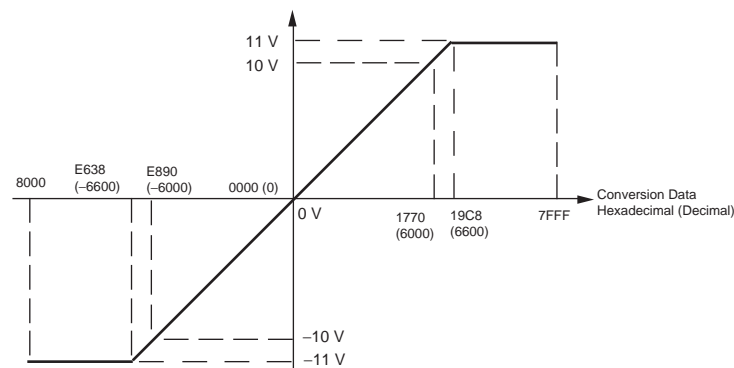




When the resolution is 1/12,000, the hexadecimal values E890 to 1770 (–6000 to 6000) correspond to an analog voltage range of –10 to 10 V.

The entire output range is –11 to 11 V.

Specify a negative voltage as a two's complement.

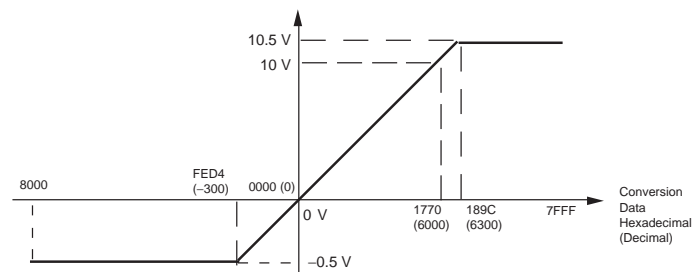


#### ■ 0 to 10 V

When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 0 to 10 V.

The entire output range is –0.5 to 10.5 V.

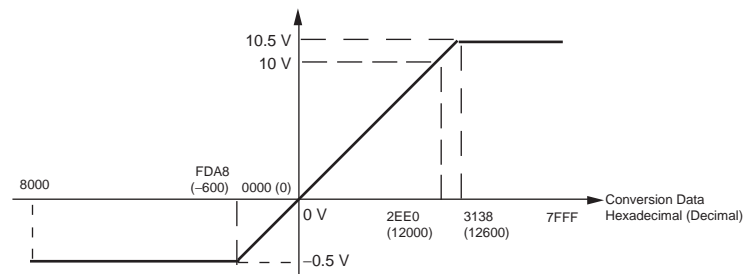
Specify a negative voltage as a two's complement.



When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 0 to 10 V.

The entire output range is –0.5 to 10.5 V.

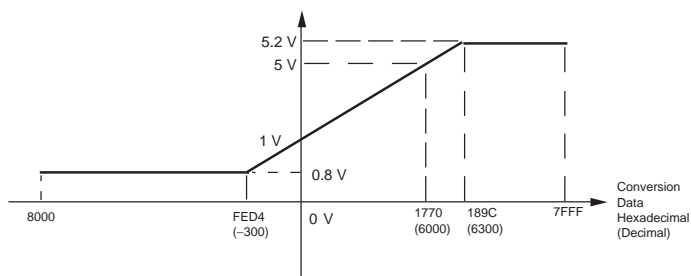
Specify a negative voltage as a two's complement.



### ■ 1 to 5 V

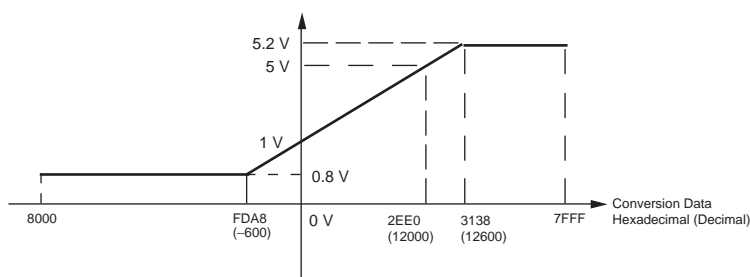
When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 1 to 5 V.

The entire output range is 0.8 to 5.2 V.



When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 1 to 5 V.

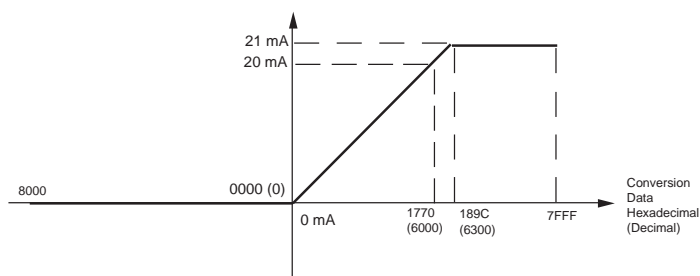
The entire output range is 0.8 to 5.2 V.



### ■ 0 to 20 mA

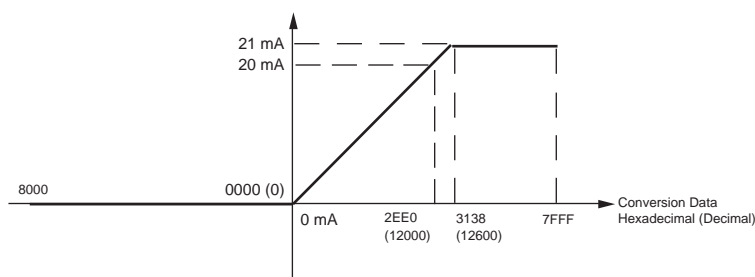
When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 0 to 20 mA.

The entire output range is 0 to 21 mA.



When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 0 to 20 mA.

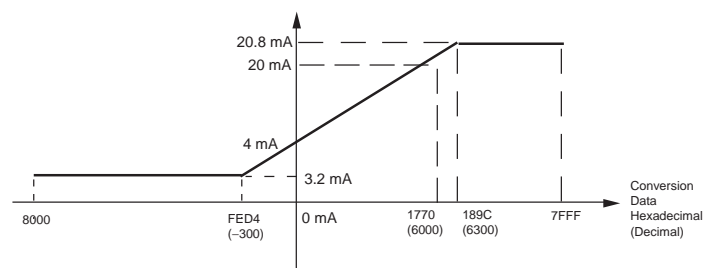
The entire output range is 0 to 21 mA.



### ■ 4 to 20 mA

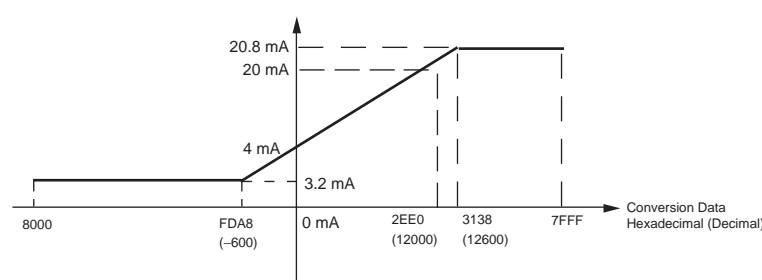
When the resolution is 1/6,000, the hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 4 to 20 mA.

The entire output range is 3.2 to 20.8 mA.



When the resolution is 1/12,000, the hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 4 to 20 mA.

The entire output range is 3.2 to 20.8 mA.



## Procedure

Connect and wire Units.

- Connect Analog Output Units.
- Wire to analog input devices.

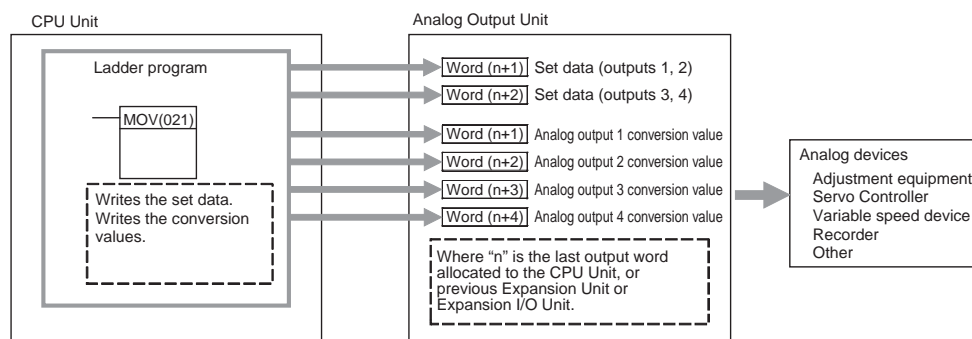


Create a ladder program.

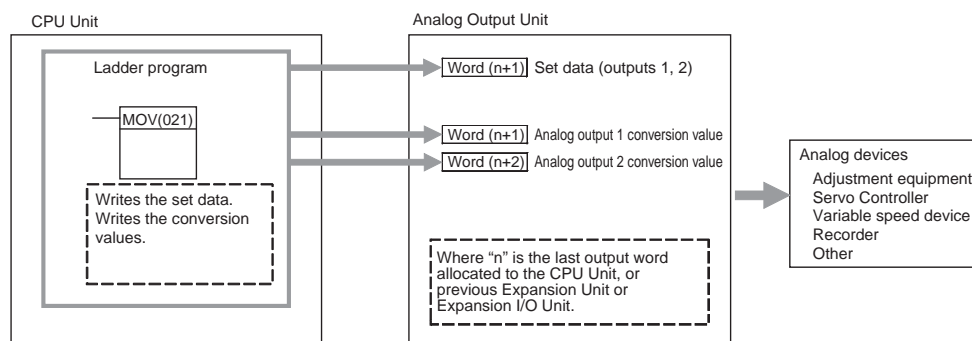
- Write set data to output words  
CP1W-DA041/DA042: Words (n+1, n+2)  
CP1W-DA021: Word (n+1)
  - Set use of outputs.
  - Select output signals using range codes.
- Write D/A conversion values to output words  
CP1W-DA041/DA042: Words (n+1 to n+4)  
CP1W-DA021: Words (n+1, n+2)

## Writing Set Data and Writing D/A Conversion Data

### ■ CP1W-DA041/CP1W-DA042

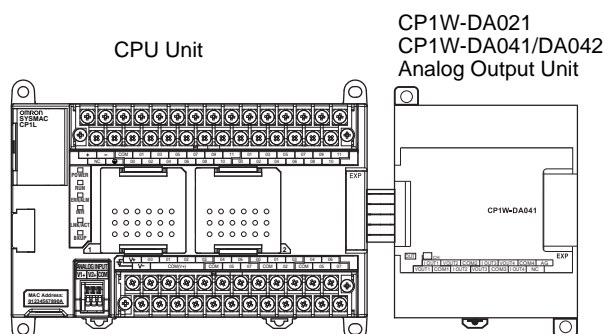


### ■ CP1W-DA021



## 1. Connecting the Analog Output Unit

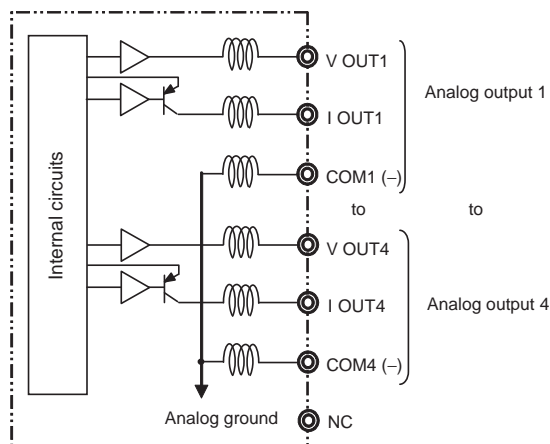
Connect the Analog Output Unit to the CPU Unit.



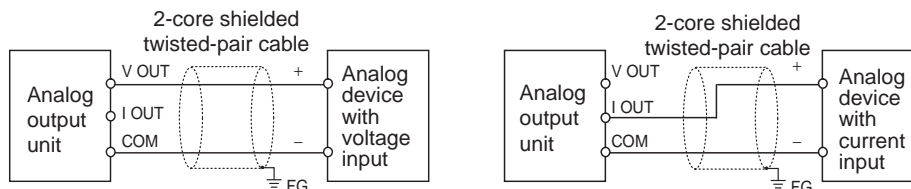
## 2. Wiring Analog Outputs

### Internal Circuits

The following diagram shows the internal circuit using CP1W-DA041/DA042 as an example, which wires analog outputs 1 to 4. In the case of CP1W-DA021, analog outputs 1 to 2 can be used.



### ■ Wiring for Analog Outputs



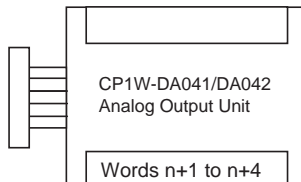
#### Note

- (1) Connect the shield to the FG terminal to prevent noise.
- (2) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- (3) When there is noise in the power supply line, install a noise filter on the input section and the power supply.
- (4) When external power is supplied (when range codes are set), or when the power is interrupted, there may be a pulse status analog output of up to 1 ms. If this status is a problem, take the following measures.
  - Turn ON the power to the CP1L-EL/EM CPU Unit, check the operation status, and then turn ON the power at the load.
  - Turn OFF the power to the load and then turn OFF the power to the CP1L-EL/EM CPU Unit.

### 3. Creating the Ladder Program

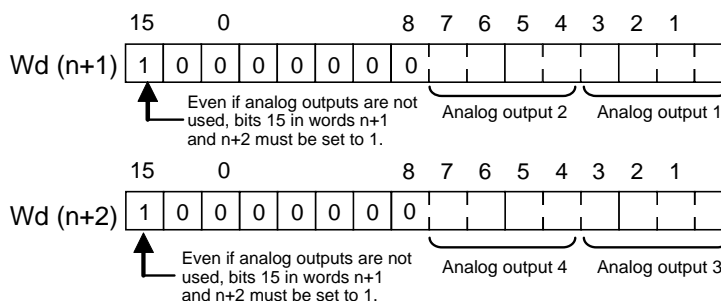
#### Allocating Output Words

Four output words (n+1 to n+4) are allocated, beginning from the first word following the last I/O word allocated to the CPU Unit or already-connected Expansion I/O Unit or Expansion Unit. For CP1W-DA021, two output words (n+1, n+2) are allocated.

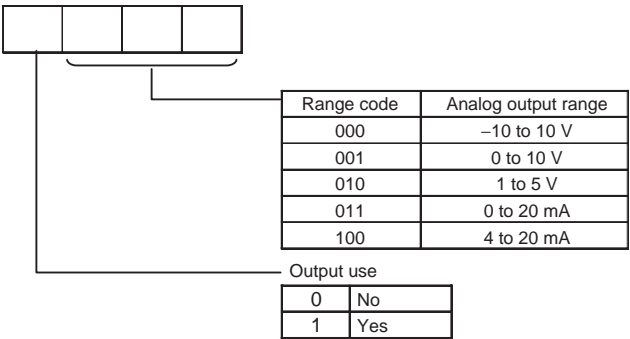


#### Writing Set Data

Write the output use and the range code to words n+1 and n+2. For CP1W-DA021, only word n+1 can be used. The D/A conversion will start when the set data is transferred from the CPU Unit to the Analog Output Unit.



■ Set Data



- The Analog Output Unit will not start converting analog output values until the set data has been written.
- Before the range code is written, 0 V or 0 mA will be output in the 0 to 10 V, -10 to +10 V, and 0 to 20 mA ranges, and 1 V or 4 mA will be output in the 1 to 5 V and 4 to 20 mA ranges.
- Once the range code has been set, it is not possible to be changed while power is being supplied to the CPU Unit. To change the range code, turn the CPU Unit OFF then ON again.

Writing Analog Output Conversion Values

The ladder program can be used to write conversion data to the output words. The output word starts from “n+1” where “n” is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit.

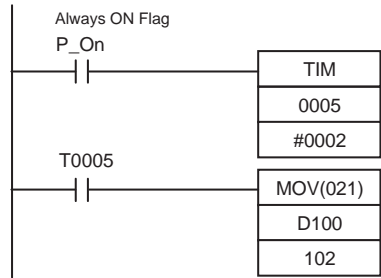
Startup Operation

After power is turned ON, it will require two cycle times plus approximately 50 ms before the first conversion data is output.

The following table shows the output status after the initial processing is completed.

| Output type                  | Voltage output             |          | Current output |            |
|------------------------------|----------------------------|----------|----------------|------------|
| Output range                 | 0 to 10 V,<br>-10 to +10 V | 1 to 5 V | 0 to 20 mA     | 4 to 20 mA |
| Before range code is written | 0 V                        |          | 0 mA           |            |
| After range code is written  | 0 V                        | 1 V      | 0 mA           | 4 mA       |

Therefore, create a program as shown below, so that when operation begins simultaneously with startup it will wait for valid set data.



TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON, and the data stored in D100 will be moved to 102 as the conversion data for analog output 1.

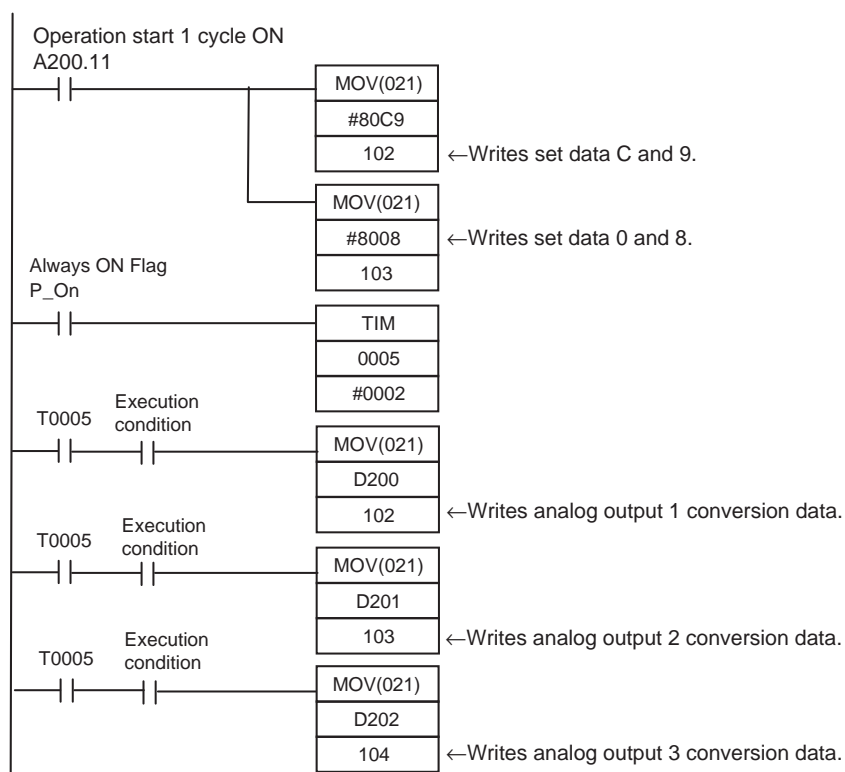
## Handling Unit Errors

- When an error occurs at the Analog Output Unit, the analog output will be 0 V or 0 mA. If a CPU Unit fatal error occurs when analog outputs are set in the 1 to 5 V or 4 to 20 mA range, 0 V or 0 mA will be output for a CPU error I/O bus error, and 1 V or 4 mA will be output for all other errors.
- CP-series Expansion Unit errors are output to bits 0 to 5 of word A436. The bits are allocated from A436.00 in order starting with the Unit nearest the CPU Unit. Use these flags in the program when it is necessary to detect errors.

## Program Example

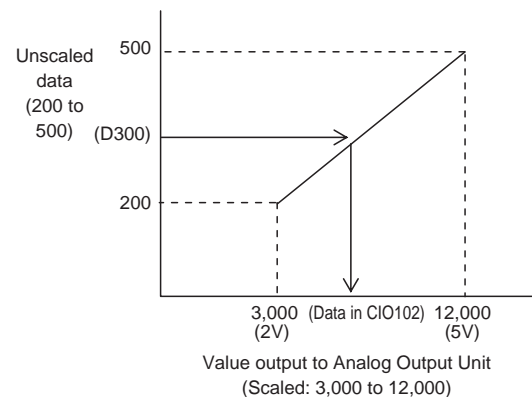
## ■ CP1W-DA041/CP1W-DA042

| Analog output | Output range | Range code | Set data     | Destination word |
|---------------|--------------|------------|--------------|------------------|
| Output 1      | 0 to 10 V    | 001        | 1001 (9 hex) | n+1              |
| Output 2      | 4 to 20 mA   | 100        | 1100 (C hex) | n+1              |
| Output 3      | −10 to 10 V  | 000        | 1000 (8 hex) | n+2              |
| Output 4      | Not used.    | −(000)     | 0000 (0 hex) | n+2              |



■ **Example: Scaling analog output values**

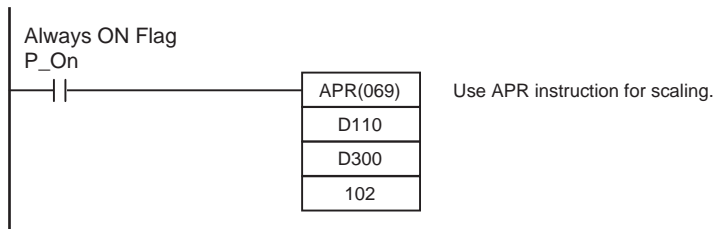
Convert a value between 200 and 500 in D300 into 2 to 5 V to output the voltage from the analog output word (CIO 102) of CP1W-DA042.



**Data memory settings**

| Setting                       | Address | Data    |
|-------------------------------|---------|---------|
| Control word                  | D110    | #0800   |
| Unscaled minimum value (200)  | D111    | &200    |
| Scaled minimum value (3,000)  | D112    | &3,000  |
| Unscaled maximum value (500)  | D113    | &500    |
| Scaled maximum value (12,000) | D114    | &12,000 |

**Ladder program**



Refer to 9-2 *Example: Scaling analog input values* for the descriptions of APR instruction.



## 9-4 Analog I/O Units

### 9-4-1 CP1W-MAD11 Analog I/O Units

Each CP1W-MAD11 Analog I/O Unit provides 2 analog inputs and 1 analog output.

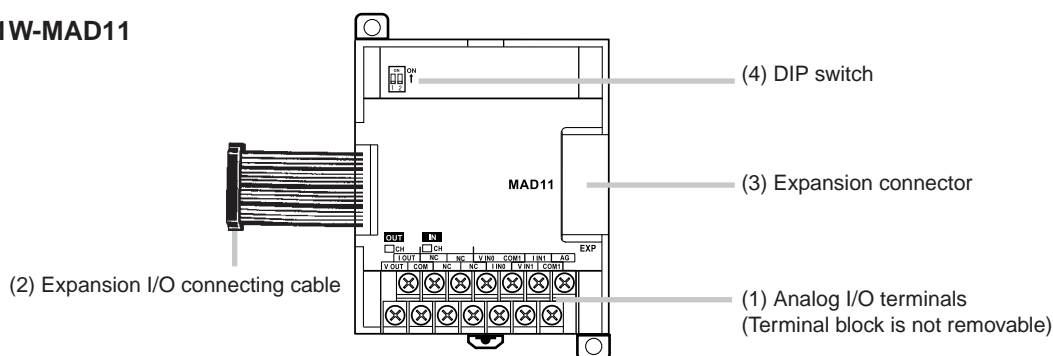
- The analog input range can be set to 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, –10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA. The inputs have a resolution of 1/6000.

An open-circuit detection function is activated in the ranges of 1 to 5 VDC and 4 to 20 mA.

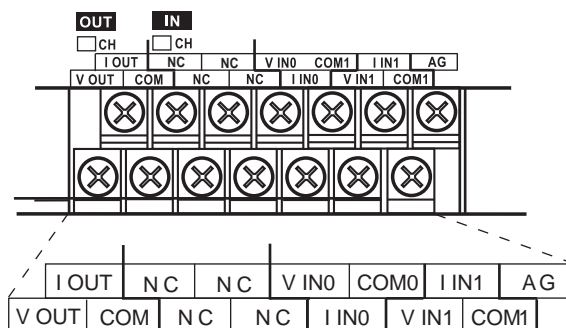
- The analog output range can be set to 1 to 5 VDC, 0 to 10 VDC, –10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA. The outputs have a resolution of 1/6000.

#### Part Names

CP1W-MAD11



- (1) Analog I/O Terminals  
Connected to analog I/O devices.



**Note** For current inputs, short V IN0 to I IN0 and V IN1 to I IN1.

|       |                 |
|-------|-----------------|
| V OUT | Voltage output  |
| I OUT | Current output  |
| COM   | Output common   |
| V IN0 | Voltage input 0 |
| I IN0 | Current input 0 |
| COM0  | Input common 0  |
| V IN1 | Voltage input 1 |
| I IN1 | Current input 1 |
| COM1  | Input common 1  |

- (2) Expansion I/O Connecting Cable  
Connected to the expansion connector of a CP1L-EL/EM CPU Unit or a CP-series Expansion Unit or Expansion I/O Unit. The cable is provided with the Analog I/O Unit and cannot be removed.

**⚠ Caution** Do not touch the cables during operation. Static electricity may cause operating errors.

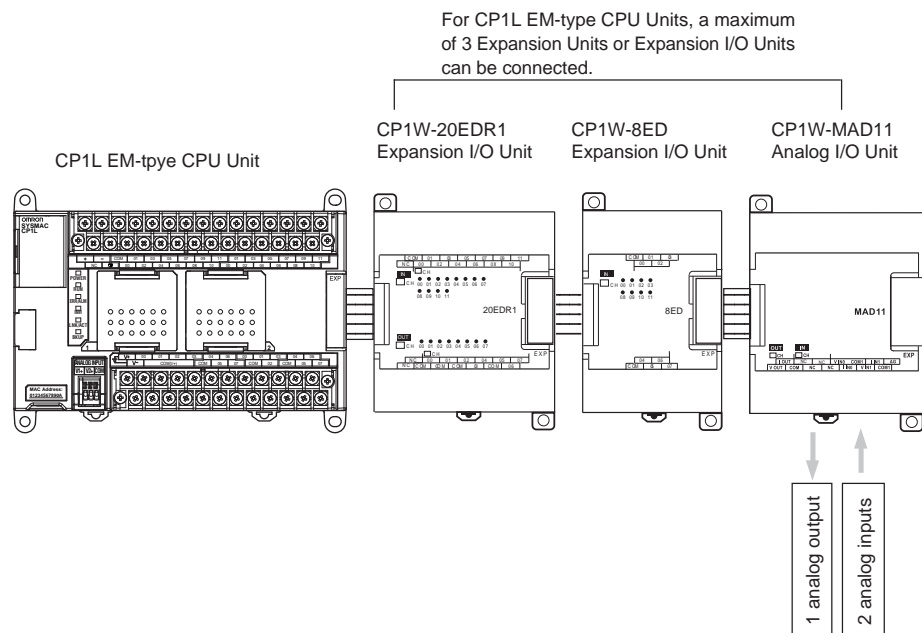
- (3) Expansion Connector  
Used for connecting CP-series Expansion Units or Expansion I/O Units.
- (4) DIP Switch  
Used to enable or disable averaging.



Pin1: Average processing for analog input 0  
(OFF: Average processing not performed; ON: Average processing performed)  
Pin2: Average processing for analog input 1  
(OFF: Average processing not performed; ON: Average processing performed)

### **Main Analog I/O Unit Specifications**

Analog I/O Units are connected to the CP1L-EL/EM CPU Unit. For CP1L EM-type CPU Units, up to three Units can be connected, including any other Expansion Units and Expansion I/O Units. For CP1L EL-type CPU Units, one unit can be connected.



| Item                  |   | Voltage I/O  | Current I/O  |
|-----------------------|---|--|--|
| Analog Input Section  | Number of inputs                          | 2 inputs (2 words allocated)   |  |
|                       | Input signal range                        | 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC  | 0 to 20 mA or 4 to 20 mA   |
|                       | Max. rated input                          | ±15 V  | ±30 mA   |
|                       | External input impedance                  | 1 MΩ min.  | Approx. 250 Ω  |
|                       | Resolution                                | 1/6000 (full scale)  |  |
|                       | Overall accuracy                          | 25°C   | 0.3% full scale  |
|                       |   | 0 to 55°C  | 0.4% full scale  |
|                       | A/D conversion data                       |  | 16-bit binary (4-digit hexadecimal)<br>Full scale for -10 to 10 V: F448 to 0BB8 hex<br>Full scale for other ranges: 0000 to 1770 hex |
|                       | Averaging function                        | Supported (Settable for individual inputs via DIP switch)  |  |
|                       | Open-circuit detection function           | Supported  |  |
| Analog Output Section | Number of outputs                         | 1 output (1 word allocated)  |  |
|                       | Output signal range                       | 1 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC,   | 0 to 20 mA or 4 to 20 mA   |
|                       | Allowable external output load resistance | 1 kΩ min.  | 600 Ω max.   |
|                       | External output impedance                 | 0.5 Ω max.   |  |
|                       | Resolution                                | 1/6000 (full scale)  |  |
|                       | Overall accuracy                          | 25°C   | 0.4% full scale  |
|                       |   | 0 to 55°C  | 0.8% full scale  |
|                       | Set data (D/A conversion)                 |  | 16-bit binary (4-digit hexadecimal)<br>Full scale for -10 to 10 V: F448 to 0BB8 hex<br>Full scale for other ranges: 0000 to 1770 hex |
| Conversion time       |   | 2 ms/point (6 ms/all points)   |  |
| Isolation method      |   | Photocoupler isolation between analog I/O terminals and internal circuits.<br>No isolation between analog I/O signals. |  |
| Current consumption   |   | 5 VDC: 83 mA max., 24 VDC: 110 mA max.   |  |

### Analog I/O Signal Ranges

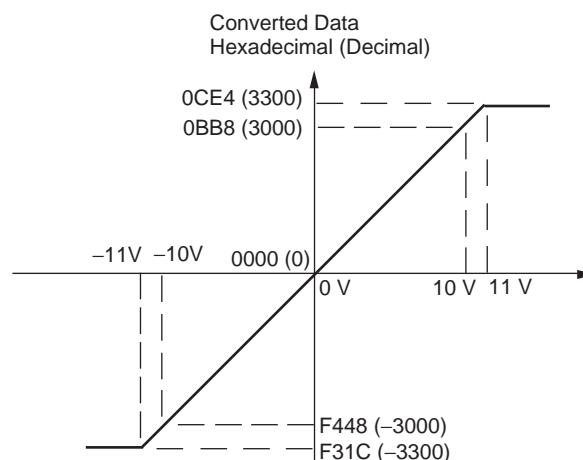
Analog I/O data is digitally converted according to the analog I/O signal range as shown below.

**Note** When the input exceeds the specified range, the AD converted data will be fixed at either the lower limit or upper limit.

### Analog Input Signal Ranges

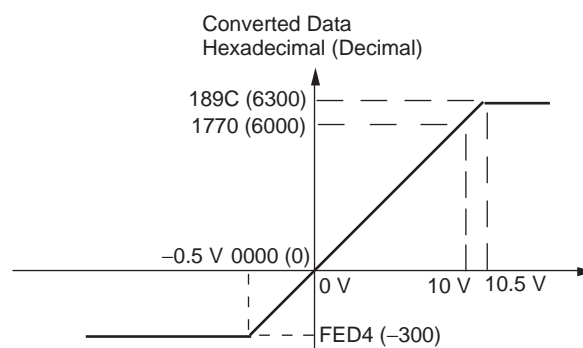
#### -10 to 10 V

The -10 to 10 V range corresponds to the hexadecimal values F448 to 0BB8 (-3000 to 3000). The entire data range is F31C to 0CE4 (-3300 to 3300). A negative voltage is expressed as a two's complement.



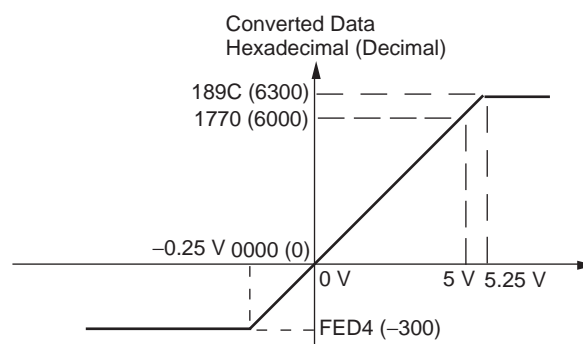
#### 0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (-300 to 6300). A negative voltage is expressed as a two's complement.



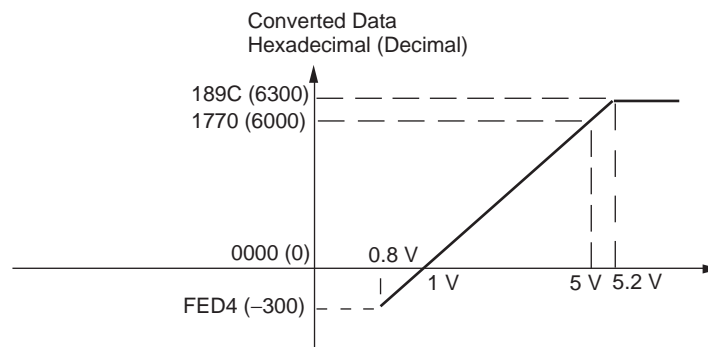
#### 0 to 5 V

The 0 to 5 V range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (-300 to 6300). A negative voltage is expressed as a two's complement.

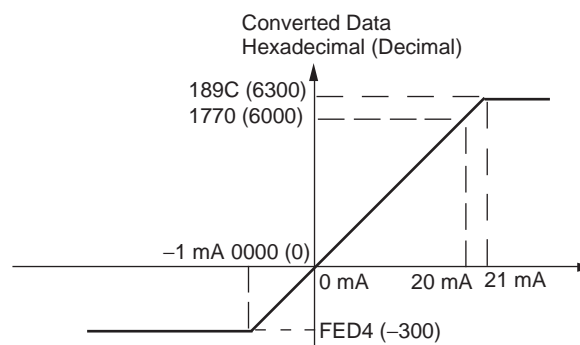


**1 to 5 V**

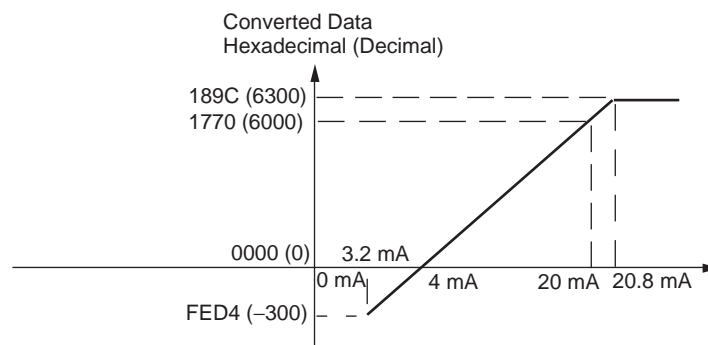
The 1 to 5 V range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (–300 to 6300). Inputs between 0.8 and 1 V are expressed as two's complements. If the input falls below 0.8 V, open-circuit detection will activate and converted data will be 8000.

**0 to 20 mA**

The 0 to 20 mA range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (–300 to 6300). A negative voltage is expressed as a two's complement.

**4 to 20 mA**

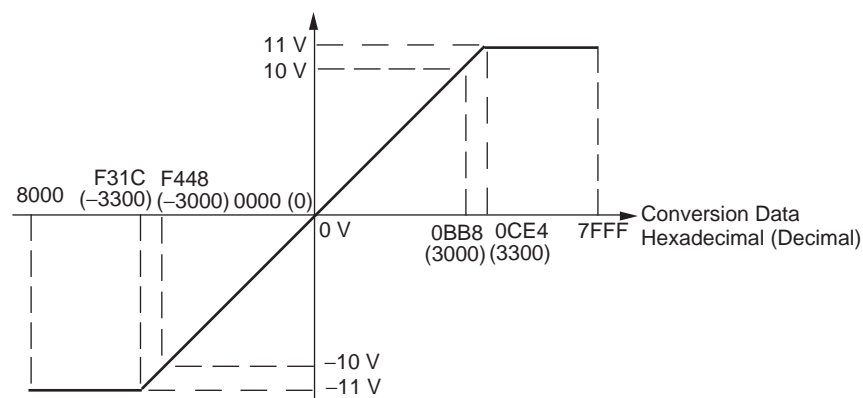
The 4 to 20 mA range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (–300 to 6300). Inputs between 3.2 and 4 mA are expressed as two's complements. If the input falls below 3.2 mA, open-circuit detection will activate and converted data will be 8000.



### Analog Output Signal Ranges

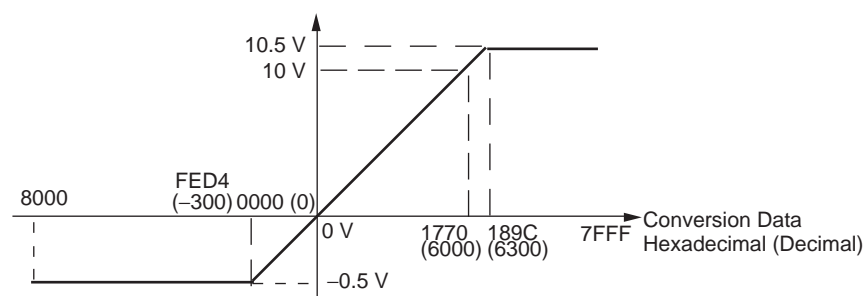
#### -10 to 10 V

The hexadecimal values F448 to 0BB8 (-3000 to 3000) correspond to an analog voltage range of -10 to 10 V. The entire output range is -11 to 11 V. Specify a negative voltage as a two's complement.



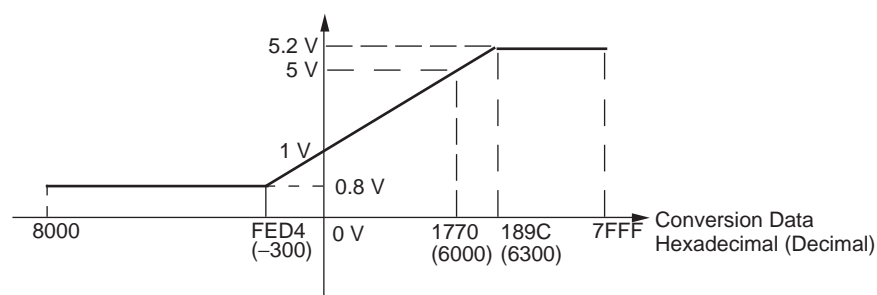
#### 0 to 10 V

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 0 to 10 V. The entire output range is -0.5 to 10.5 V. Specify a negative voltage as a two's complement.



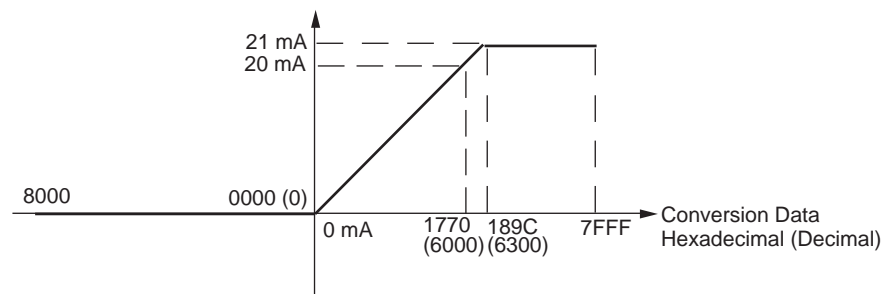
#### 1 to 5 V

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 1 to 5 V. The entire output range is 0.8 to 5.2 V.

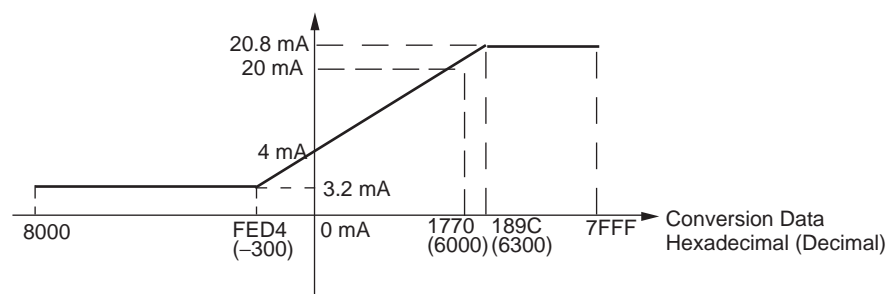


**0 to 20 mA**

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 0 to 20 mA. The entire output range is 0 to 21 mA.

**4 to 20 mA**

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 4 to 20 mA. The entire output range is 3.2 to 20.8 mA.

**Averaging Function for Analog Inputs**

The averaging function can be enabled for inputs using the DIP switch. The averaging function stores the average (a moving average) of the last eight input values as the converted value. Use this function to smooth inputs that vary at a short interval.

**Open-circuit Detection Function for Analog Inputs**

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA. When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

## Using Analog I/O

Connect and wire the Unit.

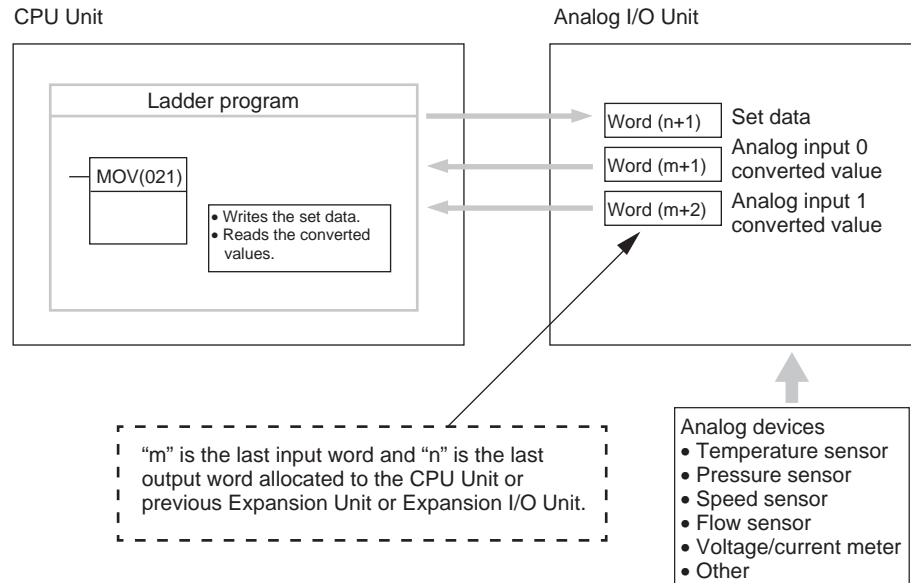
- Connect the Analog I/O Unit.
- Wire to analog I/O devices.



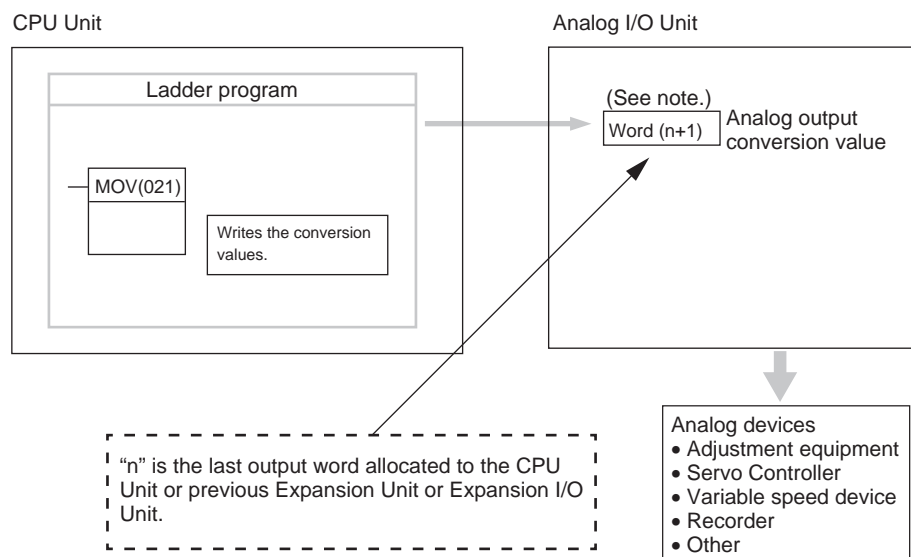
Create a ladder program.

- Analog inputs: 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, -10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA
- Analog outputs: 1 to 5 VDC, 0 to 10 VDC, -10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA
- Set analog inputs as voltage or current inputs and set the averaging function.
- Write set data to output words.

## Writing Set Data and Reading A/D Converted Values



## Writing D/A Conversion Data

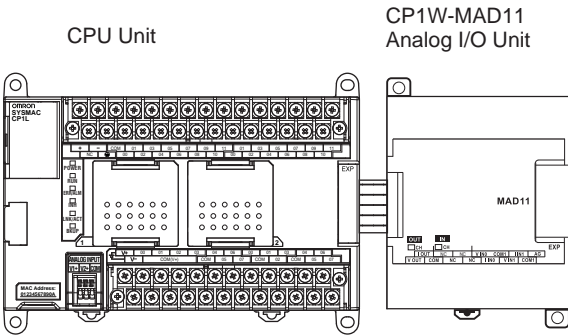


**Note** Word (n+1) can be used for either the set data or the analog output conversion value.



Connecting the Analog I/O Unit and Setting the DIP Switch

This section describes how to connect an Analog I/O Unit to the CPU Unit.



Setting the Averaging Function

DIP switch pins 1-1 and 1-2 are used to set the averaging function. When averaging is enabled, a moving average of the last eight input values is output as the converted value. The averaging function can be set separately for analog inputs 1 and 2.

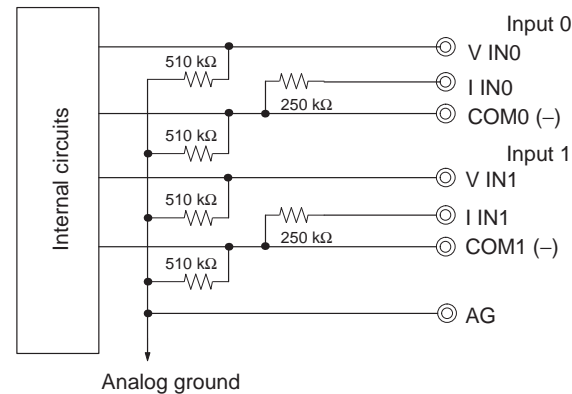


| DIP switch pin | Function  | Setting                                      | Default |
|----------------|-----------|--|---------|
| 1-1            | Averaging | Analog input 0<br>OFF: Disabled; ON: Enabled | OFF     |
| 1-2            |           | Analog input 1<br>OFF: Disabled; ON: Enabled | OFF     |

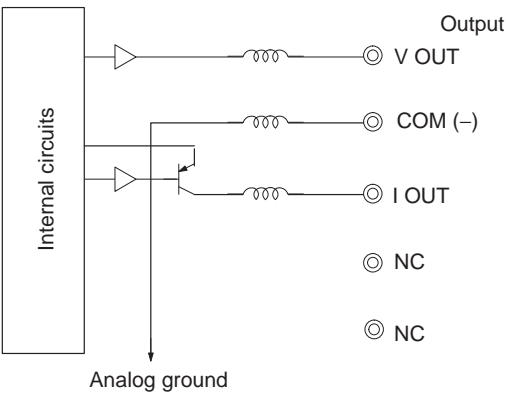
Wiring Analog I/O Devices

Internal Circuits

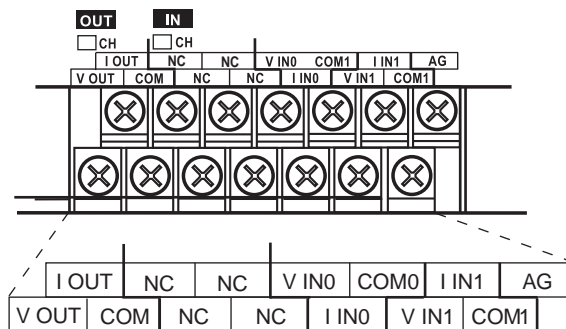
Analog Inputs



Analog Outputs



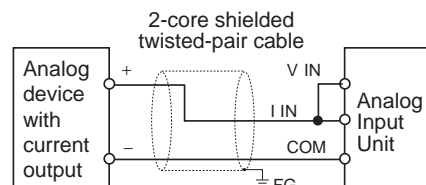
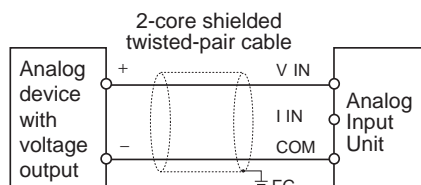
## Terminal Arrangements



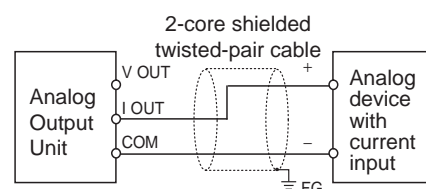
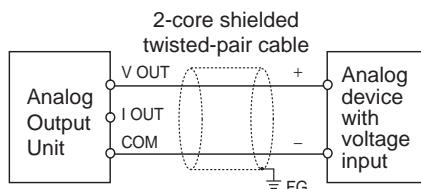
**Note** For current inputs, short V IN0 to I IN0 and V IN1 to I IN1.

|       |                 |
|-------|-----------------|
| V OUT | Voltage output  |
| I OUT | Current output  |
| COM   | Output common   |
| V IN0 | Voltage input 0 |
| I IN0 | Current input 0 |
| COM0  | Input common 0  |
| V IN1 | Voltage input 1 |
| I IN1 | Current input 1 |
| COM1  | Input common 1  |

## Wiring for Analog Inputs

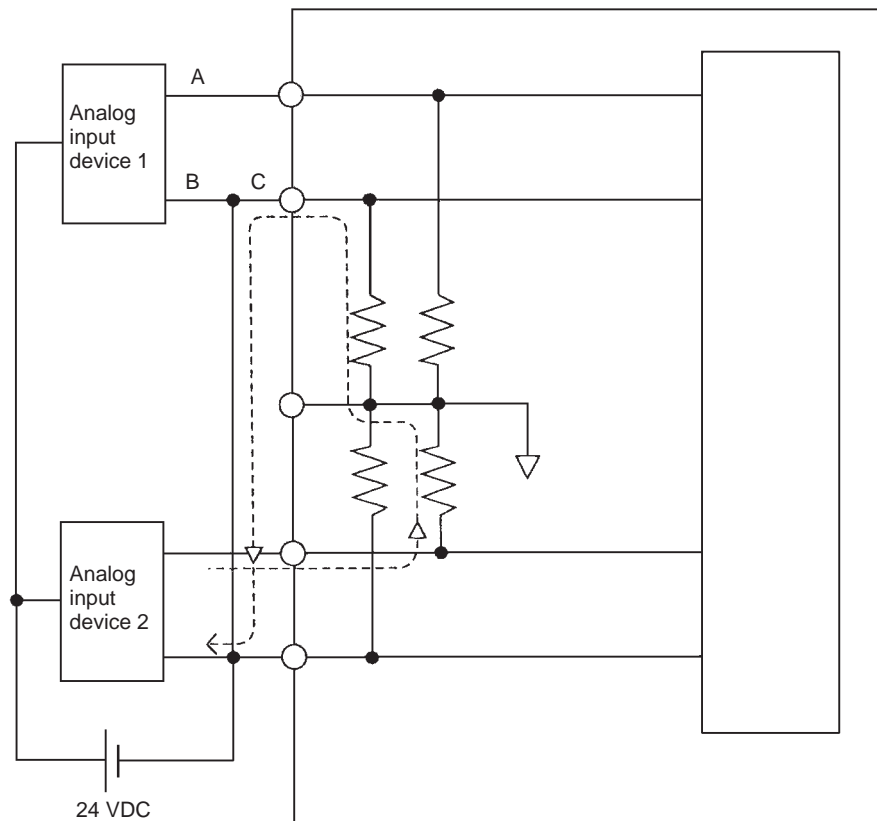


## Wiring for Analog Outputs



- Note**
- (1) Connect the shield to the FG terminal to prevent noise.
  - (2) When an input is not being used, short the + and – terminals.
  - (3) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
  - (4) When there is noise in the power supply line, install a noise filter on the input section and the power supply terminals.

- (5) Refer to the following diagram regarding wiring disconnections when voltage input is being used.



Example: If analog input device 2 is outputting 5 V and the same power supply is being used for both devices as shown above, approximately 1/3, or 1.6 V, will be applied to the input for input device 1.

If a wiring disconnection occurs when voltage input is being used, the situation described below will result. Either separate the power supplies for the connected devices, or use an isolator for each input.

If the same power supply is being used by the connected devices and a disconnection occurs at points A or B in the above diagram, an unwanted circuit path will occur as shown along the dotted line in the diagram. If that occurs, a voltage of approximately 1/3 to 1/2 of the output voltage of the other connected device will be generated. If that voltage is generated while the setting is for 1 to 5 V, open-circuit detection may not be possible. Also, if a disconnection occurs at point C in the diagram, the negative (-) side will be used in for both devices and open-circuit detection will not be possible.

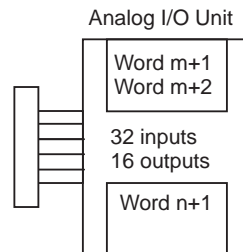
This problem will not occur for current inputs even if the same power supply is used.

- (6) When external power is supplied (when setting the range code), or when there is a power interruption, pulse-form analog output of up to 1 ms may be generated. If this causes problems with operation, take countermeasures such as those suggested below.
- Turn ON the power supply for the CP1L-EL/EM CPU Unit first, and then turn ON the power supply for the load after confirming correct operation.
  - Turn OFF the power supply for the load before turning OFF the power supply for the CP1L-EL/EM CPU Unit.

### Creating a Ladder Program

#### I/O Allocation

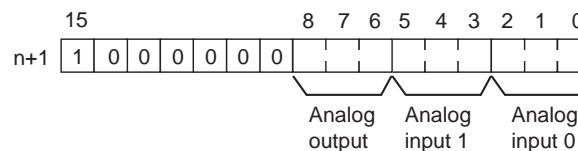
Two input words and one output word are allocated to the Analog I/O Unit starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.



#### Writing Set Data

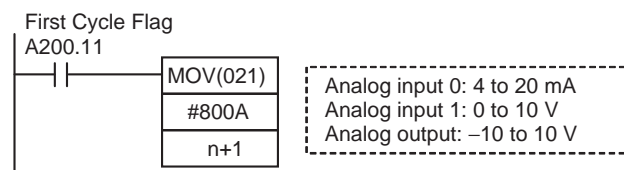
Write the set data to word (n+1). A/D or D/A conversion begins when the set data is transferred from the CPU Unit to the Analog I/O Unit. There are five range codes, 000 to 100, that combine the analog input 1 and 2 and analog output signal ranges, as shown below.

| Range code | Analog input 0 range | Analog input 1 range | Analog output range |
|------------|----------------------|----------------------|---------------------|
| 000        | -10 to 10 V          | -10 to 10 V          | -10 to 10 V         |
| 001        | 0 to 10 V            | 0 to 10 V            | 0 to 10 V           |
| 010        | 1 to 5 V/4 to 20 mA  | 1 to 5 V/4 to 20 mA  | 1 to 5 V            |
| 011        | 0 to 5 V/0 to 20 mA  | 0 to 5 V/0 to 20 mA  | 0 to 20 mA          |
| 100        | ---                  | ---                  | 4 to 20 mA          |



#### Example

The following instructions set analog input 0 to 4 to 20 mA, analog input 1 to 0 to 10 V, and the analog output to -10 to 10 V.



- The Analog I/O Unit will not start converting analog I/O values until the range code has been written. Until conversion starts, inputs will be 0000, and 0 V or 0 mA will be output.
- After the range code has been set, 0 V or 0 mA will be output for the 0 to 10 V, -10 to 10 V, or 0 to 20 mA ranges, and 1 V or 4 mA will be output for the 1 to 5 V and 4 to 20 mA ranges until a convertible value has been written to the output word.
- Once the range code has been set, it is not possible to change the setting while power is being supplied to the CPU Unit. To change the I/O range, turn the CPU Unit OFF then ON again.

**Reading Analog Input Converted Values**

The ladder program can be used to read the memory area words where the converted values are stored. Values are output to the next two words ( $m + 1$ ,  $m + 2$ ) following the last input word ( $m$ ) allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.

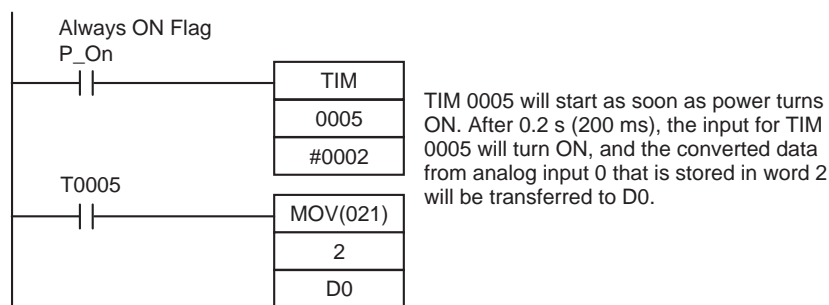
**Writing Analog Output Converted Values**

The ladder program can be used to write data to the memory area where the set value is stored. The output word will be “ $n+1$ ,” where “ $n$ ” is the last output word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.

**Startup Operation**

After power is turned ON, it will require two cycle times plus approx. 50 ms before the first data is converted. The following instructions can be placed at the beginning of the program to delay reading converted data from analog inputs until conversion is actually possible.

Analog input data will be 0000 until initial processing has been completed. Analog output data will be 0 V or 0 mA until the range code has been written. After the range code has been written, the analog output data will be 0 V or 0 mA if the range is 0 to 10 V, –10 to 10 V, or 0 to 20 mA, or it will be 1 V or 4 mA if the range is 1 to 5 V or 4 to 20 mA.

**Handling Unit Errors**

- When an error occurs in the Analog I/O Unit, analog input data will be 0000 and 0 V or 0 mA will be output as the analog output. If a CPU error or an I/O bus error (fatal errors) occurs at the CPU Unit and the analog output is set to 1 to 5 V or 4 to 20 mA, 0 V or 0 mA will be output. For any other fatal errors at the CPU Unit, 1 V or 4 mA will be output.
- CP-series Expansion Unit or Expansion I/O Unit errors are output to bits 0 to 5 of word A436. The bits are allocated from A436.00 in order starting with the Unit nearest the CPU Unit. Use these flags in the program when it is necessary to detect errors.

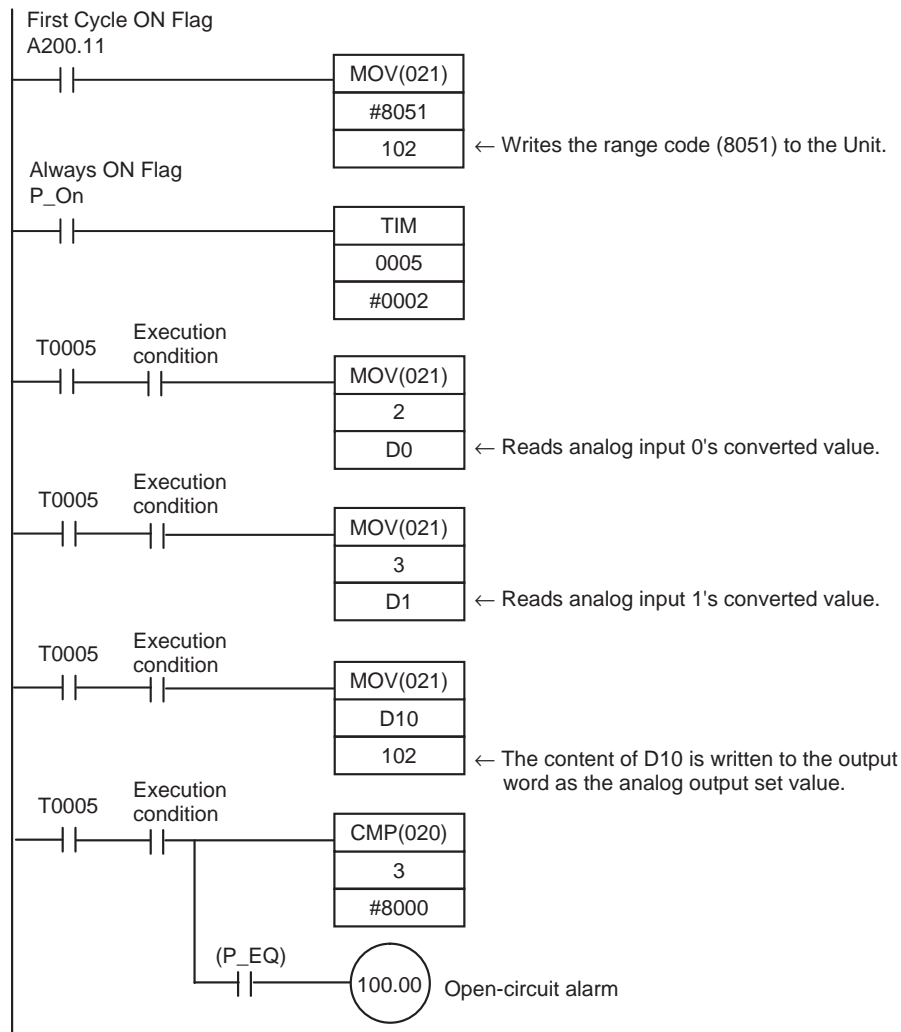
**Program Example**

This programming example uses these ranges:

Analog input 0: 0 to 10 V

Analog input 1: 4 to 20 mA

Analog output: 0 to 10 V



### 9-4-2 CP1W-MAD42/CP1W-MAD44 Analog I/O Units

Each CP1W-MAD42 Analog I/O Unit provides 4 analog inputs and 2 analog outputs.

Each CP1W-MAD44 Analog I/O Unit provides 4 analog inputs and 4 analog outputs.

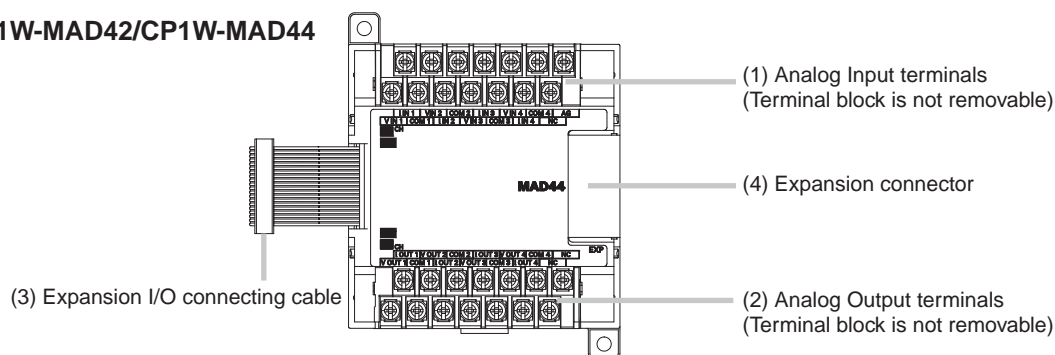
- The analog input range can be set to 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, -10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA. The inputs have a resolution of 1/12000.

An open-circuit detection function is activated in the ranges of 1 to 5 VDC and 4 to 20 mA.

- The analog output range can be set to 1 to 5 VDC, 0 to 10 VDC, -10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA. The outputs have a resolution of 1/12000.

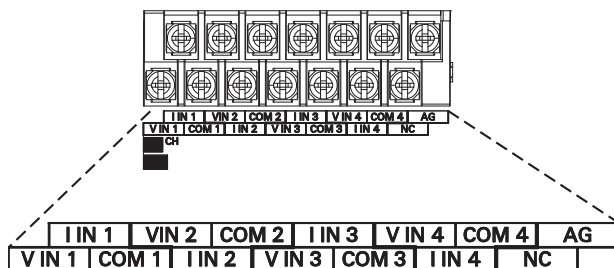
## Part Names

## CP1W-MAD42/CP1W-MAD44



- (1) Analog Input Terminals  
Connected to analog output devices.

## Input Terminal Arrangement for CP1W-MAD42/MAD44

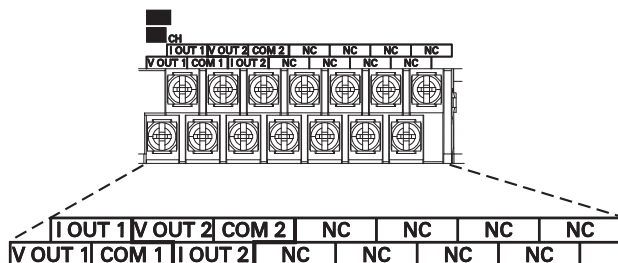


|       |                 |
|-------|-----------------|
| V IN1 | Voltage input 1 |
| I IN1 | Current input 1 |
| COM1  | Input common 1  |
| V IN2 | Voltage input 2 |
| I IN2 | Current input 2 |
| COM2  | Input common 2  |
| V IN3 | Voltage input 3 |
| I IN3 | Current input 3 |
| COM3  | Input common 3  |
| V IN4 | Voltage input 4 |
| I IN4 | Current input 4 |
| COM4  | Input common 4  |

**Note** When using current inputs, voltage input terminals must be short-circuited with current input terminals.

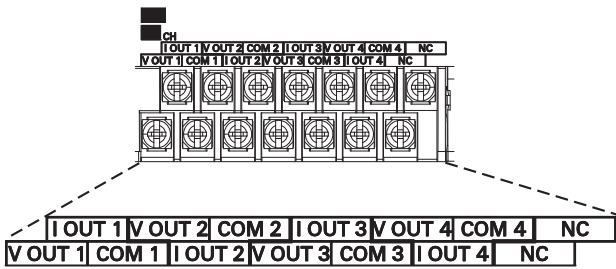
- (2) Analog Output Terminals  
Connected to analog input devices.

## Output Terminal Arrangement for CP1W-MAD42



|        |                  |
|--------|------------------|
| V OUT1 | Voltage output 1 |
| I OUT1 | Current output 1 |
| COM1   | Output common 1  |
| V OUT2 | Voltage output 2 |
| I OUT2 | Current output 2 |
| COM2   | Output common 2  |

Output Terminal Arrangement for CP1W-MAD44



|        |                  |
|--------|------------------|
| V OUT1 | Voltage output 1 |
| I OUT1 | Current output 1 |
| COM1   | Output common 1  |
| V OUT2 | Voltage output 2 |
| I OUT2 | Current output 2 |
| COM2   | Output common 2  |
| V OUT3 | Voltage output 3 |
| I OUT3 | Current output 3 |
| COM3   | Output common 3  |
| V OUT4 | Voltage output 4 |
| I OUT4 | Current output 4 |
| COM4   | Output common 4  |

- (3) Expansion I/O Connecting Cable  
Connected to the expansion connector of a CP1L-EL/EM CPU Unit or a CP-series Expansion Unit or Expansion I/O Unit. The cable is provided with the Analog I/O Unit and cannot be removed.

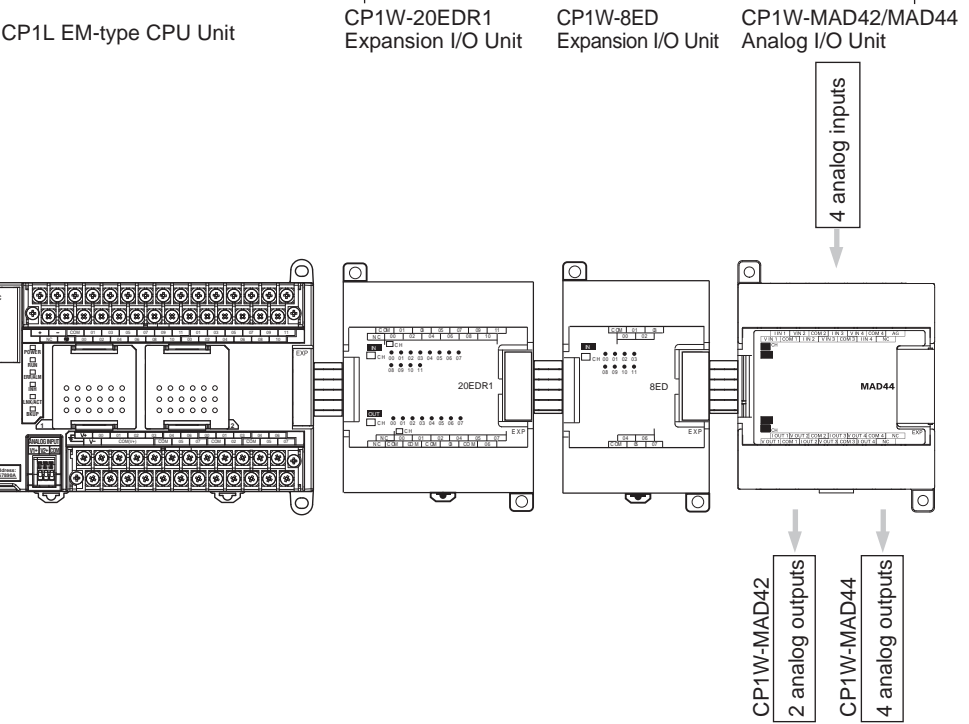
**Caution** Do not touch the cables during operation. Static electricity may cause operating errors.

- (4) Expansion Connector  
Used for connecting CP-series Expansion Units or Expansion I/O Units.

Main Analog I/O Unit Specifications

Analog I/O Units are connected to the CP1L-EL/EM CPU Unit. For CP1L EM-type CPU Units, up to three Units can be connected, including any other Expansion Units and Expansion I/O Units. For CP1L EL-type CPU Units, one Unit can be connected.

For CP1L EM-type CPU Units, a maximum of 3 Expansion Units or Expansion I/O Units can be connected.





| Item                            |   |           | Voltage I/O  | Current I/O              |
|---------------------------------|---|-----------|--|--------------------------|
| Analog Input Section            | Number of inputs                          |           | 4 inputs (4 words allocated)   |                          |
|                                 | Input signal range                        |           | 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, or –10 to 10 VDC  | 0 to 20 mA or 4 to 20 mA |
|                                 | Max. rated input                          |           | ±15 V  | ±30 mA                   |
|                                 | External input impedance                  |           | 1 MΩ min.  | Approx. 250 Ω            |
|                                 | Resolution                                |           | 1/12000 (full scale)   |                          |
|                                 | Overall accuracy                          | 25°C      | 0.2% full scale  | 0.3% full scale          |
|                                 |   | 0 to 55°C | 0.5% full scale  | 0.7% full scale          |
|                                 | A/D conversion data                       |           | 16-bit binary (4-digit hexadecimal)<br>Full scale for –10 to 10 V: E890 to 1770 hex<br>Full scale for other ranges: 0000 to 2EE0 hex |                          |
|                                 | Averaging function                        |           | Supported  |                          |
| Open-circuit detection function |   | Supported |  |                          |
| Analog Output Section           | Number of outputs                         |           | CP1W-MAD42: 2 outputs (2 words allocated)<br>CP1W-MAD44: 4 outputs (4 words allocated)   |                          |
|                                 | Output signal range                       |           | 1 to 5 VDC, 0 to 10 VDC, or –10 to 10 VDC,   | 0 to 20 mA or 4 to 20 mA |
|                                 | Allowable external output load resistance |           | 2 kΩ min.  | 350 Ω max.               |
|                                 | External output impedance                 |           | 0.5 Ω max.   |                          |
|                                 | Resolution                                |           | 1/12000 (full scale)   |                          |
|                                 | Overall accuracy                          | 25°C      | 0.3% full scale  |                          |
|                                 |   | 0 to 55°C | 0.7% full scale  |                          |
|                                 | Set data (D/A conversion)                 |           | 16-bit binary (4-digit hexadecimal)<br>Full scale for –10 to 10 V: E890 to 1770 hex<br>Full scale for other ranges: 0000 to 2EE0 hex |                          |
| Conversion time                 |   |           | CP1W-MAD42: 1 ms/point (6 ms/all points)<br>CP1W-MAD44: 1 ms/point (8 ms/all points)   |                          |
| Isolation method                |   |           | Photocoupler isolation between analog I/O terminals and internal circuits.<br>No isolation between analog I/O signals.               |                          |
| Current consumption             |   |           | CP1W-MAD42: 5 VDC: 120 mA max., 24 VDC: 120 mA max.<br>CP1W-MAD44: 5 VDC: 120 mA max., 24 VDC: 170 mA max.                           |                          |

### Analog I/O Signal Ranges

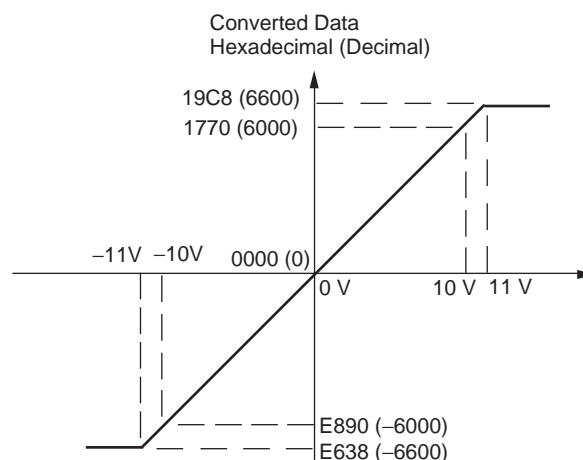
Analog I/O data is digitally converted according to the analog I/O signal range as shown below.

**Note** When the input exceeds the specified range, the AD converted data will be fixed at either the lower limit or upper limit.

### Analog Input Signal Ranges

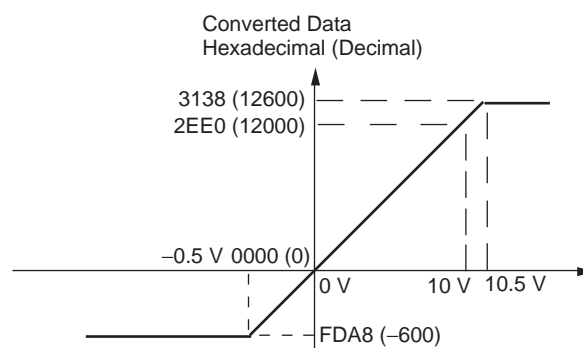
#### -10 to 10 V

The -10 to 10 V range corresponds to the hexadecimal values E890 to 1770 (-6000 to 6000). The entire data range is E638 to 19C8 (-6600 to 6600). A negative voltage is expressed as a two's complement.



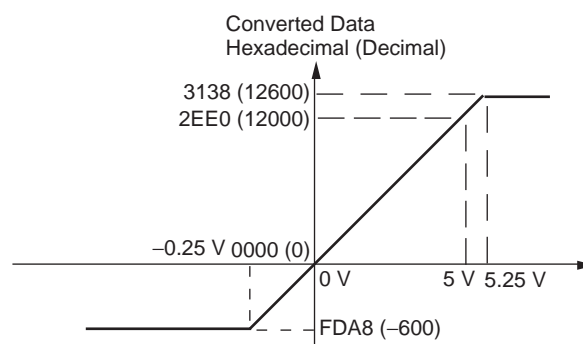
#### 0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (-600 to 12600). A negative voltage is expressed as a two's complement.



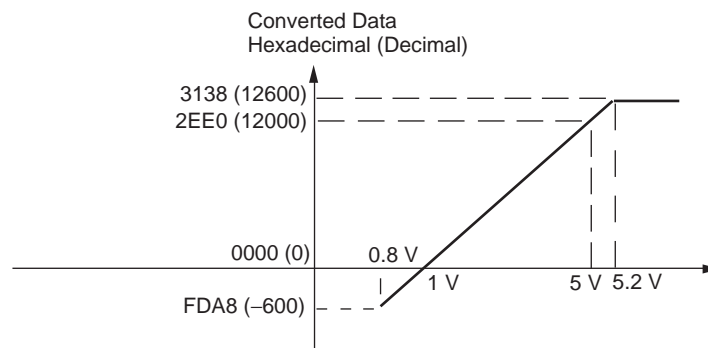
#### 0 to 5 V

The 0 to 5 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (-600 to 12600). A negative voltage is expressed as a two's complement.

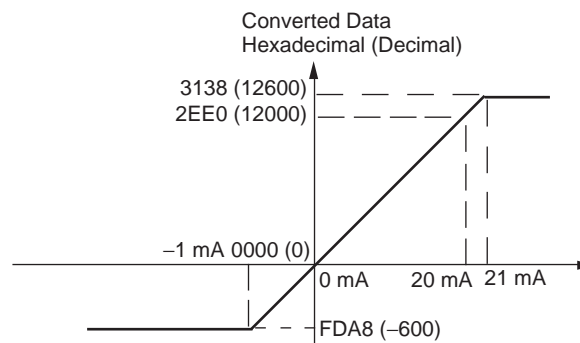


**1 to 5 V**

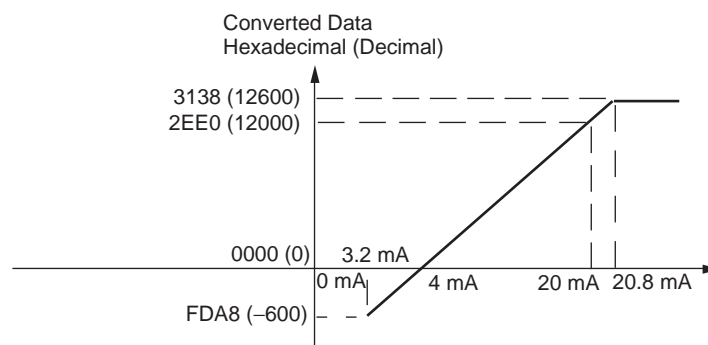
The 1 to 5 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (–600 to 12600). Inputs between 0.8 and 1 V are expressed as two's complements. If the input falls below 0.8 V, open-circuit detection will activate and converted data will be 8000.

**0 to 20 mA**

The 0 to 20 mA range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (–600 to 12600). A negative current is expressed as a two's complement.

**4 to 20 mA**

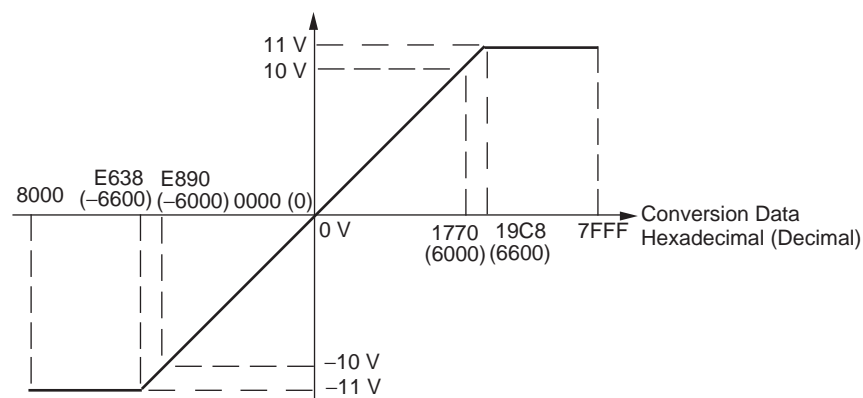
The 4 to 20 mA range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (–600 to 12600). Inputs between 3.2 and 4 mA are expressed as two's complements. If the input falls below 3.2 mA, open-circuit detection will activate and converted data will be 8000.



### Analog Output Signal Ranges

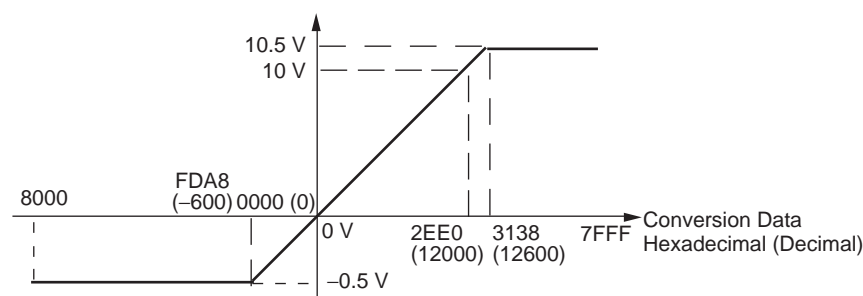
#### -10 to 10 V

The hexadecimal values E890 to 1770 (-6000 to 6000) correspond to an analog voltage range of -10 to 10 V. The entire output range is -11 to 11 V. Specify a negative voltage as a two's complement.



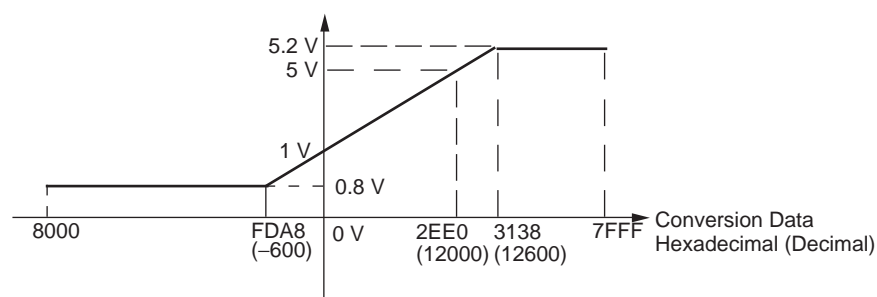
#### 0 to 10 V

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 0 to 10 V. The entire output range is -0.5 to 10.5 V. Specify a negative voltage as a two's complement.



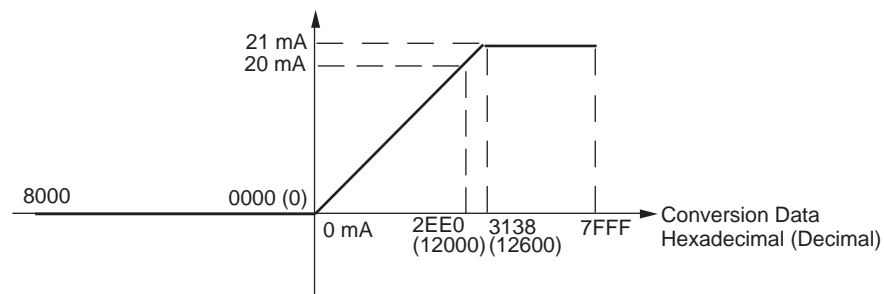
#### 1 to 5 V

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog voltage range of 1 to 5 V. The entire output range is 0.8 to 5.2 V.

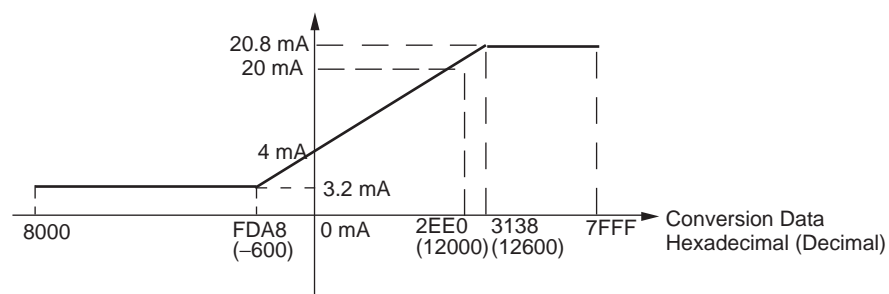


**0 to 20 mA**

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog current range of 0 to 20 mA. The entire output range is 0 to 21 mA.

**4 to 20 mA**

The hexadecimal values 0000 to 2EE0 (0 to 12000) correspond to an analog current range of 4 to 20 mA. The entire output range is 3.2 to 20.8 mA.

**Averaging Function for Analog Inputs**

For analog inputs, the averaging function operates when the averaging bit is set to 1. The averaging function outputs the average (a moving average) of the last eight input values as the converted value. If there is only a slight variation in inputs, it is handled by the averaging function as a smooth input.

The averaging function stores the average (a moving average) of the last eight input values as the converted value. Use this function to smooth inputs that vary at a short interval.

**Open-circuit Detection Function for Analog Inputs**

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA. When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

## Using Analog I/O

Connect and wire the Unit.

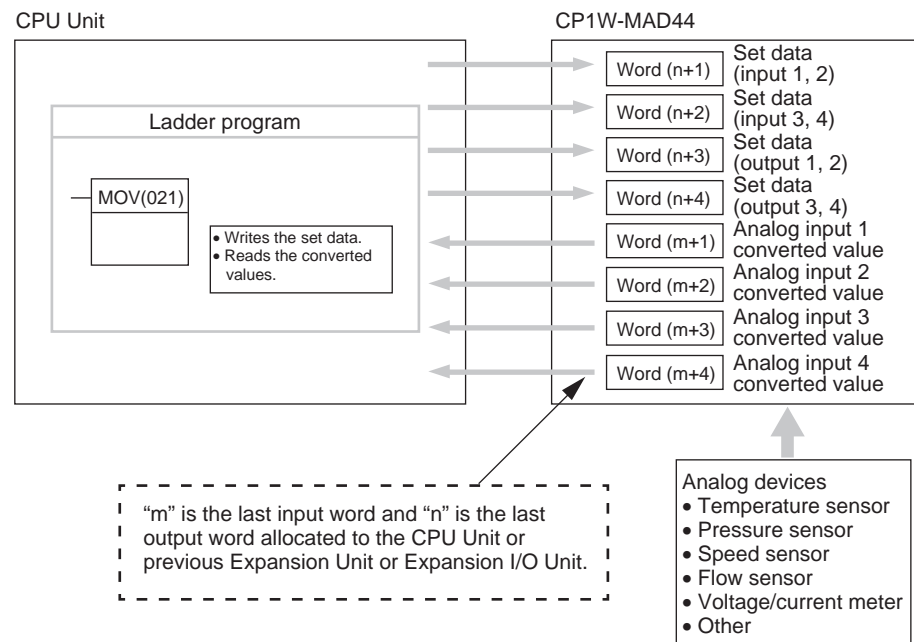
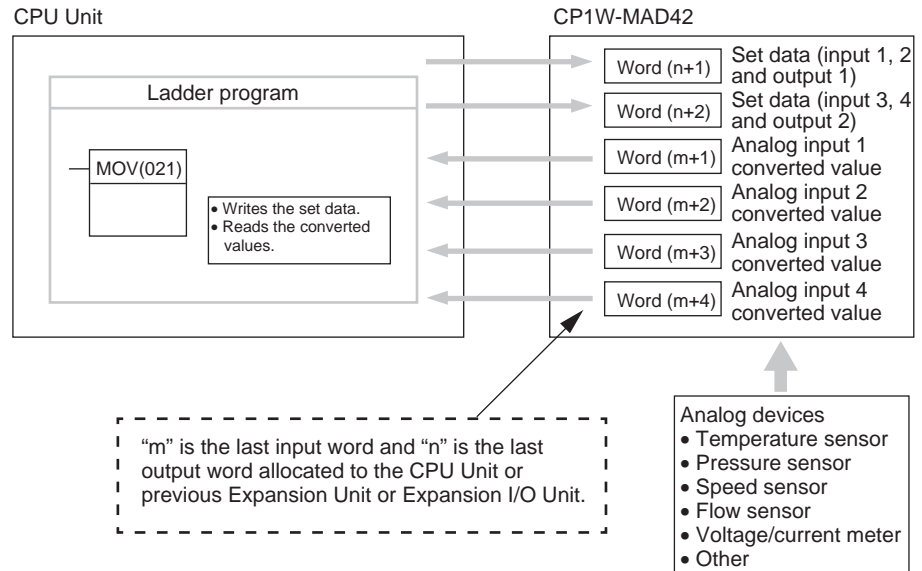
- Connect the Analog I/O Unit.
- Wire to analog I/O devices.



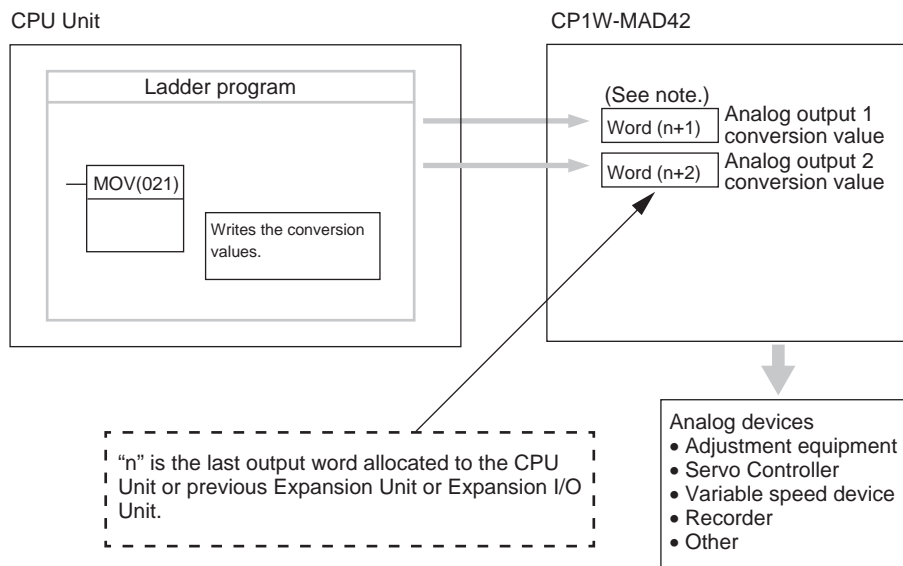
Create a ladder program.

- Analog inputs: 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC, -10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA
- Analog outputs: 1 to 5 VDC, 0 to 10 VDC, -10 to 10 VDC, 0 to 20 mA, or 4 to 20 mA
- Set analog inputs as voltage or current inputs and set the averaging function.
- Write set data to output words.

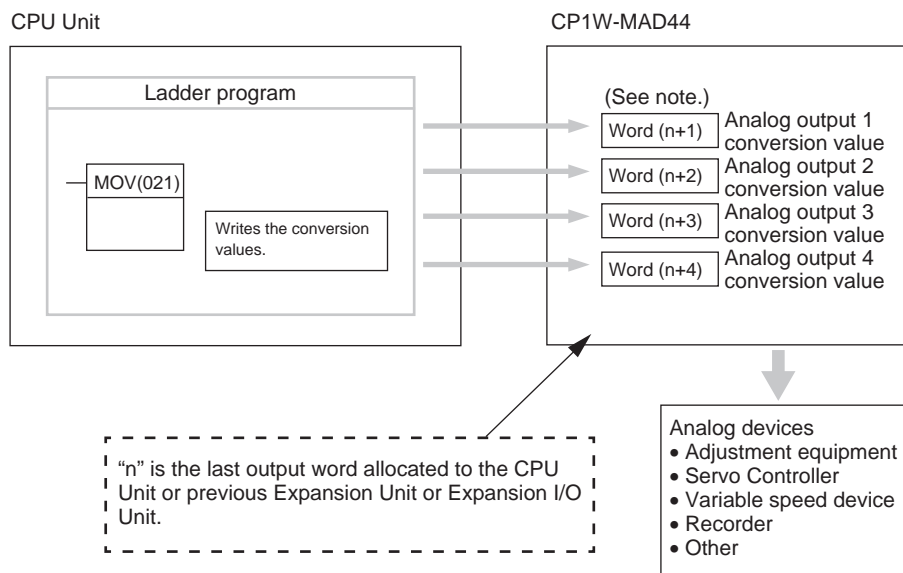
## Writing Set Data and Reading A/D Converted Values



### Writing D/A Conversion Data



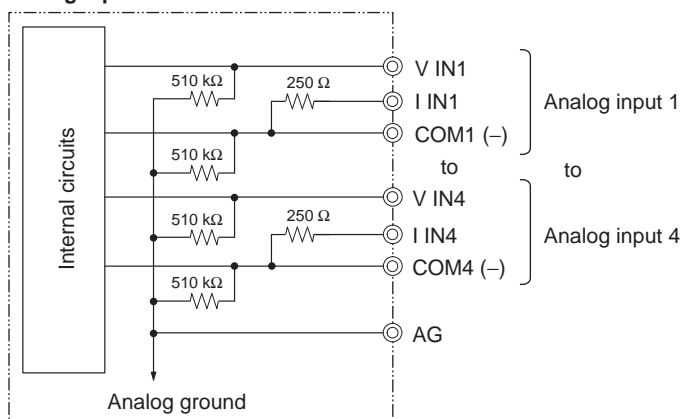
**Note** Words (n+1, n+2) can be used for either the set data or the analog output conversion value.



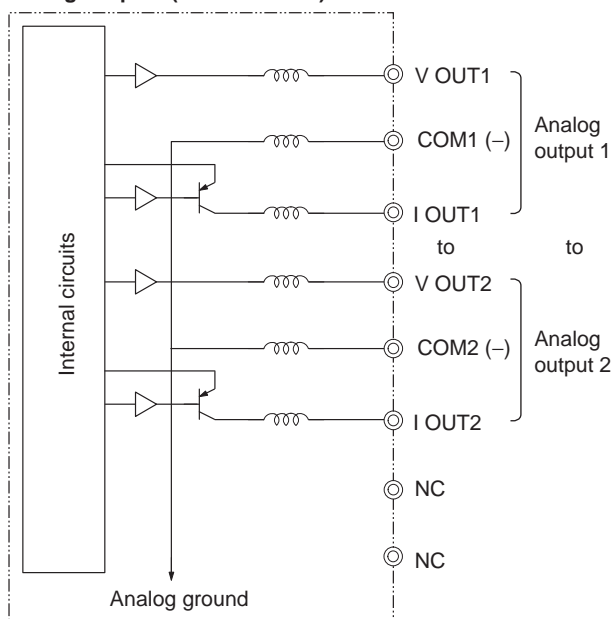
**Note** Words (n+1 to n+4) can be used for either the set data or the analog output conversion value.

## Wiring Analog I/O Devices Internal Circuits

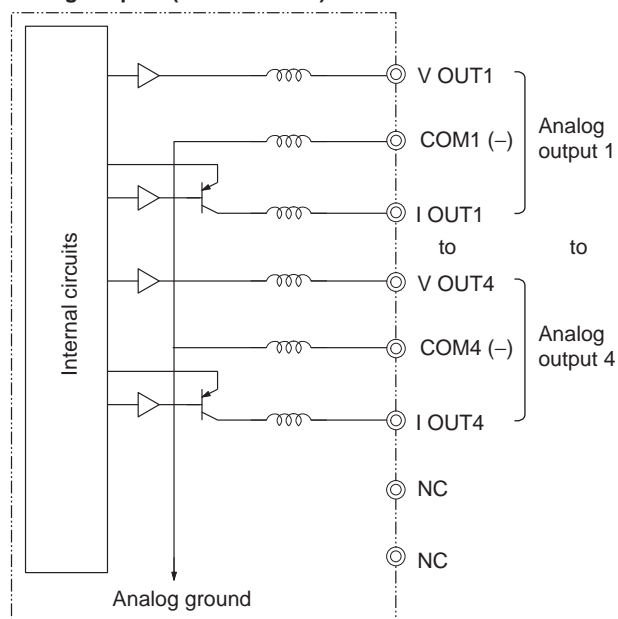
### Analog Inputs



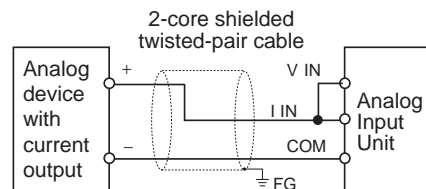
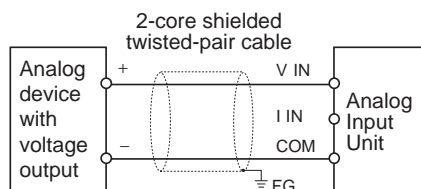
### Analog Outputs (CP1W-MAD42)



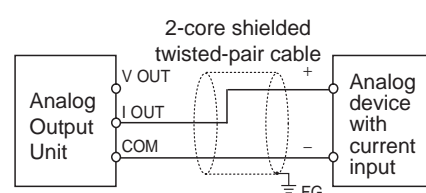
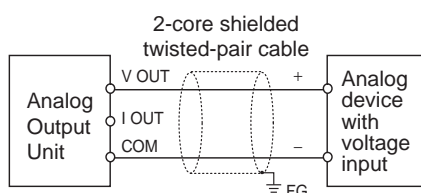
### Analog Outputs (CP1W-MAD44)



## Wiring for Analog Inputs



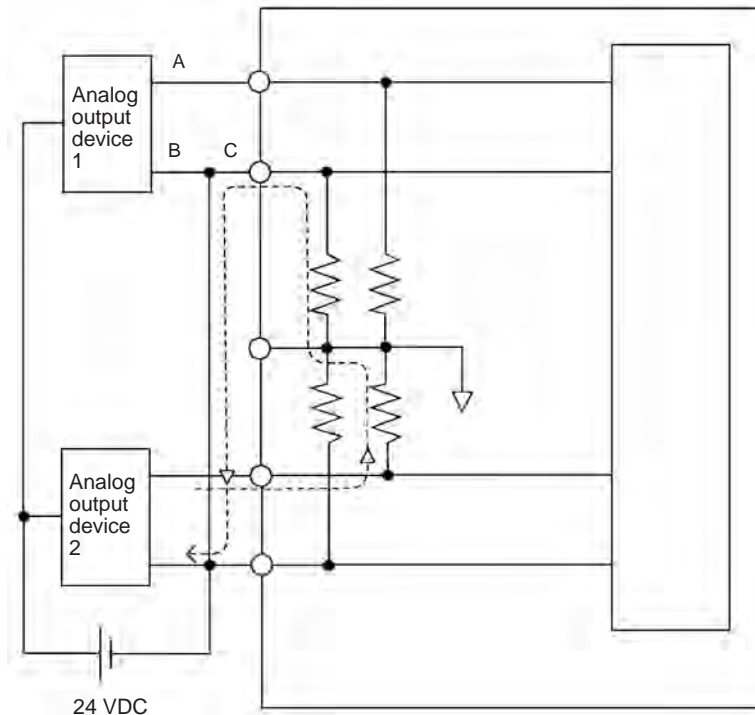
## Wiring for Analog Outputs





**Note**

- (1) Connect the shield to the FG terminal to prevent noise.
- (2) When an input is not being used, short the + and – terminals.
- (3) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- (4) When there is noise in the power supply line, install a noise filter on the input section and the power supply terminals.
- (5) Refer to the following diagram regarding wiring disconnections when voltage input is being used.



For example, if analog input device 2 is outputting 5 V and the same power supply is being used as shown above, about 1/3, or 1.6 V, will be applied at the input for input device 1.

Consider the following information on open input circuits when using voltage inputs. Either use separate power supplies, or install an isolator at each input.

If the same power supply is used as shown in the following diagram and an open circuit occurs at point A or B, an unwanted current flow will occur as shown by the dotted lines in the diagram, creating a voltage at the other input of about 1/3 to 1/2. If the 1 to 5 V range is being used, the open-circuit detection function will not operate. Also, if there is an open circuit at C, the open-circuit detection function will not operate because the negative sides are the same.

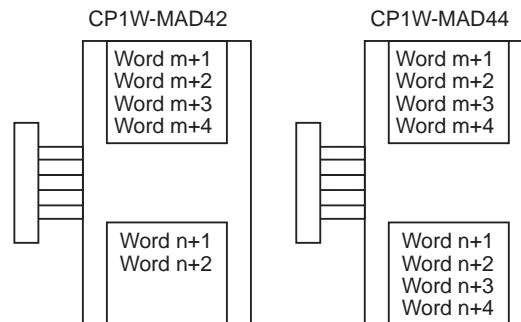
- (6) When external power is supplied (when range codes are set), or when the power is interrupted, there may be a pulse status analog output of up to 1 ms. If this status is a problem, take the following measures.
  - Turn ON the power to the CP1L-EL/EM CPU Unit, check the operation status, and then turn ON the power at the load.
  - Turn OFF the power to the load and then turn OFF the power to the CP1L-EL/EM CPU Unit.

### Creating a Ladder Program

#### I/O Allocation

Four input words and two output words are allocated to the CP1W-MAD42, starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.

Four input words and four output words are allocated to the CP1W-MAD44, starting from the next word following the last word allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.



#### Writing Set Data

##### CP1W-MAD42

Write the set data to words (n+1 to n+2). A/D or D/A conversion begins when the set data is transferred from the CPU Unit to the Analog I/O Unit. Setting contents are shown as the following table.

| Word (n+1) | 15 | 14 | 13 | 12 | 11              | 10 | 9 | 8 | 7              | 6 | 5 | 4 | 3              | 2 | 1 | 0 |
|------------|----|----|----|----|-----------------|----|---|---|----------------|---|---|---|----------------|---|---|---|
| Value      | 1  | 0  | 0  | 0  | Analog output 1 |    |   |   | Analog input 2 |   |   |   | Analog input 1 |   |   |   |
| Word (n+2) | 15 | 14 | 13 | 12 | 11              | 10 | 9 | 8 | 7              | 6 | 5 | 4 | 3              | 2 | 1 | 0 |
| Value      | 1  | 0  | 0  | 0  | Analog output 2 |    |   |   | Analog input 4 |   |   |   | Analog input 3 |   |   |   |

##### CP1W-MAD44

Write the set data to words (n+1 to n+4). A/D or D/A conversion begins when the set data is transferred from the CPU Unit to the Analog I/O Unit. Setting contents are shown as the following table.

| Word (n+1) | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7               | 6 | 5 | 4 | 3               | 2 | 1 | 0 |
|------------|----|----|----|----|----|----|---|---|-----------------|---|---|---|-----------------|---|---|---|
| Value      | 1  | 0  | 0  | 0  | 0  | 0  | 0 | 0 | Analog input 2  |   |   |   | Analog input 1  |   |   |   |
| Word (n+2) | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7               | 6 | 5 | 4 | 3               | 2 | 1 | 0 |
| Value      | 1  | 0  | 0  | 0  | 0  | 0  | 0 | 0 | Analog input 4  |   |   |   | Analog input 3  |   |   |   |
| Word (n+3) | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7               | 6 | 5 | 4 | 3               | 2 | 1 | 0 |
| Value      | 1  | 0  | 0  | 0  | 0  | 0  | 0 | 0 | Analog output 2 |   |   |   | Analog output 1 |   |   |   |
| Word (n+4) | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7               | 6 | 5 | 4 | 3               | 2 | 1 | 0 |
| Value      | 1  | 0  | 0  | 0  | 0  | 0  | 0 | 0 | Analog output 4 |   |   |   | Analog output 3 |   |   |   |

Even if analog inputs are not used, bit 15 in word (n+1) and (n+2) must be set to 1.

#### Set Data of Analog Inputs

|       | 7      | 6       | 5             | 4 | 3      | 2       | 1             | 0 |
|-------|--------|---------|---------------|---|--------|---------|---------------|---|
| Value | Enable | Average | AD Range Code |   | Enable | Average | AD Range Code |   |

Enable Bit  
0 : Disable channel  
1 : Enable channel

Average Bit  
0 : Disable  
1 : Enable

AD Range Code  
00 : -10 to 10V  
01 : 0 to 10V  
10 : 1 to 5V (4 to 20mA)  
11 : 0 to 5V (0 to 20mA)

| Range Code | Analog input range    |
|------------|-----------------------|
| 00         | –10 to 10 V           |
| 01         | 0 to 10 V             |
| 10         | 1 to 5 V (4 to 20 mA) |
| 11         | 0 to 5 V (0 to 20 mA) |

### Set Data of Analog Outputs

| Value | 7      | 6             | 5 | 4 | 3      | 2             | 1 | 0 |
|-------|--------|---------------|---|---|--------|---------------|---|---|
|       | Enable | DA Range Code |   |   | Enable | DA Range Code |   |   |

Enable Bit  
 0 : Disable channel  
 1 : Enable channel

DA Range Code  
 000 : –10 to 10V  
 001 : 0 to 10V  
 010 : 1 to 5V  
 011 : 0 to 20mA  
 100 : 4 to 20mA

| Range Code | Analog output range |
|------------|---------------------|
| 000        | –10 to 10 V         |
| 001        | 0 to 10 V           |
| 010        | 1 to 5 V            |
| 011        | 0 to 20 mA          |
| 100        | 4 to 20 mA          |

- The Analog I/O Unit will not start converting analog I/O values until the set data has been written.
- Before range code is written, 0 V or 0 mA will be output in the 0 to 10 V, –10 to +10 V, and 0 to 20 mA ranges, and 1 V or 4 mA will be output in the 1 to 5 V and 4 to 20 mA ranges.
- Once the range code has been set, it is not possible to be changed while power is being supplied to the CPU Unit. To change the code range, turn the CPU Unit OFF then ON again.

### Averaging

Set whether averaging is to be used for set data. When the averaging bit is set to 1, the average (moving average) for the past eight inputs is output as conversion data.

### Reading Analog Input Converted Values

Read the conversion value storage area with the ladder program. With word m as the last input word allocated to the CPU Unit or an already-connected Expansion Unit, the A/D conversion data will be output to the following words m+1 to m+4.

### Writing Analog Output Converted Values

The ladder program can be used to write conversion data to the output words. The output word start from “n+1” where “n” is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit.

### Startup Operation

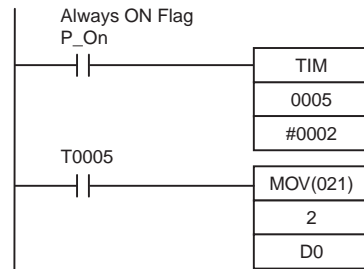
After power is turned ON, it will require two cycle times plus approximately 50ms before the first conversion data is output.

Analog input data will be 0000 until the first conversion data is stored in the input words.

The following table shows the output status after the initial processing is completed.

| Output type                  | Voltage output             |          | Current output |            |
|------------------------------|----------------------------|----------|----------------|------------|
| Output range                 | 0 to 10 V,<br>–10 to +10 V | 1 to 5 V | 0 to 20 mA     | 4 to 20 mA |
| Before range code is written | 0 V                        |          | 0 mA           |            |
| After range code is written  | 0 V                        | 1 V      | 0 mA           | 4 mA       |

Therefore, create a program as shown below, so that the ladder can start to operate with valid conversion data in input words.



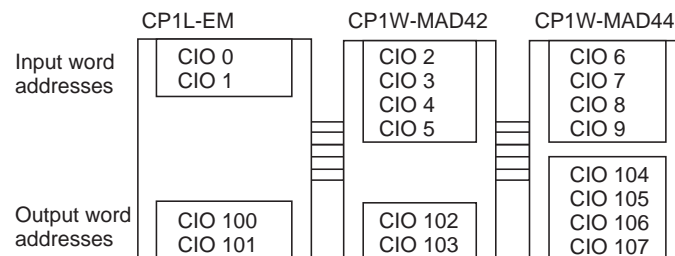
TIM0005 is started when the power is turned ON. After 0.2 s (200 ms) elapses, the TIM0005 contact turns ON and the analog input 1 conversion data stored in word 2 is transferred to D0.

### Handling Unit Errors

When an error occurs in the Analog I/O Unit, analog input data will be 0000 and 0 V or 0 mA will be output as the analog output.

If a CPU error or an I/O bus error (fatal errors) occurs at the CPU Unit and the analog output is set to 1 to 5 V or 4 to 20 mA, 0 V or 0 mA will be output. For any other fatal errors at the CPU Unit, 1 V or 4 mA will be output.

### Program Example



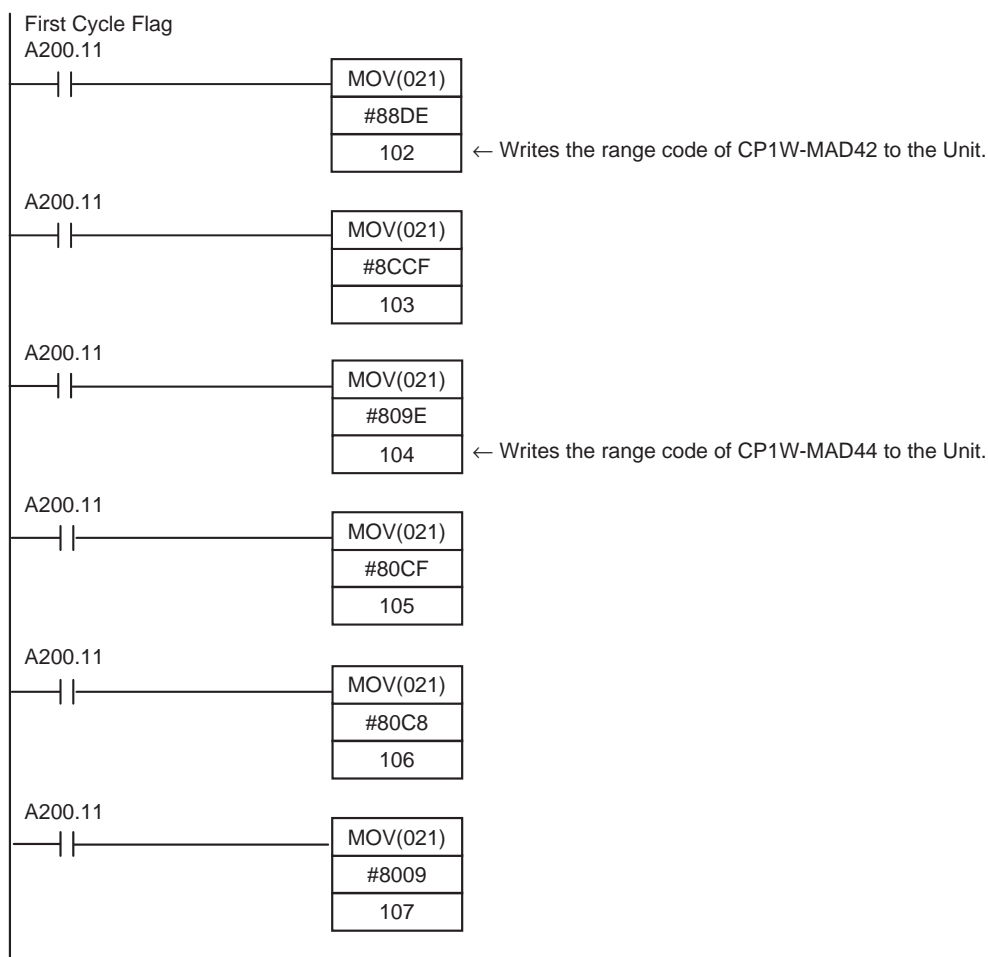
This programming example uses these ranges:

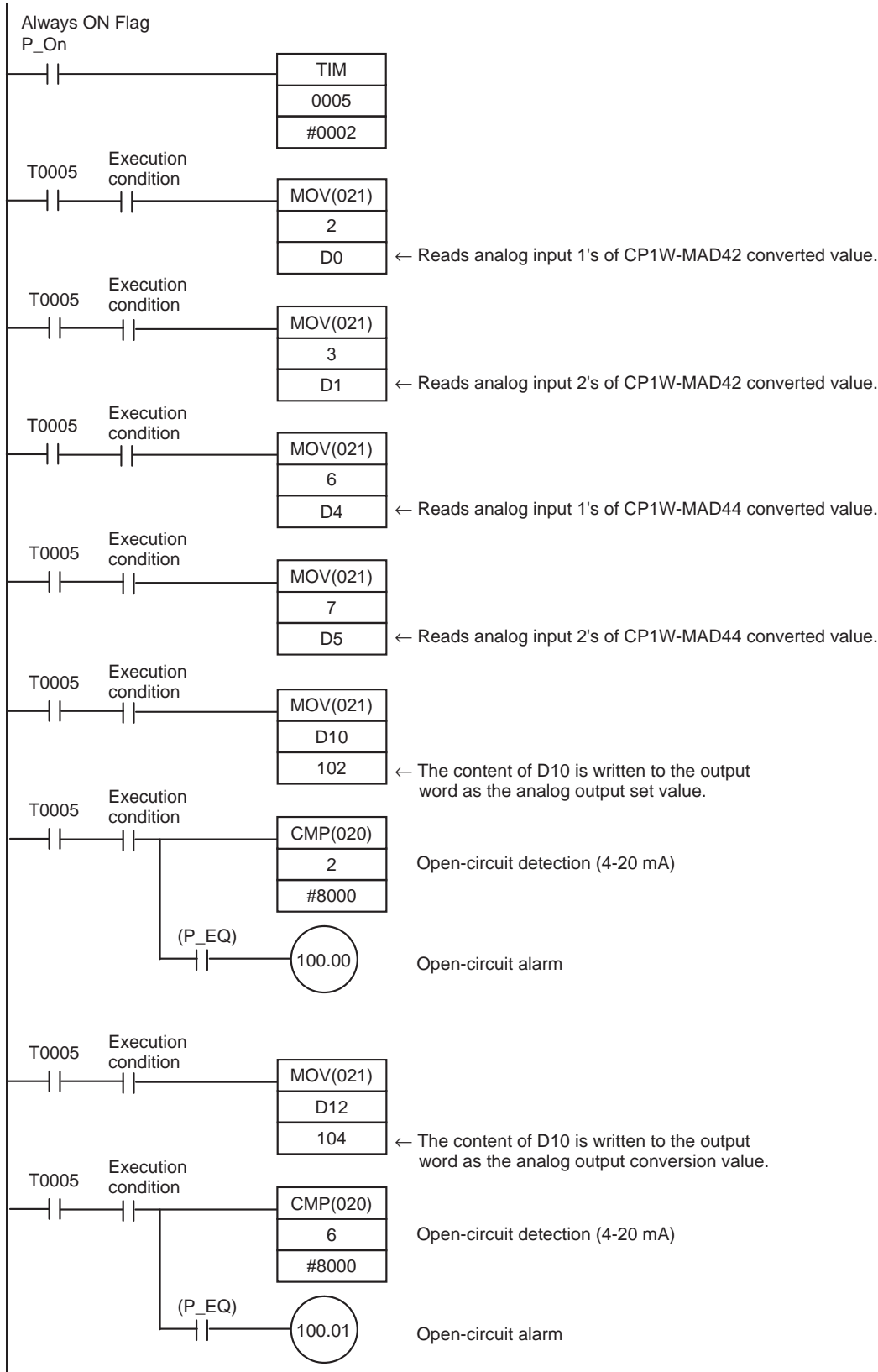
#### CP1W-MAD42

| Analog input | Input range | Range code | Averaging | Set data     | Destination word |
|--------------|-------------|------------|-----------|--------------|------------------|
| Input 1      | 4 to 20 mA  | 10         | Yes       | 1110 (E hex) | n+1              |
| Input 2      | 0 to 10 V   | 01         | Yes       | 1101 (D hex) | n+1              |
| Input 3      | 0 to 5 V    | 11         | Yes       | 1111 (F hex) | n+2              |
| Input 4      | –10 to 10 V | 00         | Yes       | 1100 (C hex) | n+2              |
| Output 1     | –10 to 10 V | 000        | ---       | 1000 (8 hex) | n+1              |
| Output 2     | 4 to 20 mA  | 100        | ---       | 1100 (C hex) | n+2              |

## CP1W-MAD44

| Analog input | Input range | Range code | Averaging | Set data     | Destination word |
|--------------|-------------|------------|-----------|--------------|------------------|
| Input 1      | 4 to 20 mA  | 10         | Yes       | 1110 (E hex) | n+1              |
| Input 2      | 0 to 10 V   | 01         | No        | 1001 (9 hex) | n+1              |
| Input 3      | 0 to 5 V    | 11         | Yes       | 1111 (F hex) | n+2              |
| Input 4      | −10 to 10 V | 00         | Yes       | 1100 (C hex) | n+2              |
| Output 1     | −10 to 10 V | 000        | ---       | 1000 (8 hex) | n+3              |
| Output 2     | 4 to 20 mA  | 100        | ---       | 1100 (C hex) | n+3              |
| Output 3     | 0 to 10 V   | 001        | ---       | 1001 (9 hex) | n+4              |
| Output 4     | Not use     | ---        | ---       | 0000 (0 hex) | n+4              |





## 9-5 Temperature Sensor Units

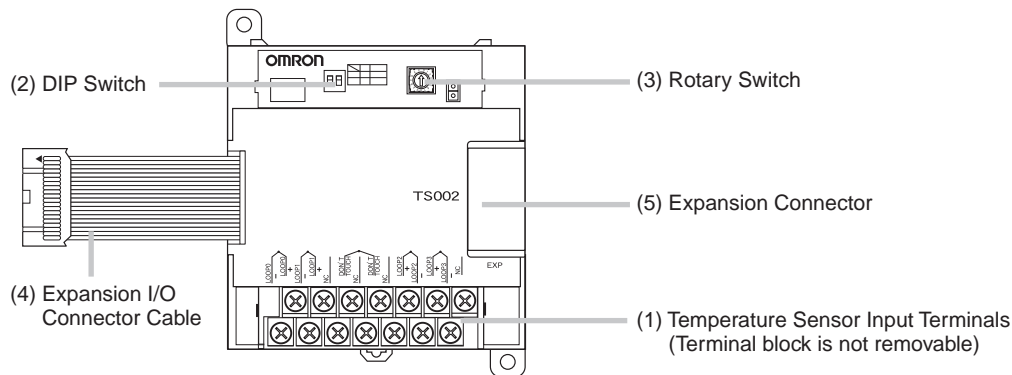
### 9-5-1 CP1W-TS□01/TS□02 Temperature Sensor Units

CP1W-TS002/TS102 Temperature Sensor Units each provide up to four input points, and CP1W-TS001/TS101 Temperature Sensor Units each provide up to two input points. The inputs can be from thermocouples or platinum resistance thermometers.

CP1W-TS002/TS102 Temperature Sensor Units are each allocated four input words, so no more than three Units can be connected.

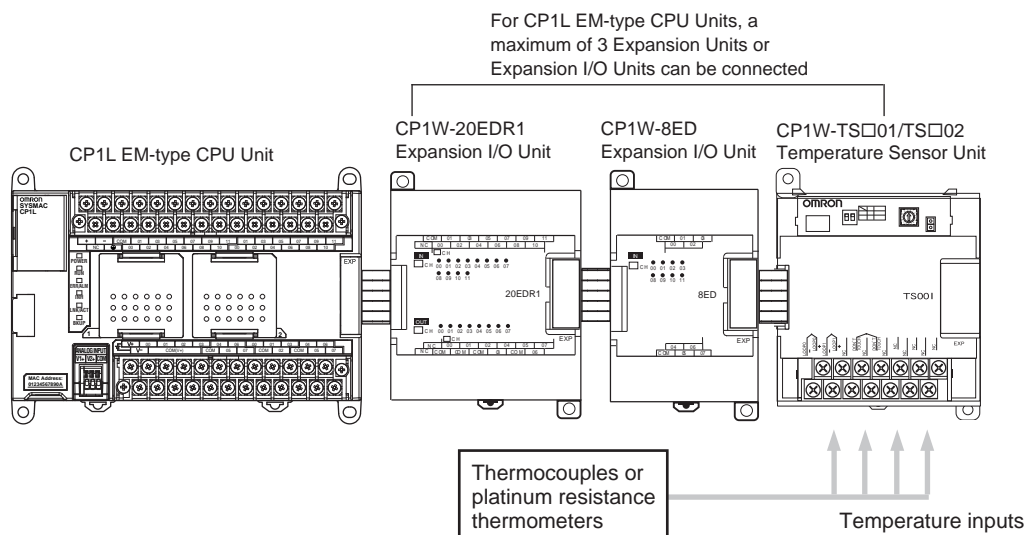
#### Part Names

##### Temperature Sensor Units: CP1W-TS001/002/101/102



- (1) Temperature Sensor Input Terminals  
Used to connect temperature sensors such as thermocouples or platinum resistance thermometers.
  - (2) DIP Switch  
Used to set the temperature unit (°C or °F) and the number of decimal places used.
  - (3) Rotary Switch  
Used to set the temperature input range. Make the setting according to the specifications of the temperature sensors that are connected.
  - (4) Expansion I/O Connecting Cable  
Connected to the expansion connector of a CP1L-EL/EM CPU Unit or a CP-series Expansion Unit or Expansion I/O Unit. The cable is included with the Temperature Sensor Unit and cannot be removed.
- Note** Do not touch the cables during operation. Static electricity may cause operating errors.
- (5) Expansion Connector  
Used for connecting CP-series Expansion Units or Expansion I/O Units.

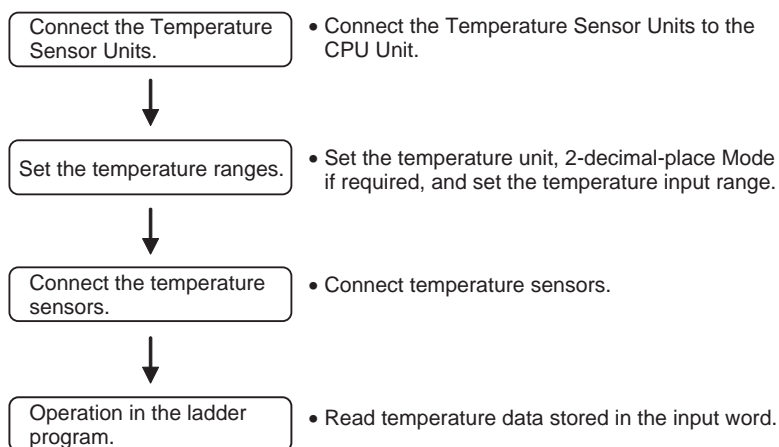
## Main Specifications



| Item                       | CP1W-TS001  | CP1W-TS002 | CP1W-TS101  | CP1W-TS102 |
|----------------------------|---|------------|---|------------|
| Temperature sensors        | Thermocouples   |            | Platinum resistance thermometer   |            |
|                            | Switchable between K and J, but same type must be used for all inputs.                                    |            | Switchable between Pt100 and JPt100, but same type must be used for all inputs.               |            |
| Number of inputs           | 2   | 4          | 2   | 4          |
| Allocated input words      | 2   | 4          | 2   | 4          |
| Accuracy                   | (The larger of $\pm 0.5\%$ of converted value or $\pm 2^{\circ}\text{C}$ ) $\pm 1$ digit max. (See note.) |            | (The larger of $\pm 0.5\%$ of converted value or $\pm 1^{\circ}\text{C}$ ) $\pm 1$ digit max. |            |
| Conversion time            | 250 ms for 2 or 4 input points  |            |   |            |
| Converted temperature data | 16-bit binary data (4-digit hexadecimal)  |            |   |            |
| Isolation                  | Photocouplers between all temperature input signals   |            |   |            |
| Current consumption        | 5 VDC: 40 mA max., 24 VDC: 59 mA max.   |            | 5 VDC: 54 mA max., 24 VDC: 73 mA max.   |            |

**Note** Accuracy for a K-type sensor at  $-100^{\circ}\text{C}$  or less is  $\pm 4^{\circ}\text{C} \pm 1$  digit max.

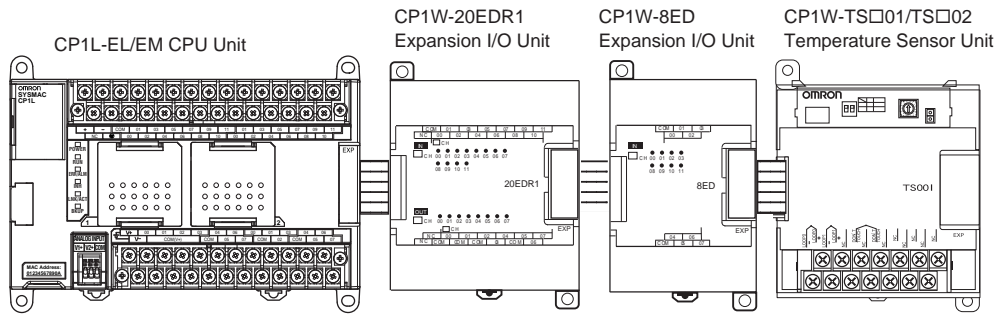
## Using Temperature Sensor Units





Connecting Temperature Sensor Units

For CP1L EM-type CPU Units, a maximum of three CP1W-TS002 and CP1W-TS102 Temperature Sensor Units can be connected, because each unit is allocated four words. For CP1L EL-type CPU Units, one Unit can be connected.

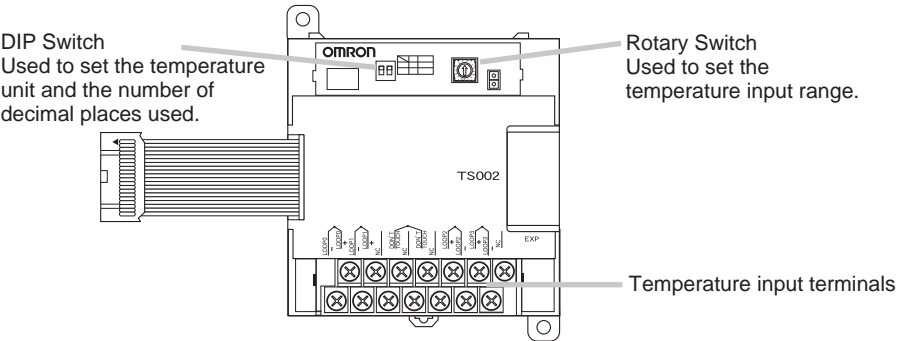


Setting Temperature Ranges

- Note
- (1) Always turn OFF the power supply before setting the temperature range.

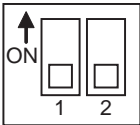
(2) Never touch the DIP switch or rotary switch during Temperature Sensor Unit operation. Static electricity may cause operating errors.

The Temperature Sensor Unit's DIP switch and rotary switch are used to set the temperature unit, to select 2-decimal-place Mode is to be used, and to set the temperature input range.



DIP Switch Settings

The DIP switch is used to set the temperature unit (°C or °F) and the number of decimal places used.



| SW1 |   | Setting |   |
|-----|---|---------|---|
|     |   |         |   |
| 1   | Temperature unit  | OFF     | °C  |
|     |   | ON      | °F  |
| 2   | Number of decimal places used (See note.) (0.01 expression) | OFF     | Normal (0 or 1 digit after the decimal point, depending on the input range) |
|     |   | ON      | 2-decimal-place Mode  |

Note

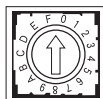
For details on 2-decimal-place Mode, refer to *Two-decimal-place Mode* on page 522.

**Rotary Switch Setting**

**⚠ Caution** Set the temperature range according to the type of temperature sensor connected to the Unit. Temperature data will not be converted correctly if the temperature range does not match the sensor.

**⚠ Caution** Do not set the temperature range to any values other than those for which temperature ranges are given in the following table. An incorrect setting may cause operating errors.

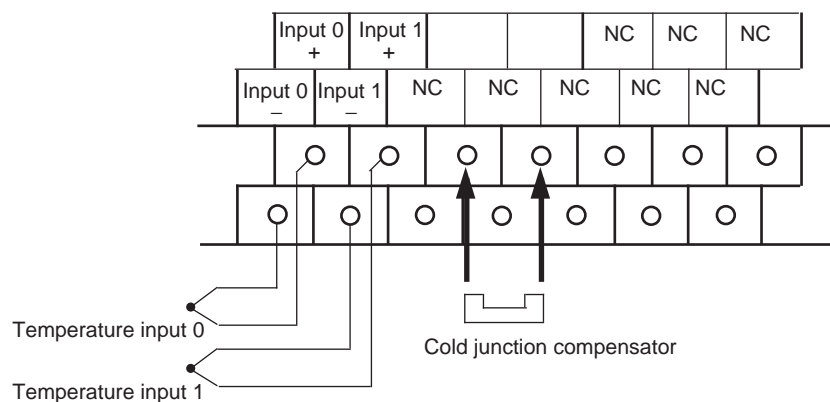
The rotary switch is used to set the temperature range.



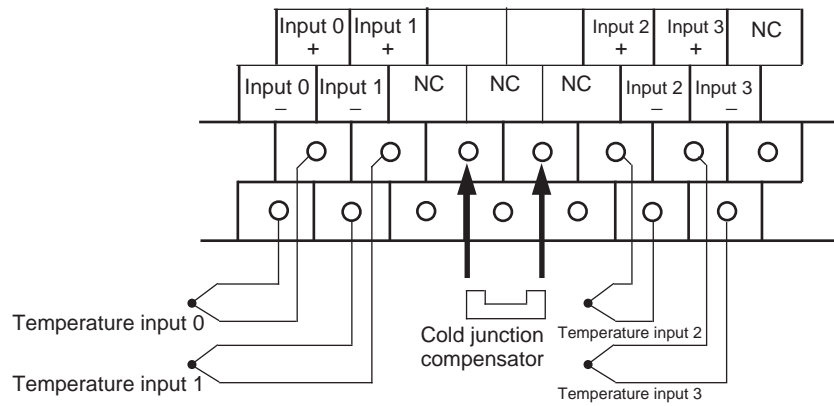
| Setting | CP1W-TS001/002 |                |               | CP1W-TS101/102 |                 |                   |
|---------|----------------|----------------|---------------|----------------|-----------------|-------------------|
|         | Input type     | Range (°C)     | Range (°F)    | Input type     | Range (°C)      | Range (°F)        |
| 0       | K              | –200 to 1,300  | –300 to 2,300 | Pt100          | –200.0 to 650.0 | –300.0 to 1,200.0 |
| 1       |                | 0.0 to 500.0   | 0.0 to 900.0  | JPt100         | –200.0 to 650.0 | –300.0 to 1,200.0 |
| 2       | J              | –100 to 850    | –100 to 1,500 | ---            | Cannot be set.  |                   |
| 3       |                | 0.0 to 400.0   | 0.0 to 750.0  | ---            |                 |                   |
| 4 to F  | ---            | Cannot be set. |               | ---            |                 |                   |

**Connecting Temperature Sensors****Thermocouples****CP1W-TS001**

Either K or J thermocouples can be connected, but both thermocouples must be the same type and the same input range.

**CP1W-TS002**

Either K or J thermocouples can be connected, but all four thermocouples must be the same type and the same input range.



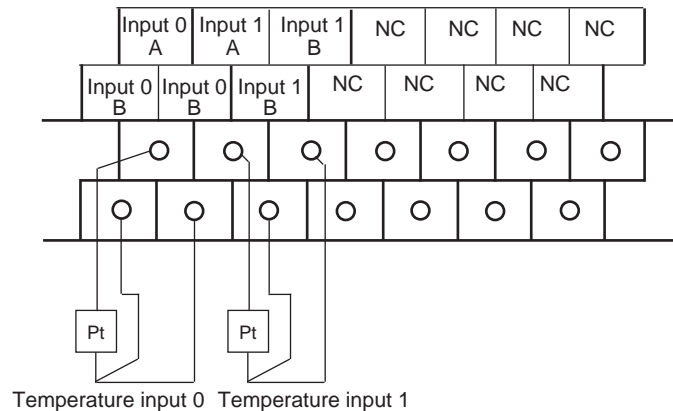
**Note** When connecting a thermocouple input, observe the following precautions:

- Do not remove the cold junction compensator attached at the time of delivery. If the cold junction compensator is removed, the Unit will not be able to measure temperatures correctly.
- Each of the input circuits is calibrated with the cold junction compensator attached to the Unit. If the Unit is used with the cold junction compensator from other Units, the Unit will not be able to measure temperatures correctly.
- Do not touch the cold junction compensator. Doing so may result in incorrect temperature measurement.

### **Platinum Resistance Thermometers**

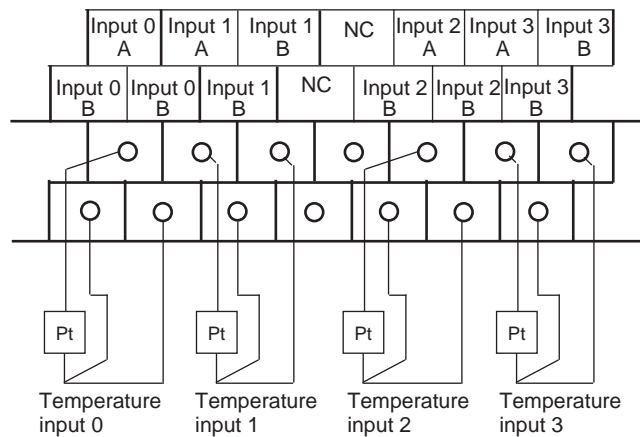
#### **CP1W-TS101**

One or two Pt or JPt platinum resistance thermometers can be connected, but both thermometers must be the same type and the same input range.



#### **CP1W-TS102**

Up to four Pt100 or JPt100 platinum resistance thermometers can be connected, but all four thermometers must be the same type and the same input range.



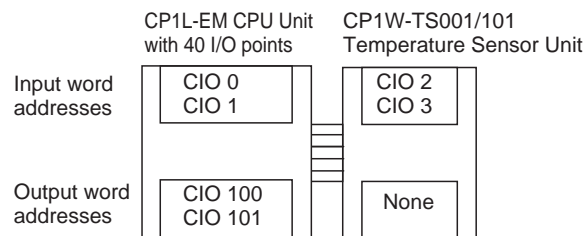
**Note** Do not connect anything to terminals not used for inputs.

### Creating a Ladder Program

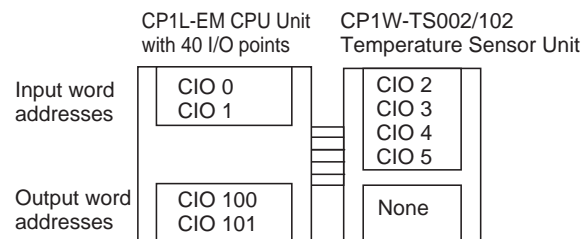
#### Word Allocations

Temperature Sensor Units are allocated words in the same way as other CP-series Expansion Units or Expansion I/O Units, in order of connection. A Temperature Sensor Unit is allocated the next input words following the input words of the CPU Unit or previous Expansion Unit or Expansion I/O Unit. Four input words are allocated to the 2-input CP1W-TS001 or CP1W-TS101 and four input words are allocated to the 4-input CP1W-TS002 or CP1W-TS102. No output words are allocated.

#### Example 1



#### Example 2



#### Converted Temperature Data

The temperature data will be stored in the input words allocated to the Temperature Sensor Unit in 4-digit hexadecimal.

TS002/TS102

|     |   |
|-----|---|
| m+1 | Converted temperature data from input 0 |
| m+2 | Converted temperature data from input 1 |
| m+3 | Converted temperature data from input 2 |
| m+4 | Converted temperature data from input 3 |

TS001/TS101

|     |   |
|-----|---|
| m+1 | Converted temperature data from input 0 |
| m+2 | Converted temperature data from input 1 |

“m” is the last input word allocated to the CPU Unit, Expansion I/O Unit, or Expansion Unit connected immediately before the Temperature Sensor Unit.

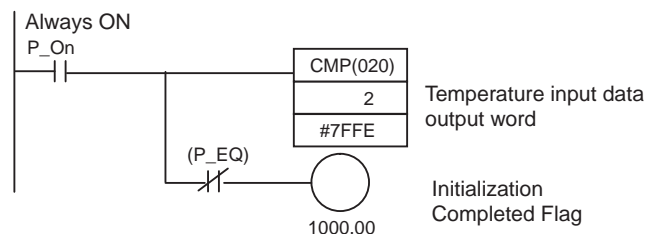
- Negative values are stored as 2's complements.
- Data for range codes that include one digit after the decimal point are stored without the decimal point, i.e., 10 times the actual value is stored.

| Input       |                       | Data conversion examples   |
|-------------|-----------------------|--|
| Unit: 1°C   | K or J                | 850°C → 0352 hex<br>-200°C → FF38 hex  |
| Unit: 0.1°C | K, J, Pt100 or JPt100 | ×10    500.0°C → 5000 → 1388 hex<br>-20.0°C → -200 → FF38 hex<br>-200.0°C → -2000 → F830 hex |

- If the input temperature exceeds the maximum or minimum value in the temperature input range that has been set by  $\pm 20^{\circ}\text{C}$  or  $\pm 20^{\circ}\text{F}$ , the displayed value will be held.
- If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.
- The open-circuit detection function will be automatically cleared and normal input temperature conversion will begin automatically when the input temperature returns to the convertible range.

### Startup Operation

After power is turned ON, approximately 1 s is required for the first conversion data to be stored in the input word. During that period, the data will be 7FFE. Therefore, create a program as shown below, so that when operation begins simultaneously with startup it will wait for valid conversion data.

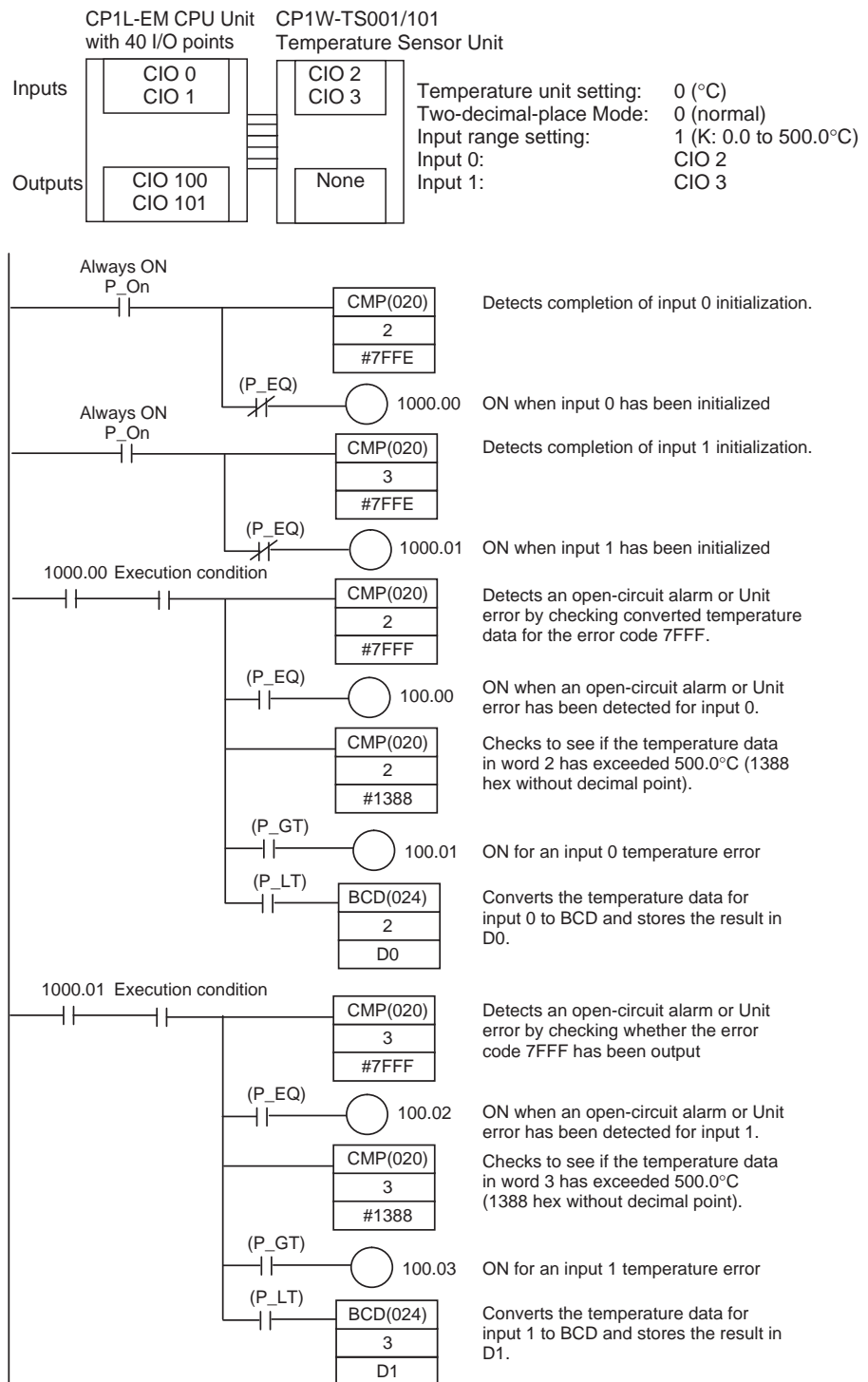


### Handling Unit Errors

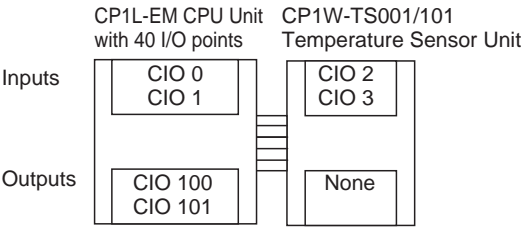
- CP-series Expansion Unit/Expansion I/O Unit errors are output to bits 0 to 5 of word A436. The bits are allocated from A436.00 in order starting from the Unit nearest the CPU Unit. CP1W-TS002 and CP1W-TS102 Temperature Sensor Units are allocated two bits each. Use these flags in the program when it is necessary to detect Expansion Unit/Expansion I/O Unit errors.
- When an error occurs, the Temperature Sensor Unit data becomes 7FFF hex (the same as for an open-circuit detection). With an open-circuit detection, it is not reflected in word A436.

**Programming Example****1,2,3...**

- The following programming example shows how to convert the input data from 2 temperature sensor inputs to BCD and store the result in D0 and D1.

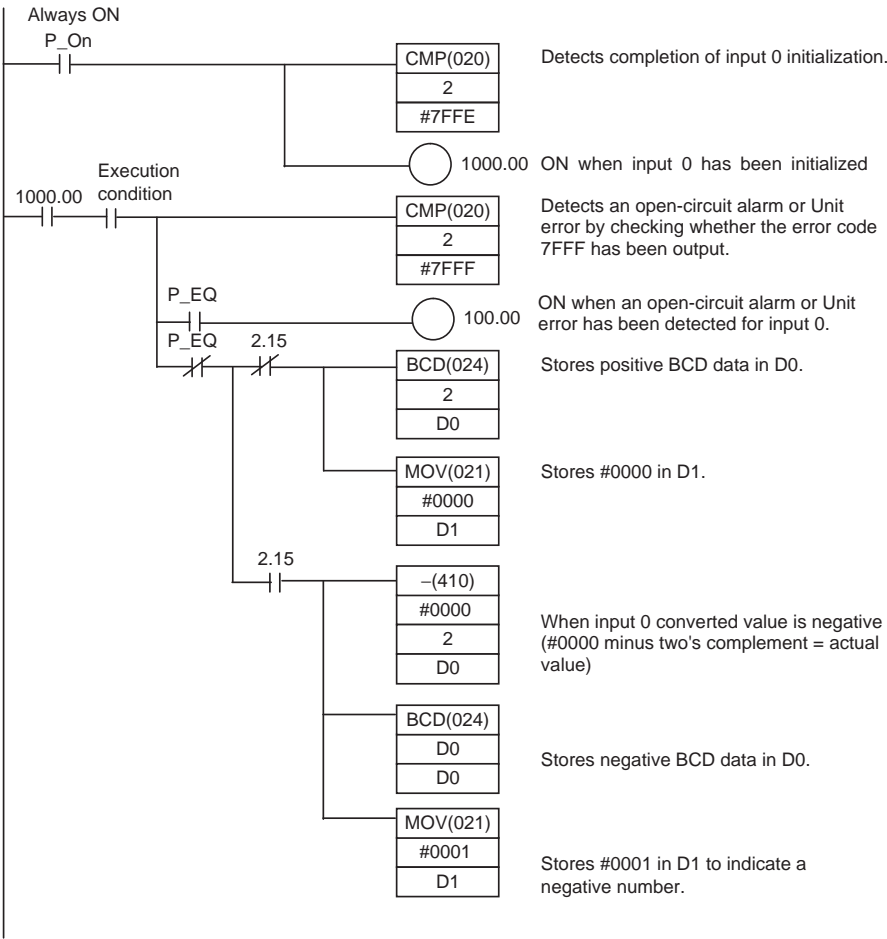


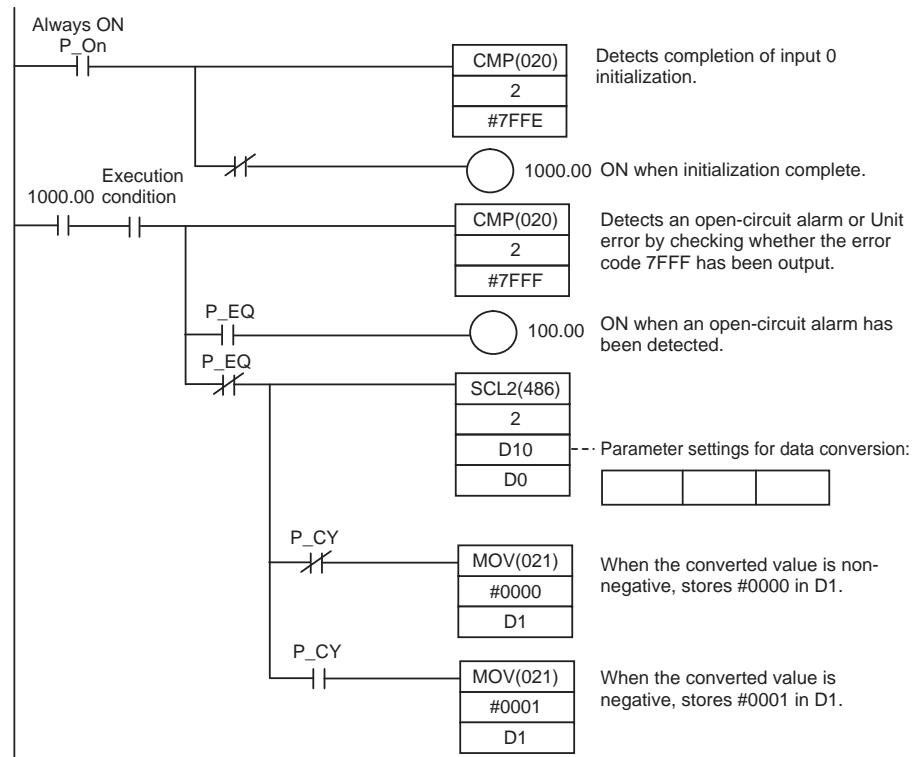
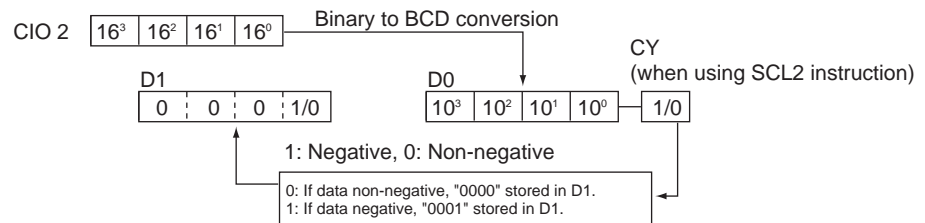
2. The following programming example shows how to convert the data for temperature input 0 to BCD and store the result in D0 and D1. “0001” is stored in D1 when the input data is a negative value. The following system configuration is used.



|                          |                              |
|--------------------------|------------------------------|
| Temperature unit setting | 0 (°C)                       |
| Two-decimal-place Mode   | 0 (normal)                   |
| Input range setting      | 1 (Pt100: -200.0 to 650.0°C) |
| Input 0                  | CIO 2                        |

Programming with BCD(24) Instruction



**Programming with SCL2(-) Instruction****Operation****Two-decimal-place Mode**

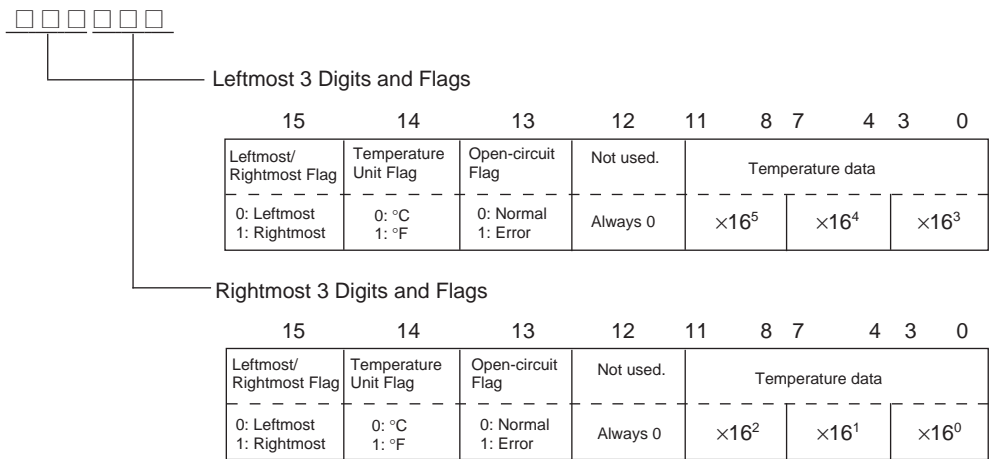
If pin 2 on the DIP switch is turned ON, values are stored to two decimal places. In this case, temperature data is stored as 6-digit signed hexadecimal (binary) data with 4 digits in the integer portion and 2 digits after the decimal point. The actual data stored in memory is 100 times the actual value, i.e., the decimal point is not indicated. Methods for handling this data are described in this section.

**Note** When set to store values to two decimal places, temperature data as far as two digits after the decimal point is converted to 6-digit binary data, but the actual resolution is not 0.01°C (°F). For this reason, there may be skipping and inaccuracies in the first digit after the decimal point (0.1). Treat any resolution above that specified for the normal data format as reference data.



Temperature Data Partitioning and Structure

Temperature Data (Actual Temperature x 100 Binary)

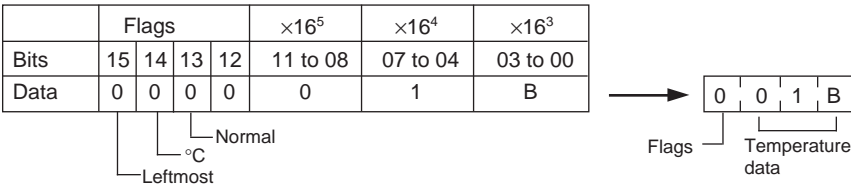


Leftmost/Rightmost Flag: Indicates whether the leftmost or rightmost 3 digits are provided.  
Temperature Unit Flag: Indicates whether the temperature is in °C or °F.  
Open-circuit Flag: Turns ON (1) when an open-circuit is detected. The temperature data will be 7FF FFF if this flag is ON.

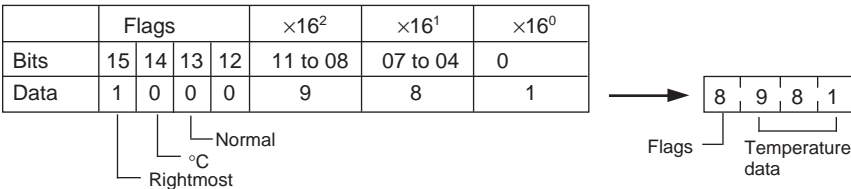
Data Conversion Examples

**Example 1**  
Temperature: 1,130.25°C  
×100: 113025  
Temperature Data: 01B981 (hexadecimal for 113025)

Leftmost 3 Digits and Flags



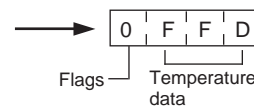
Rightmost 3 Digits and Flags



**Example 2**Temperature:  $-100.12^{\circ}\text{C}$  $\times 100$ :  $-10012$ Temperature Data: FFD8E4 (hexadecimal for  $-10012$ )**Leftmost 3 Digits and Flags**

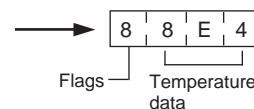
|      | Flags |    |    |    | $\times 16^5$ | $\times 16^4$ | $\times 16^3$ |
|------|-------|----|----|----|---------------|---------------|---------------|
| Bits | 15    | 14 | 13 | 12 | 11 to 08      | 07 to 04      | 03 to 00      |
| Data | 0     | 0  | 0  | 0  | F             | F             | D             |

Normal  
 $^{\circ}\text{C}$   
 Leftmost

**Rightmost 3 Digits and Flags**

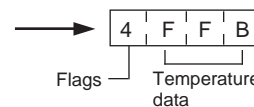
|      | Flags |    |    |    | $\times 16^2$ | $\times 16^1$ | $\times 16^0$ |
|------|-------|----|----|----|---------------|---------------|---------------|
| Bits | 15    | 14 | 13 | 12 | 11 to 08      | 07 to 04      | 03 to 00      |
| Data | 1     | 0  | 0  | 0  | 8             | E             | 4             |

Normal  
 $^{\circ}\text{C}$   
 Rightmost

**Example 3**Temperature:  $-200.12^{\circ}\text{F}$  $\times 100$ :  $-20012$ Temperature Data: FFB1D4 (hexadecimal for  $-20012$ )**Leftmost 3 Digits and Flags**

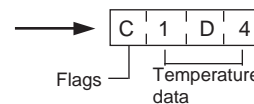
|      | Flags |    |    |    | $\times 16^5$ | $\times 16^4$ | $\times 16^3$ |
|------|-------|----|----|----|---------------|---------------|---------------|
| Bits | 15    | 14 | 13 | 12 | 11 to 08      | 107 to 04     | 03 to 00      |
| Data | 0     | 1  | 0  | 0  | F             | F             | B             |

Normal  
 $^{\circ}\text{F}$   
 Leftmost

**Rightmost 3 Digits and Flags**

|      | Flags |    |    |    | $\times 16^2$ | $\times 16^1$ | $\times 16^0$ |
|------|-------|----|----|----|---------------|---------------|---------------|
| Bits | 15    | 14 | 13 | 12 | 11 to 08      | 07 to 04      | 03 to 00      |
| Data | 1     | 1  | 0  | 0  | 1             | D             | 4             |

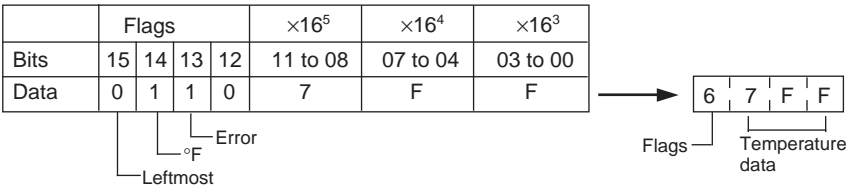
Normal  
 $^{\circ}\text{F}$   
 Rightmost



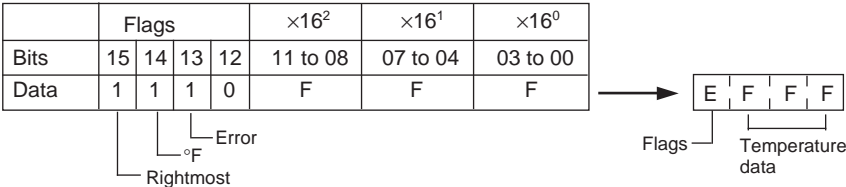
Example 4

Temperature: Open circuit (°F)  
Temperature Data: 7FFFFFFF

Leftmost 3 Digits and Flags



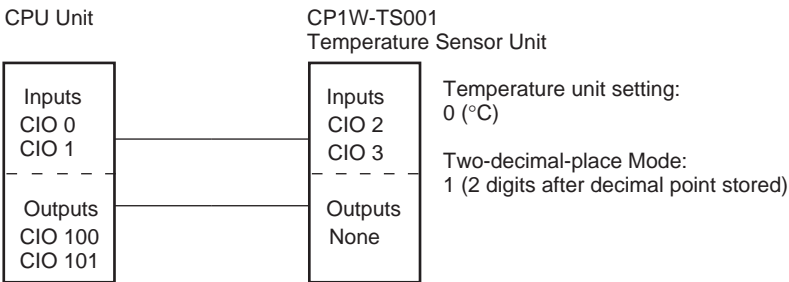
Rightmost 3 Digits and Flags



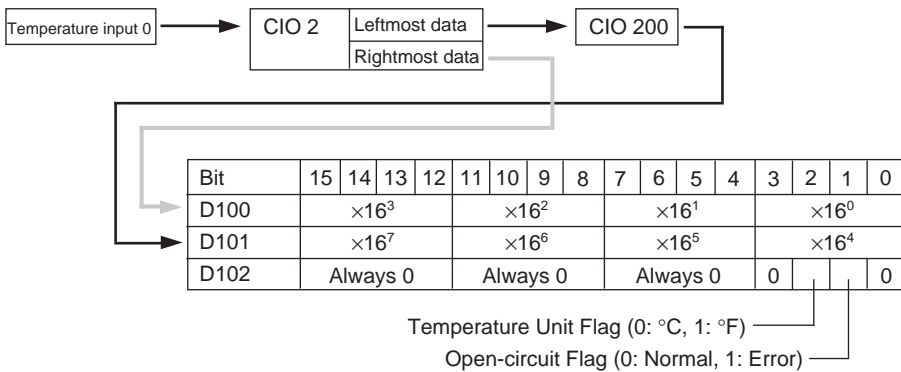
- Note**
- (1) Leftmost digits are stored in the lower memory addresses. Treat the data in the lower memory address as the leftmost digits when programming.
  - (2) Be sure that the data is read at least once every 125 ms to allow for the CPU Unit's cycle time and communications time. Correct data may not be obtained if the read cycle is greater than 125 ms.

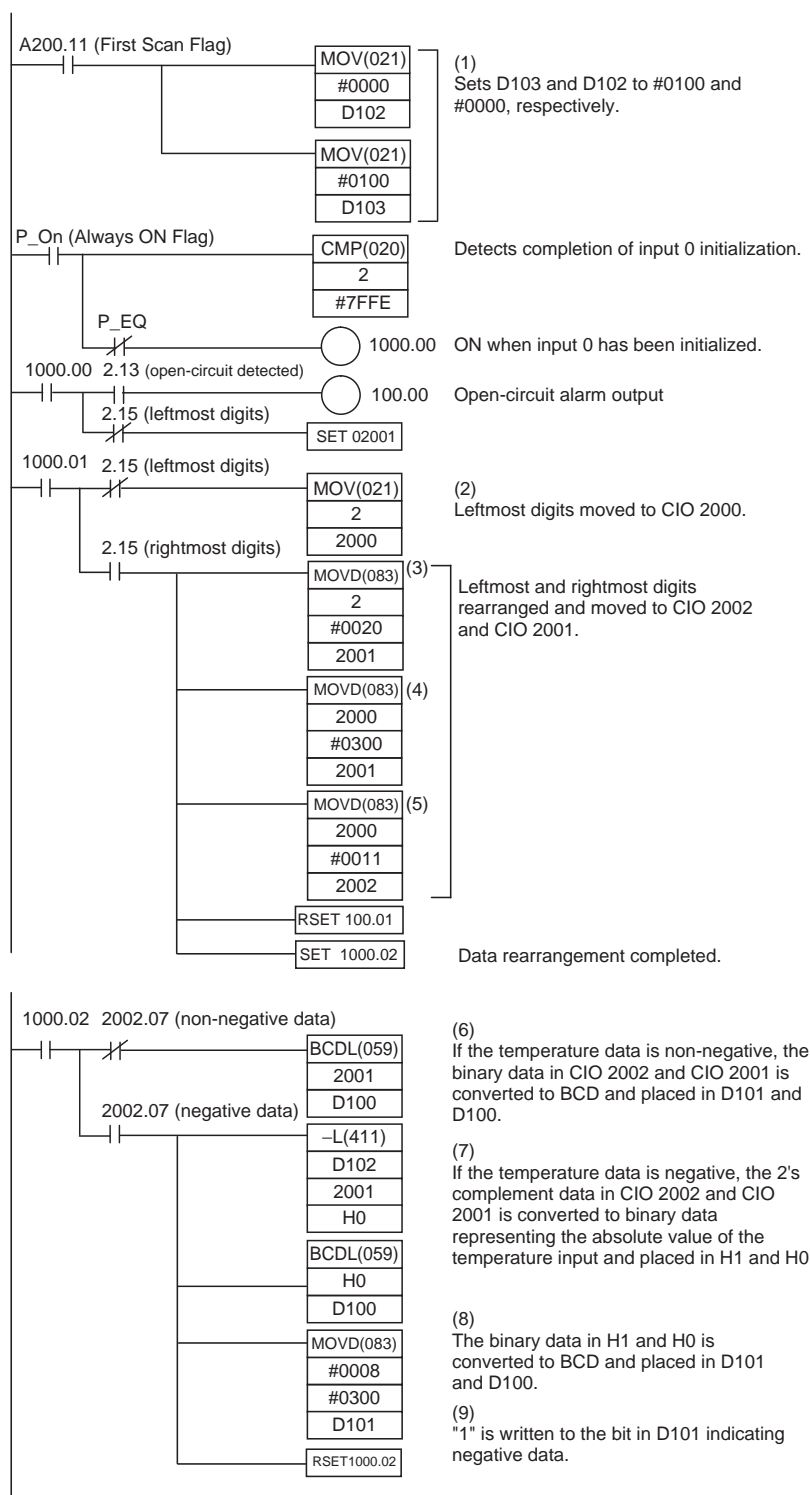
Programming Example

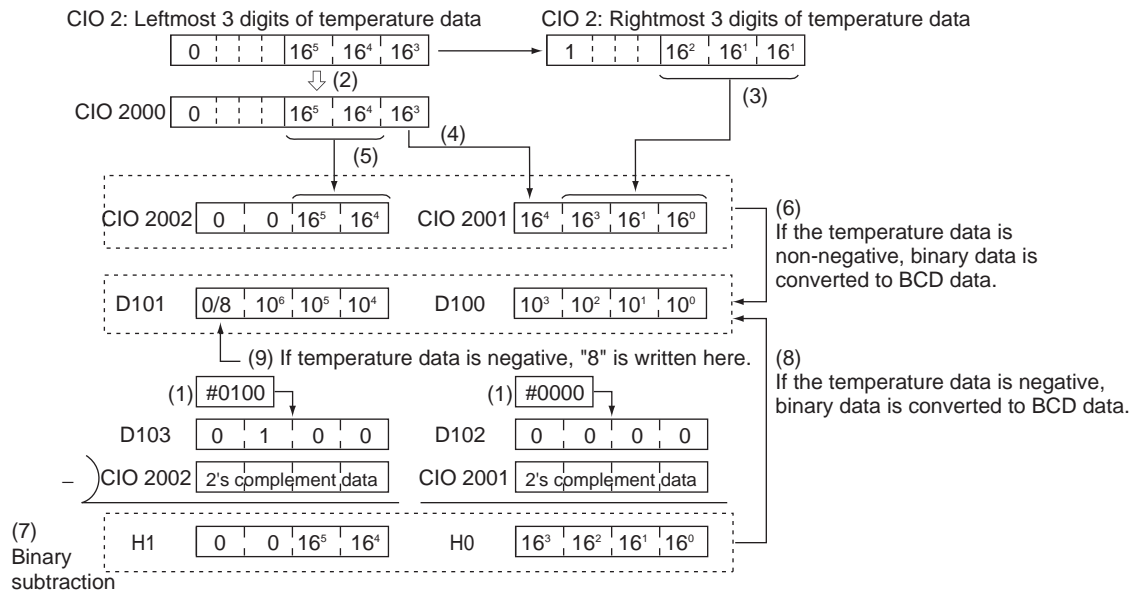
The following programming example shows how to use 2-decimal-place Mode for the following PC configuration.



In this example, 100 times the temperature data for temperature input 0 is stored in binary form in D100 to D102.





**Description of Operation**

## 9-5-2 CP1W-TS003 Temperature Sensor Units

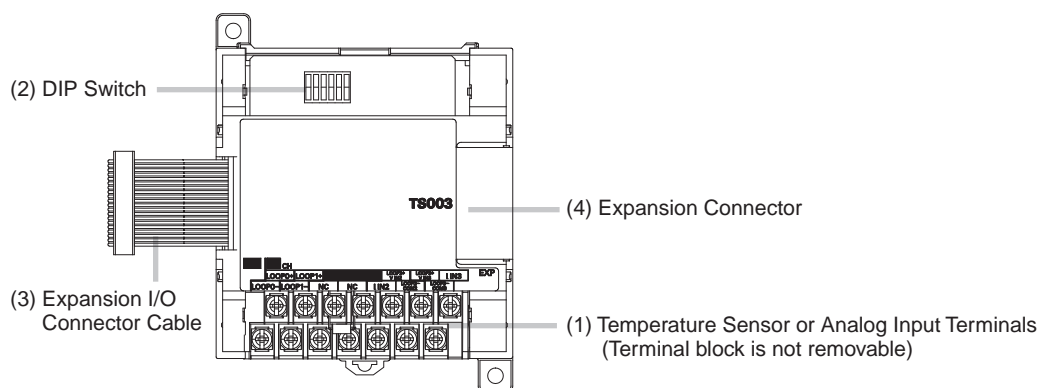
CP1W-TS003 Temperature Sensor Unit provides up to four input points.

The inputs can be from thermocouples or analog inputs.

CP1W-TS003 Temperature Sensor Unit is allocated four input words, so no more than three Units can be connected.

### Part Names

#### Temperature Sensor Units: CP1W-TS003



- (1) Temperature Sensor Input Terminals  
Used to connect temperature sensors such as thermocouples or analog inputs.
- (2) DIP Switch  
Used to set the input type (temperature or analog input), the input thermocouple type (K or J) and the temperature unit (°C or °F). Make the setting according to the specifications of the temperature sensors or analog inputs that are connected.
- (3) Expansion I/O Connecting Cable  
Connected to the expansion connector of a CP1L-EL/EM CPU Unit or a CP-series Expansion Unit or Expansion I/O Unit. The cable is included with the Temperature Sensor Unit and cannot be removed.  
**Note** Do not touch the cables during operation. Static electricity may cause operating errors.
- (4) Expansion Connector  
Used for connecting CP-series Expansion Units or Expansion I/O Units.

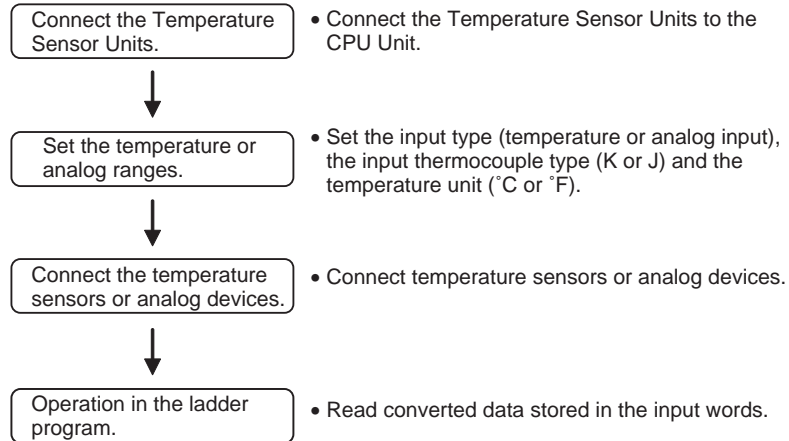
**Main Specifications**

| Item                            |                       | CP1W-TS003  |
|---------------------------------|-----------------------|---|
| Temperature sensors             |                       | Thermocouples or Analog input (See note1.)  |
|                                 |                       | Switchable between K and J, but same type must be used for all inputs.  |
| Number of inputs                |                       | 4   |
| Allocated input words           |                       | 4   |
| Max. number of Units            |                       | 3   |
| Accuracy at 25°C                | Thermocouple inputs   | (The larger of $\pm 0.5\%$ of converted value or $\pm 2^\circ\text{C}$ ) $\pm 1$ digit max. (See note2.)  |
|                                 | Analog voltage inputs | 0.5% full scale   |
|                                 | Analog current inputs | 0.6% full scale   |
| Accuracy at 0 to 55 °C          | Thermocouple inputs   | (The larger of $\pm 1\%$ of converted value or $\pm 4^\circ\text{C}$ ) $\pm 1$ digit max. (See note3.)  |
|                                 | Analog voltage inputs | 1.0% full scale   |
|                                 | Analog current inputs | 1.2% full scale   |
| Input signal range              | Thermocouple inputs   | K: $-200.0$ to $1300.0^\circ\text{C}$ or $-300.0$ to $2300.0^\circ\text{F}$<br>J: $-100.0$ to $850.0^\circ\text{C}$ or $-100.0$ to $1500.0^\circ\text{F}$ |
|                                 | Analog voltage inputs | 0 to 10V, 1 to 5V   |
|                                 | Analog current inputs | 4 to 20mA   |
| Resolution                      | Thermocouple inputs   | $0.1^\circ\text{C}$ or $0.1^\circ\text{F}$  |
|                                 | Analog inputs         | 1/12000 (full scale)  |
| Max. rated input                | Analog voltage inputs | $\pm 15\text{V}$  |
|                                 | Analog current inputs | $\pm 30\text{mA}$   |
| External input impedance        | Analog voltage inputs | 1M $\Omega$ min.  |
|                                 | Analog current inputs | 250 $\Omega$  |
| Open-circuit detection function |                       | Supported   |
| Averaging function              |                       | Unsupported   |
| Conversion time                 |                       | 250 ms for 4 input points   |
| Converted temperature data      |                       | 16-bit binary data (4-digit hexadecimal)<br>2-decimal-place mode is not supported   |
| Converted AD data               |                       | 16-bit binary data (4-digit hexadecimal)  |
| Isolation                       |                       | Photocouplers between any two input signals   |
| Current consumption             |                       | 5 VDC: 70 mA max., 24 VDC: 30 mA max.   |

**Note**

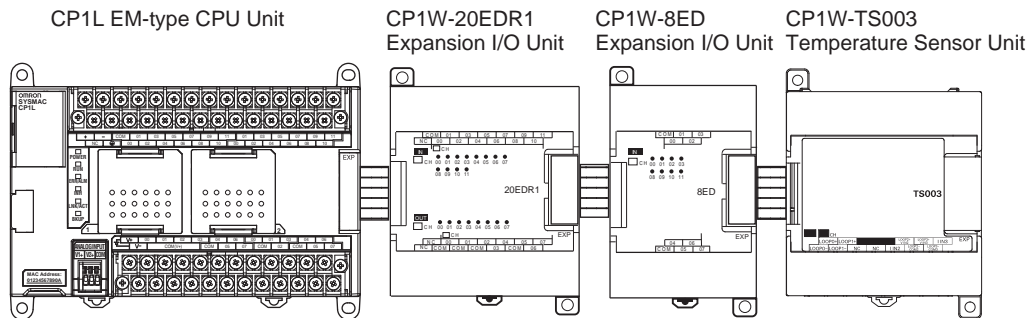
- (1) Only last two channels can be used as analog input.  
 (2) Accuracy for a K-type sensor at  $-100^\circ\text{C}$  or less is  $\pm 4^\circ\text{C} \pm 1$  digit max.  
 (3) Accuracy for a K-type sensor at  $-100^\circ\text{C}$  or less is  $\pm 10^\circ\text{C} \pm 1$  digit max.

## Using Temperature Sensor Units



### Connecting Temperature Sensor Units

For CP1L EM-type CPU Units, a maximum of three CP1W-TS003 Temperature Sensor Units can be connected, because each unit is allocated four words. For CP1L EL-type CPU Units, one Unit can be connected.



### Setting Temperature or Analog Ranges

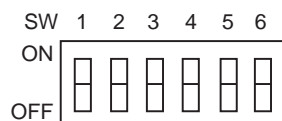
- Note**
- (1) Always turn OFF the power supply before setting the temperature or analog range.
  - (2) Never touch the DIP switch during Temperature Sensor Unit operation. Static electricity may cause operating errors.

#### DIP Switch Settings

**Caution** Set the temperature range according to the type of temperature sensor connected to the Unit. Temperature data will not be converted correctly if the temperature range does not match the sensor.

**Caution** Do not set the temperature range to any values other than those for which temperature ranges are given in the following table. An incorrect setting may cause operating errors.

The DIP switch is used to set the input type (temperature or analog input), the input thermocouple type (K or J) and the temperature unit (°C or °F).





| SW | Setting   |     |                   |
|----|---|-----|-------------------|
| 1  | Thermocouple type of temperature sensor             | ON  | J                 |
|    |   | OFF | K                 |
| 2  | Temperature unit                                    | ON  | °F                |
|    |   | OFF | °C                |
| 3  | NC  |     |                   |
| 4  | Input type selection for the third input (Input 2)  | ON  | Analog input      |
|    |   | OFF | Thermocouple      |
| 5  | Input type selection for the fourth input (Input 3) | ON  | Analog input      |
|    |   | OFF | Thermocouple      |
| 6  | Analog input signal range                           | ON  | 1 to 5V/4 to 20mA |
|    |   | OFF | 0 to 10V          |

| Temperature input |                  |                  | Analog input |                  |
|-------------------|------------------|------------------|--------------|------------------|
| Input type        | Range (°C)       | Range (°F)       | Input type   | Range            |
| K                 | −200.0 to 1300.0 | −300.0 to 2300.0 | Voltage      | 0 to 10V/1 to 5V |
| J                 | −100.0 to 850.0  | −100.0 to 1500.0 | Current      | 4 to 20mA        |

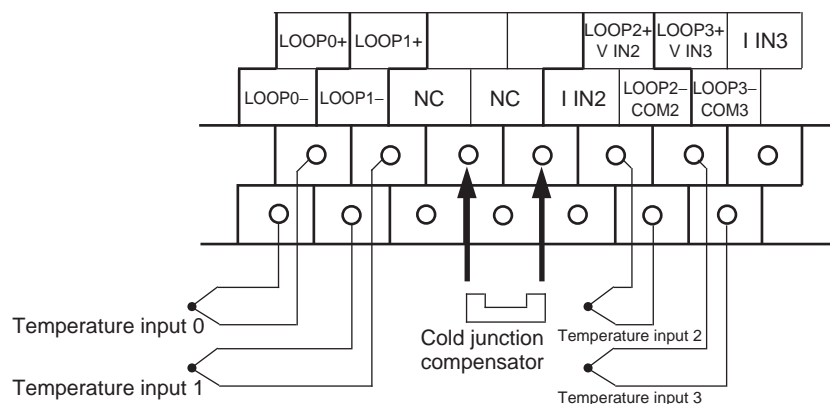
**Note** Fahrenheit temperature uses the following equation to convert the temperature unit from Celsius, but the temperature input range is different between Fahrenheit and Celsius.

$$\text{Fahrenheit temperature (°F)} = \text{Celsius temperature (°C)} \times 1.8 + 32$$

### Connecting Temperature Sensors

#### Thermocouples

Either K or J thermocouples can be connected, but all four thermocouples must be the same type and the same input range. Only last two channels can be used as analog inputs.

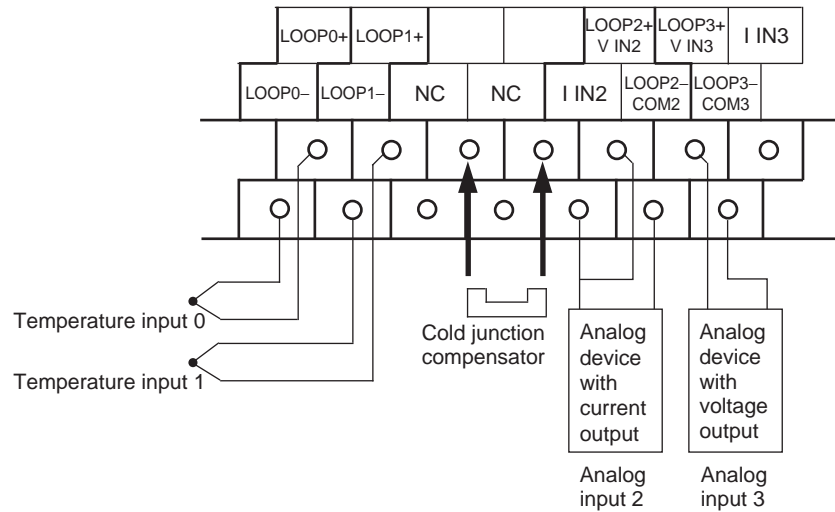


**Note** When connecting a thermocouple input, observe the following precautions:

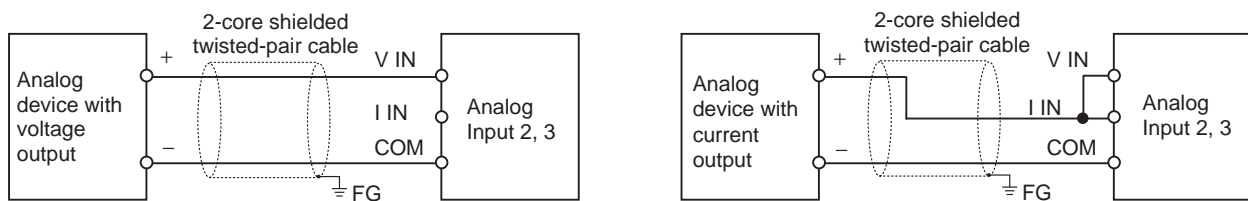
- Do not remove the cold junction compensator attached at the time of delivery. If the cold junction compensator is removed, the Unit will not be able to measure temperatures correctly.
- Each of the input circuits is calibrated with the cold junction compensator attached to the Unit. If the Unit is used with the cold junction compensator from other Units, the Unit will not be able to measure temperatures correctly.
- Do not touch the cold junction compensator. Doing so may result in incorrect temperature measurement.

### Analog Inputs

Last two channels can be used as analog inputs, but two of the analog inputs must be the same range.



### Wiring for Analog Inputs



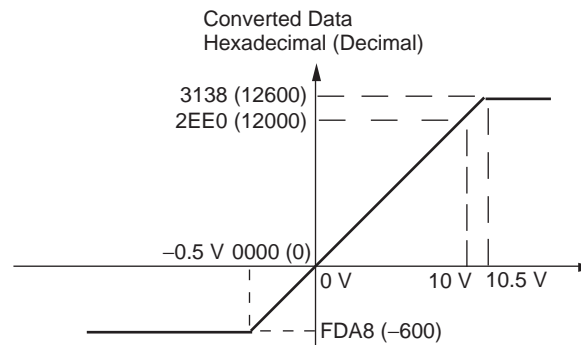
- Note**
- (1) When an input is not being used, short the + and – terminals.
  - (2) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
  - (3) When there is noise in the power supply line, install a noise filter on the input section and the power supply.

### Analog Input Signal Ranges

When the input exceeds the specified range, the AD converted data will be fixed at either the lower limit or upper limit.

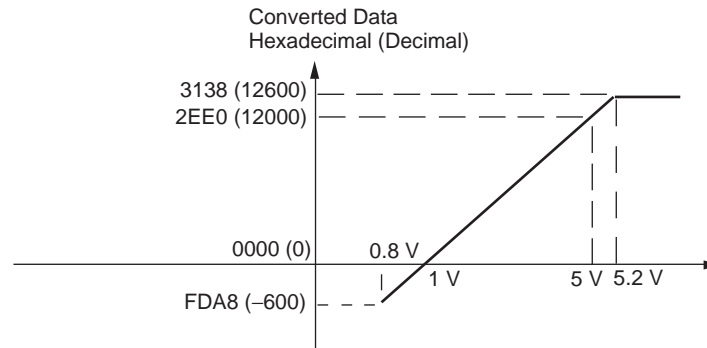
#### 0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (–600 to 12600). A negative voltage is expressed as a two's complement.

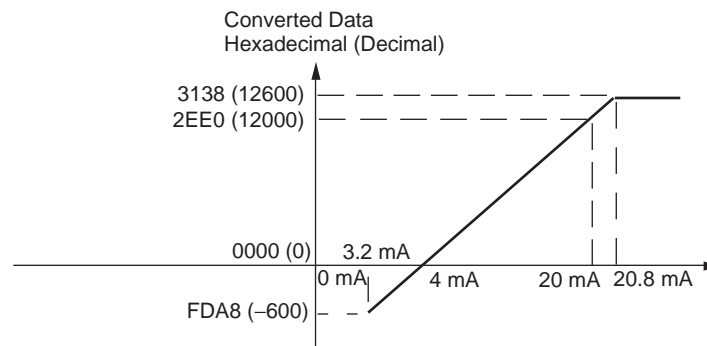


**1 to 5 V**

The 1 to 5 V range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (–600 to 12600). Inputs between 0.8 and 1 V are expressed as two's complements. If the input falls below 0.8 V, open-circuit detection will activate and converted data will be 8000.

**4 to 20 mA**

The 4 to 20 mA range corresponds to the hexadecimal values 0000 to 2EE0 (0 to 12000). The entire data range is FDA8 to 3138 (–600 to 12600). Inputs between 3.2 and 4 mA are expressed as two's complements. If the input falls below 3.2 mA, open-circuit detection will activate and converted data will be 8000.

**Open-circuit Detection Function for Temperature****Open-circuit Detection Function for Analog Inputs**

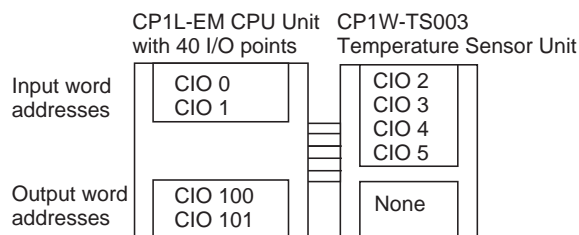
If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.

The open-circuit detection function is activated when the input range is set to 1 to 5 V and the voltage drops below 0.8 V, or when the input range is set to 4 to 20 mA and the current drops below 3.2 mA. When the open-circuit detection function is activated, the converted data will be set to 8,000.

The time for enabling or clearing the open-circuit detection function is the same as the time for converting the data. If the input returns to the convertible range, the open-circuit detection is cleared automatically and the output returns to the normal range.

**Creating a Ladder Program****Word Allocations**

Temperature Sensor Units are allocated words in the same way as other CP-series Expansion Units or Expansion I/O Units, in order of connection. A Temperature Sensor Unit is allocated the next input words following the input words of the CPU Unit or previous Expansion Unit or Expansion I/O Unit. Four input words are allocated to CP1W-TS003.

**Example****Converted Temperature Data**

The converted temperature value will be stored in the input words allocated to the Temperature Sensor Unit in 4-digit hexadecimal.

|     |   |
|-----|---|
| m+1 | Converted temperature data from input 0 |
| m+2 | Converted temperature data from input 1 |
| m+3 | Converted temperature data from input 2 |
| m+4 | Converted temperature data from input 3 |

“m” is the last input word allocated to the CPU Unit, Expansion I/O Unit, or Expansion Unit connected immediately before the Temperature Sensor Unit.

- Negative values are stored as 2's complements.
- Data for range codes that include one digit after the decimal point are stored without the decimal point, i.e., 10 times the actual value is stored.

| Input       |        | Data conversion examples |   |
|-------------|--------|--------------------------|---|
| Unit: 0.1°C | K or J | ×10                      | 500.0°C → 5000 → 1388 hex<br>-20.0°C → -200 → FF38 hex<br>-200.0°C → -2000 → F830 hex |

- If the input temperature exceeds the maximum or minimum value in the temperature input range that has been set by  $\pm 20^{\circ}\text{C}$  or  $\pm 20^{\circ}\text{F}$ , the displayed value will be held.
- If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.
- The open-circuit detection function will be automatically cleared and normal input temperature conversion will begin automatically when the input temperature returns to the convertible range.

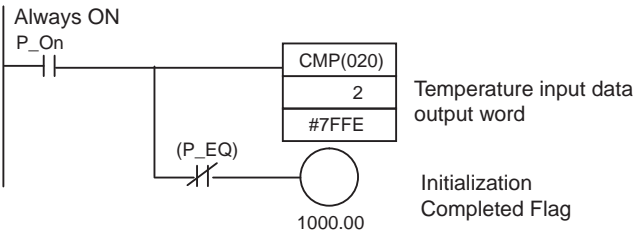
**Converted Analog Data**

|     |                                    |
|-----|------------------------------------|
| m+3 | Converted analog data from input 2 |
| m+4 | Converted analog data from input 3 |

“m” is the last input word allocated to the CPU Unit, Expansion I/O Unit, or Expansion Unit connected immediately before the Temperature Sensor Unit.

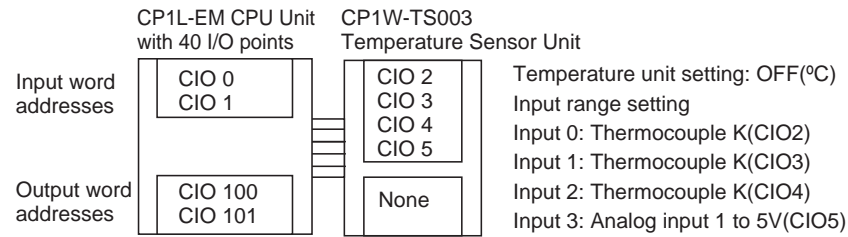
Startup Operation

After power is turned ON, approximately 1 s is required for the first conversion data to be stored in the input word. During that period, the data will be 7FFE. Therefore, create a program as shown below, so that the ladder can start to operate with valid conversion data in input words.



Programming Example

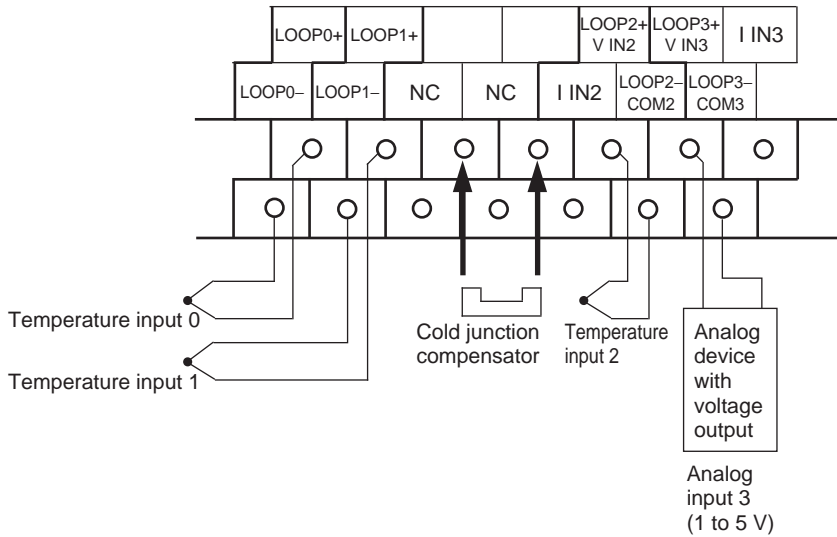
The following programming example shows how to store the input data of CP1W-TS003 (4 inputs) in D0 to D3, and W10.00 to W10.03 turn ON at the time of open-circuit detection.

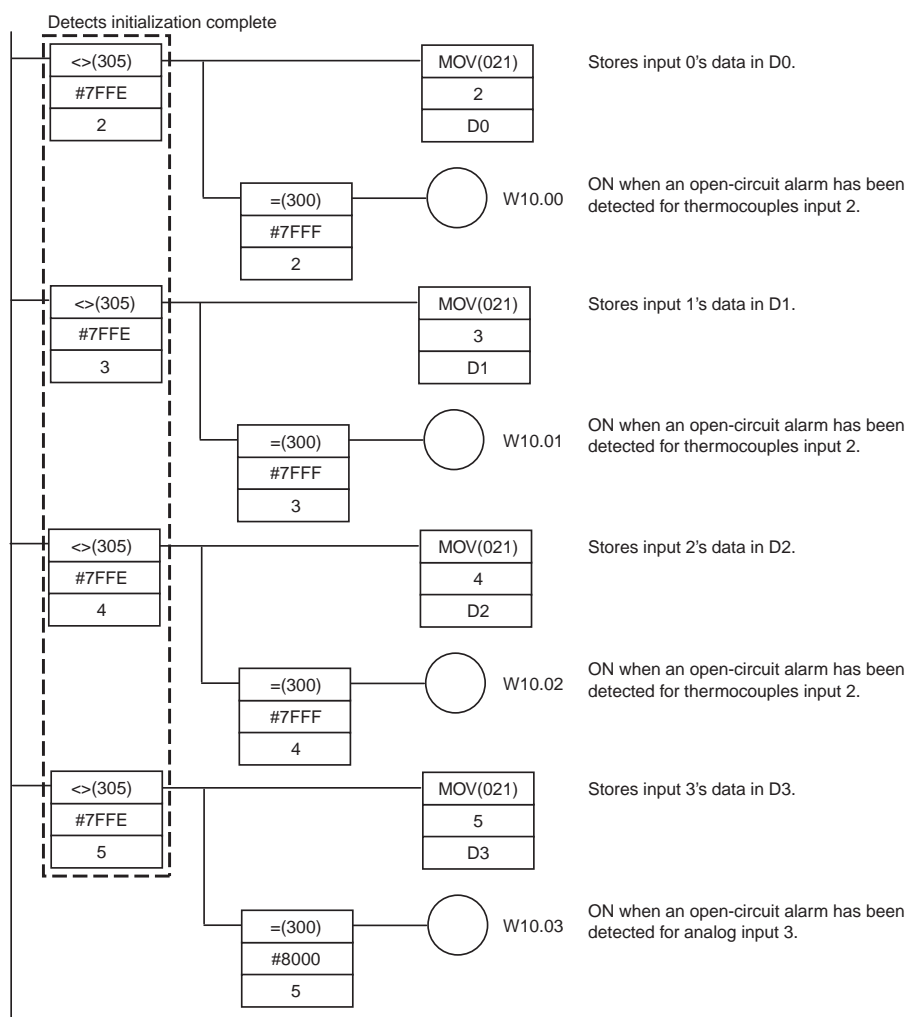


DIP Switch Setting

|     |     |                   |
|-----|-----|-------------------|
| SW1 | OFF | K                 |
| SW2 | OFF | °C                |
| SW3 | NC  |                   |
| SW4 | OFF | Thermocouple      |
| SW5 | ON  | Analog            |
| SW6 | ON  | 1 to 5V/4 to 20mA |

Wiring Diagram





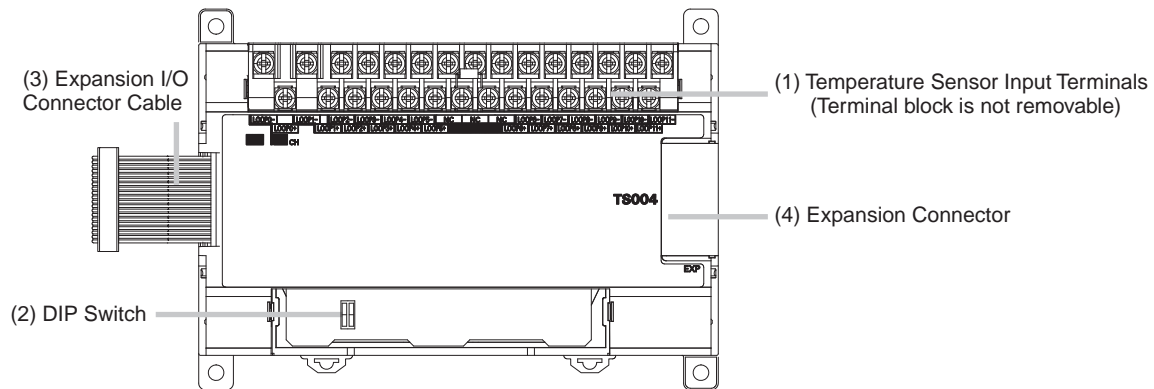
### 9-5-3 CP1W-TS004 Temperature Sensor Units

CP1W-TS004 Temperature Sensor Unit provide up to twelve input points.  
The inputs can be from thermocouples.

CP1W-TS004 Temperature Sensor Unit is allocated two input words and one output word, so no more than seven Units can be connected.

#### Part Names

##### Temperature Sensor Units: CP1W-TS004



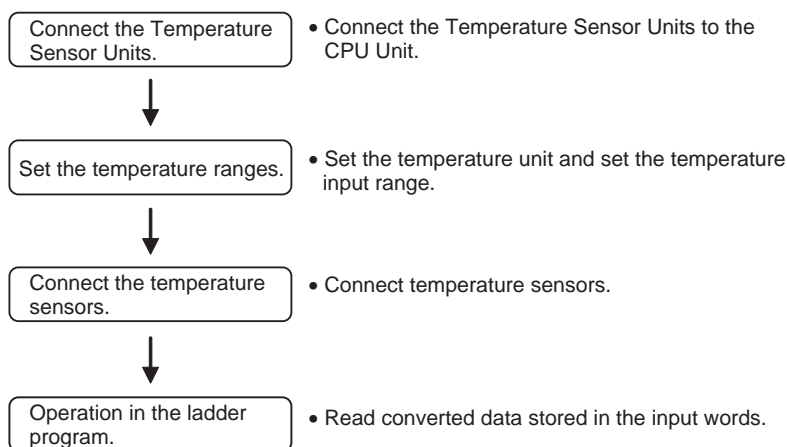
- (1) Temperature Sensor Input Terminals  
Used to connect temperature sensors such as thermocouples.
  - (2) DIP Switch  
Used to set the temperature unit ( $^{\circ}\text{C}$  or  $^{\circ}\text{F}$ ) and the temperature input range. Make the setting according to the specifications of the temperature sensors that are connected.
  - (3) Expansion I/O Connecting Cable  
Connected to the expansion connector of a CP1L-EL/EM CPU Unit or a CP-series Expansion Unit or Expansion I/O Unit. The cable is included with the Temperature Sensor Unit and cannot be removed.
- Note** Do not touch the cables during operation. Static electricity may cause operating errors.
- (4) Expansion Connector  
Used for connecting CP-series Expansion Units or Expansion I/O Units.

## Main Specifications

| Item                       |           | CP1W-TS004   |
|----------------------------|-----------|--|
| Temperature sensors        |           | Thermocouples  |
|                            |           | Switchable between K and J, but same type must be used for all inputs.                                   |
| Number of inputs           |           | 12   |
| Allocated input words      |           | 2  |
| Allocated output words     |           | 1  |
| Accuracy                   | 25°C      | (The larger of $\pm 0.5\%$ of converted value or $\pm 2^\circ\text{C}$ ) $\pm 1$ digit max. (See note1.) |
|                            | 0 to 55°C | (The larger of $\pm 1\%$ of converted value or $\pm 4^\circ\text{C}$ ) $\pm 1$ digit max. (See note2.)   |
| Conversion time            |           | 500 ms for 12 input points   |
| Converted temperature data |           | 16-bit binary data (4-digit hexadecimal)<br>2-decimal-place mode is not supported                        |
| Isolation                  |           | Photocouplers between any two input signals  |
| Current consumption        |           | 5 VDC: 80 mA max., 24 VDC: 50 mA max.  |

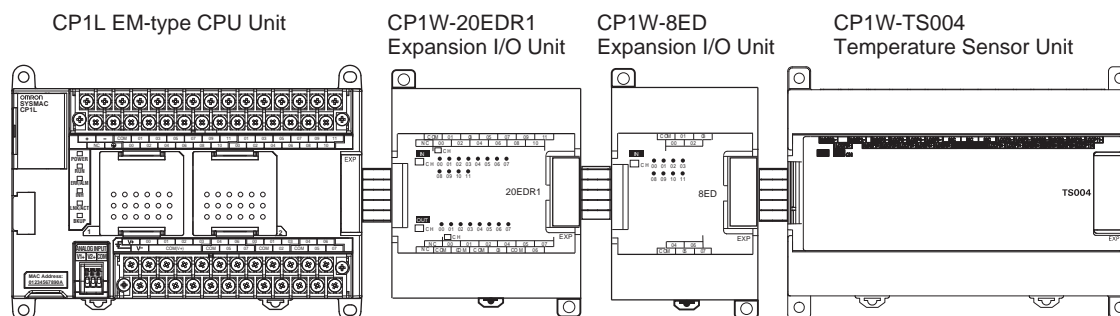
- Note**
- (1) Accuracy for a K-type sensor at  $-100^\circ\text{C}$  or less is  $\pm 4^\circ\text{C} \pm 1$  digit max.
  - (2) Accuracy for a K-type sensor at  $-100^\circ\text{C}$  or less is  $\pm 10^\circ\text{C} \pm 1$  digit max.

## Using Temperature Sensor Units



## Connecting Temperature Sensor Units

A maximum of seven CP1W-TS004 Temperature Sensor Units can be connected, because each unit is allocated two input words and one output word.





## Setting Temperature Ranges

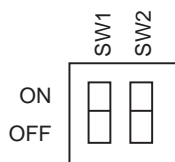
- Note**
- (1) Always turn OFF the power supply before setting the temperature range.
  - (2) Never touch the DIP switch during Temperature Sensor Unit operation. Static electricity may cause operating errors.

**DIP Switch Settings**

**Caution** Set the temperature range according to the type of temperature sensor connected to the Unit. Temperature data will not be converted correctly if the temperature range does not match the sensor.

**Caution** Do not set the temperature range to any values other than those for which temperature ranges are given in the following table. An incorrect setting may cause operating errors.

The DIP switch is used to set the temperature unit and to set the temperature input range.



| SW | Setting          |     |    |
|----|------------------|-----|----|
| 1  | Input type       | ON  | J  |
|    |                  | OFF | K  |
| 2  | Temperature unit | ON  | °F |
|    |                  | OFF | °C |

| Temperature input |                  |                  |
|-------------------|------------------|------------------|
| Input type        | Range (°C)       | Range (°F)       |
| K                 | –200.0 to 1300.0 | –300.0 to 2300.0 |
| J                 | –100.0 to 850.0  | –100.0 to 1500.0 |

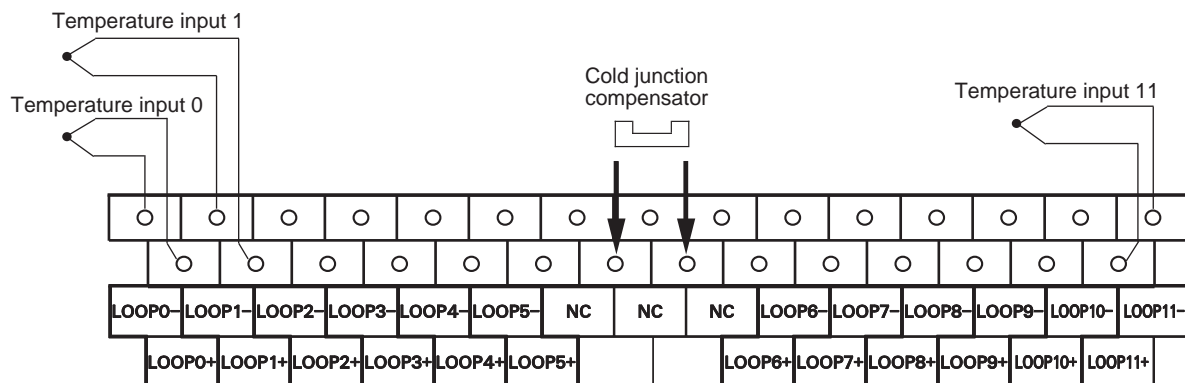
**Note** Fahrenheit temperature uses the following equation to convert the temperature unit from Celsius, but the temperature input range is different between Fahrenheit and Celsius.

$$\text{Fahrenheit temperature (°F)} = \text{Celsius temperature (°C)} \times 1.8 + 32$$

### Connecting Temperature Sensors

#### Thermocouples

Either K or J thermocouples can be connected, but all twelve of the thermocouples must be of the same type and the same input range must be used for each.



**Note** When connecting a thermocouple input, observe the following precautions:

- Do not remove the cold junction compensator attached at the time of delivery. If the cold junction compensator is removed, the Unit will not be able to measure temperatures correctly.
- Each of the input circuits is calibrated with the cold junction compensator attached to the Unit. If the Unit is used with the cold junction compensator from other Units, the Unit will not be able to measure temperatures correctly.
- Do not touch the cold junction compensator. Doing so may result in incorrect temperature measurement.
- Use the thermocouple with metallic shield and connect the shield to ground.

### Open-circuit Detection Function for Temperature

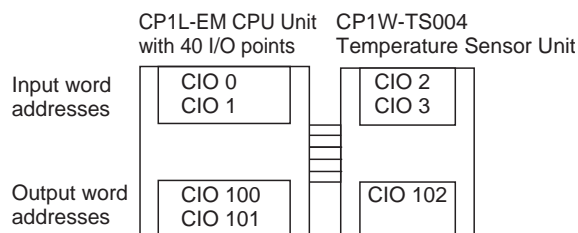
If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.

### Creating a Ladder Program

#### Word Allocations

Temperature Sensor Units are allocated words in the same way as other CP-series Expansion Units or Expansion I/O Units, in order of connection. A Temperature Sensor Unit is allocated the next input words following the input words of the CPU Unit or previous Expansion Unit or Expansion I/O Unit. Two input words and one output word are allocated to CP1W-TS004.

#### Example



#### Temperature Data Read Operation

There are 12 temperature input data to be read, but only two input words are allocated to CP1W-TS004. The operation is shown as the following.

**Input Word**

|     |  |
|-----|--|
| m+1 | Response. Input words stored in CIO m+2      |
| m+2 | Temperature data of the specified input word |

**Output Word**

|     |  |
|-----|--|
| n+1 | Read command data (input word specified) |
|-----|--|

**Read/Response Command and Temperature Data**

| Command                             | Output Word  | Input Word                     |  |
|-------------------------------------|--------------|--------------------------------|--|
|                                     | n+1          | m+1                            | m+2                                    |
|                                     | Read command | Response command               | Temperature data (4-digit hexadecimal) |
| Read temperature data from input 0  | #9901        | 9901                           | Input 0 temperature data               |
| Read temperature data from input 1  | #9902        | 9902                           | Input 1 temperature data               |
| Read temperature data from input 2  | #9903        | 9903                           | Input 2 temperature data               |
| Read temperature data from input 3  | #9904        | 9904                           | Input 3 temperature data               |
| Read temperature data from input 4  | #9905        | 9905                           | Input 4 temperature data               |
| Read temperature data from input 5  | #9906        | 9906                           | Input 5 temperature data               |
| Read temperature data from input 6  | #9907        | 9907                           | Input 6 temperature data               |
| Read temperature data from input 7  | #9908        | 9908                           | Input 7 temperature data               |
| Read temperature data from input 8  | #9909        | 9909                           | Input 8 temperature data               |
| Read temperature data from input 9  | #990A        | 990A                           | Input 9 temperature data               |
| Read temperature data from input 10 | #990B        | 990B                           | Input 10 temperature data              |
| Read temperature data from input 11 | #990C        | 990C                           | Input 11 temperature data              |
| Others                              | Others       | No response for other commands |  |

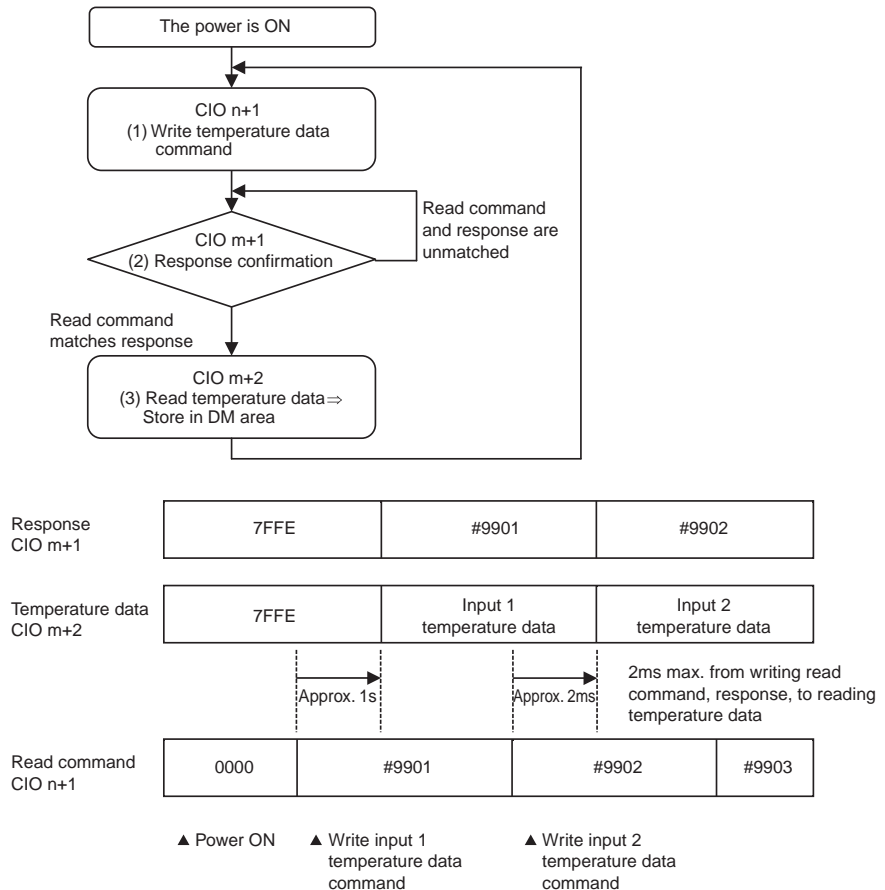
- Negative values are stored as 2's complements.
- The converted temperature data CIO m+2 is stored in 16-bit binary data (4-digit hexadecimal).
- Data for range codes that include one digit after the decimal point are stored without the decimal point, i.e., 10 times the actual value is stored.

| Input       |        | Data conversion examples |   |
|-------------|--------|--------------------------|---|
| Unit: 0.1°C | K or J | ×10                      | 500.0°C → 5000 → 1388 hex<br>-20.0°C → -200 → FF38 hex<br>-200.0°C → -2000 → F830 hex |

- If the input temperature exceeds the maximum or minimum value in the temperature input range that has been set by  $\pm 20^{\circ}\text{C}$  or  $\pm 20^{\circ}\text{F}$ , the displayed value will be held.
- If the circuit is disconnected, the open-circuit detection function will operate and the converted temperature data will be set to 7FFF.
- The open-circuit detection function will be automatically cleared and normal input temperature conversion will begin automatically when the input temperature returns to the convertible range.

**Creating Ladder Program**

- (1) Write temperature data command  
Write temperature data command which read temperature data from input word to CIO n+1.
- (2) Response confirmation  
After CP1W-TS004 receives CIO n+1 read command and CP1W-TS004's internally specified input temperature data is ready, the value which is the same as the read command will be stored in CIO m+1. The temperature data will be stored in CIO m+2 at the same time.
- (3) Read temperature data  
Store the temperature data from CIO m+2 in DM area.

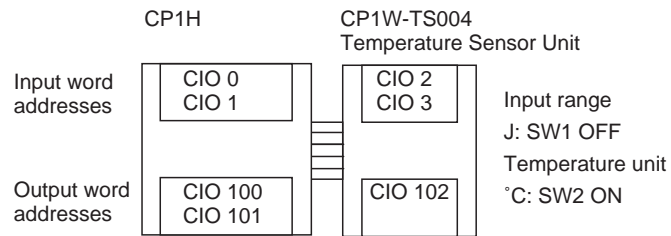
**Note**

- (1) It takes about 2ms maximum until it is reflected to CIO m+1 and m+2 from writing the read command to CIO n+1.
- (2) It takes about 1s after the power is turned ON, till a read command initial processing of CP1W-TS004 is completed, so a response to the read command after power ON takes only about 1s. After the power is turned ON, create a ladder program 1s later due to its control by temperature data.
- (3) When writing a command other than that specified in the temperature data read command, CIO m+1 and m+2 hold the previous value.

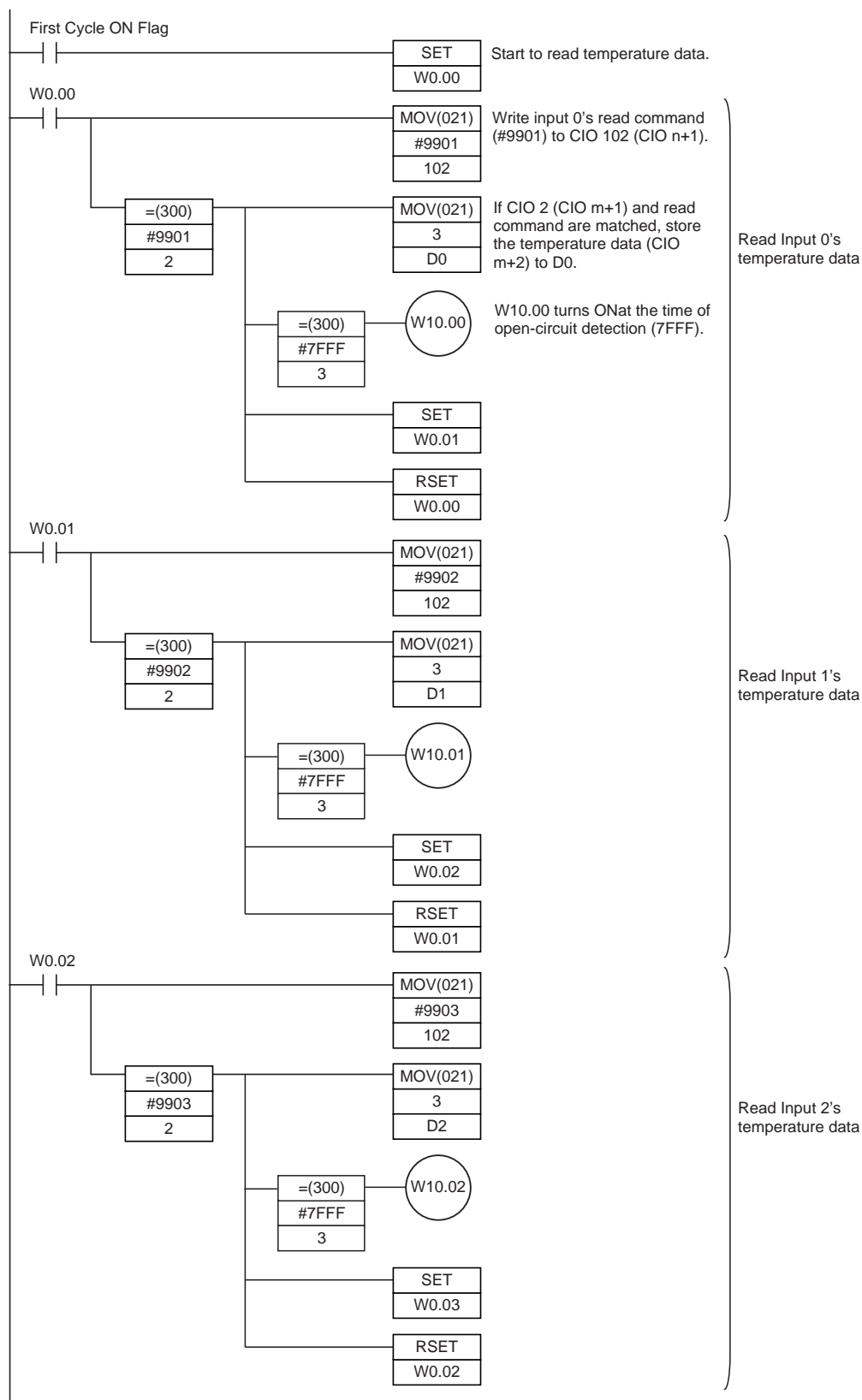
**Programming Example**

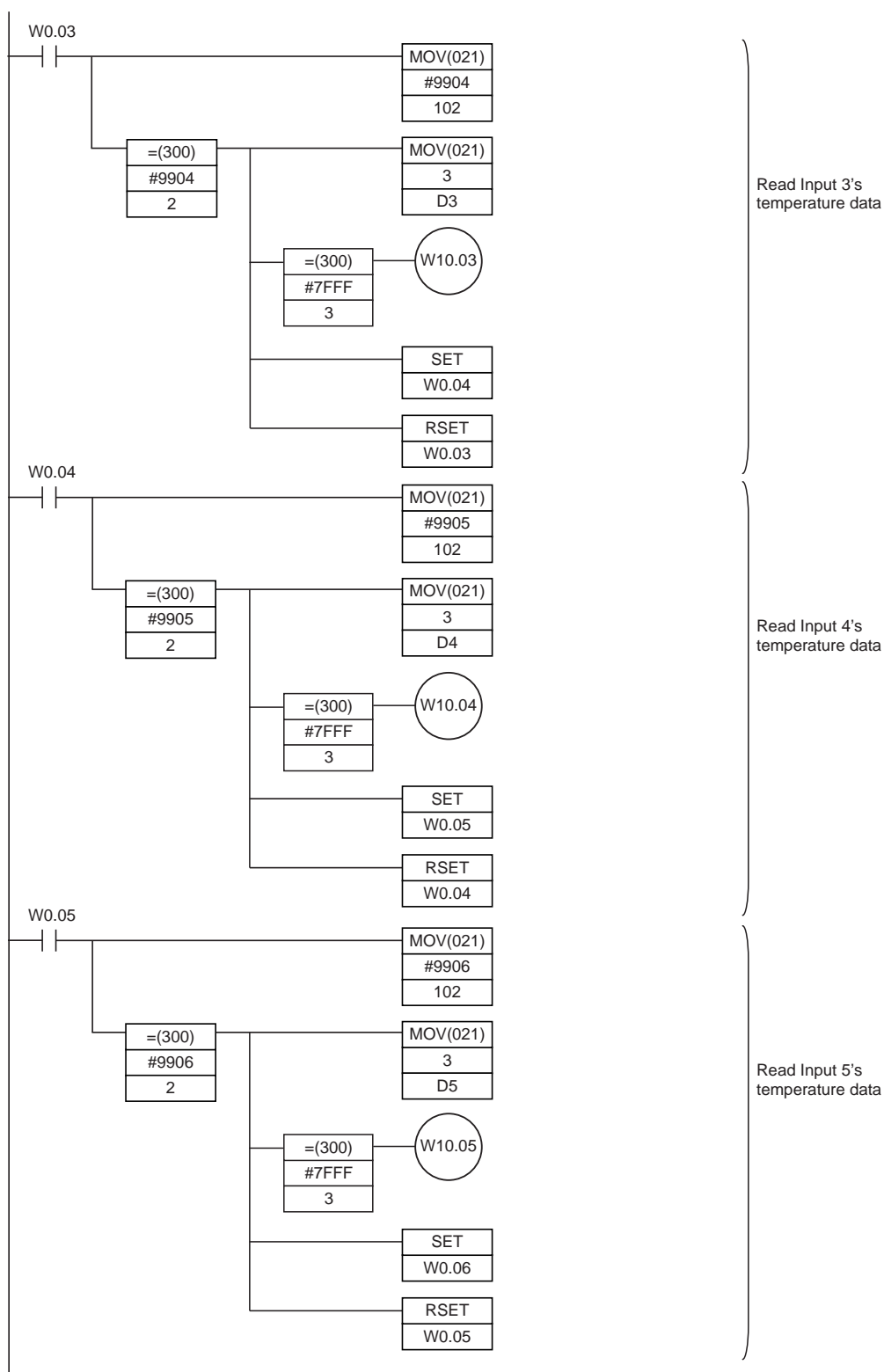
The temperature data of CP1W-TS004 (12 inputs, input type is J type and temperature unit is °C) is stored in D0 to D11.

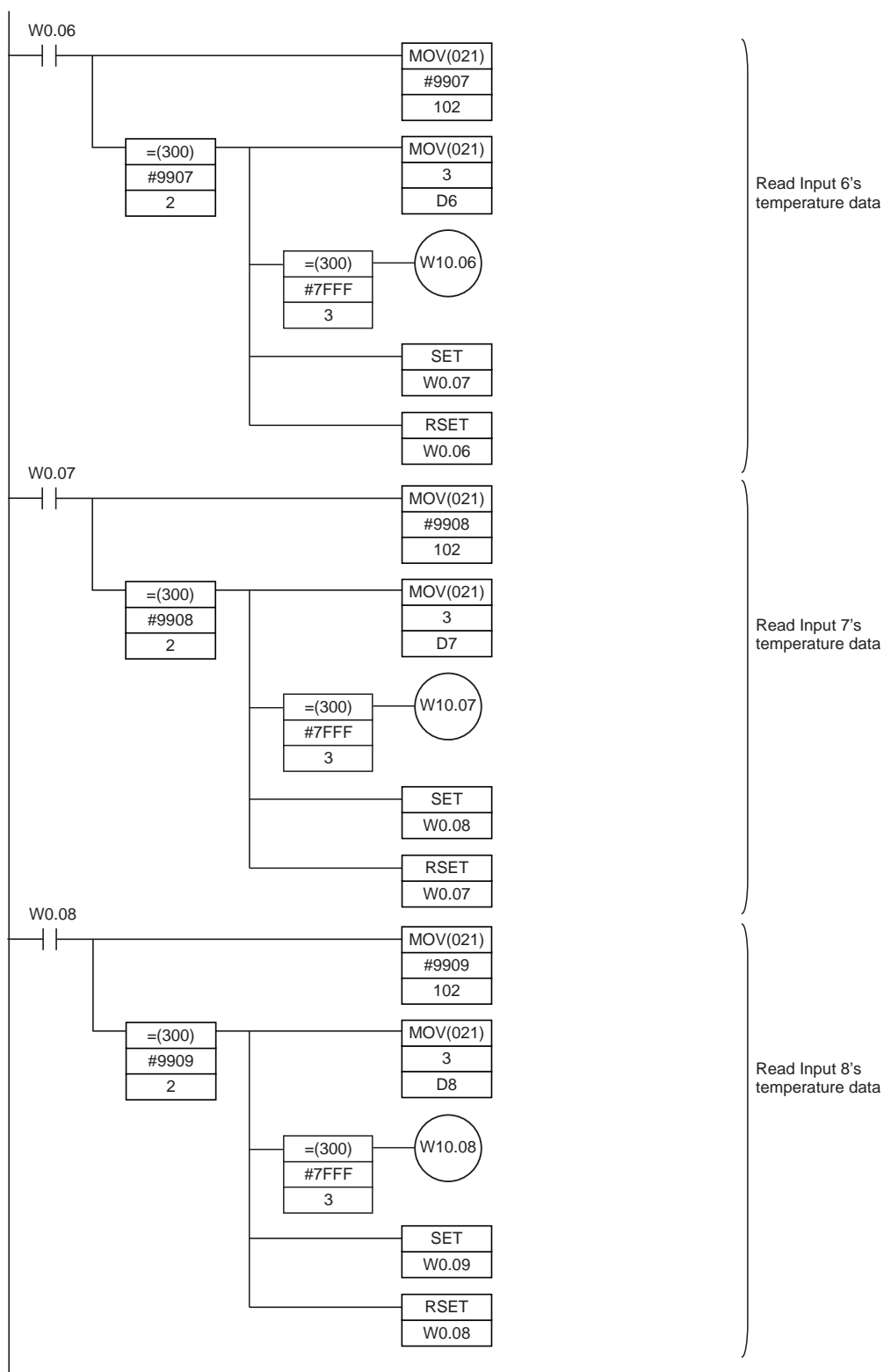
When it occurs open-circuit alarm, W10.00 to W10.11 is ON.

**Temperature Data Storage Address**

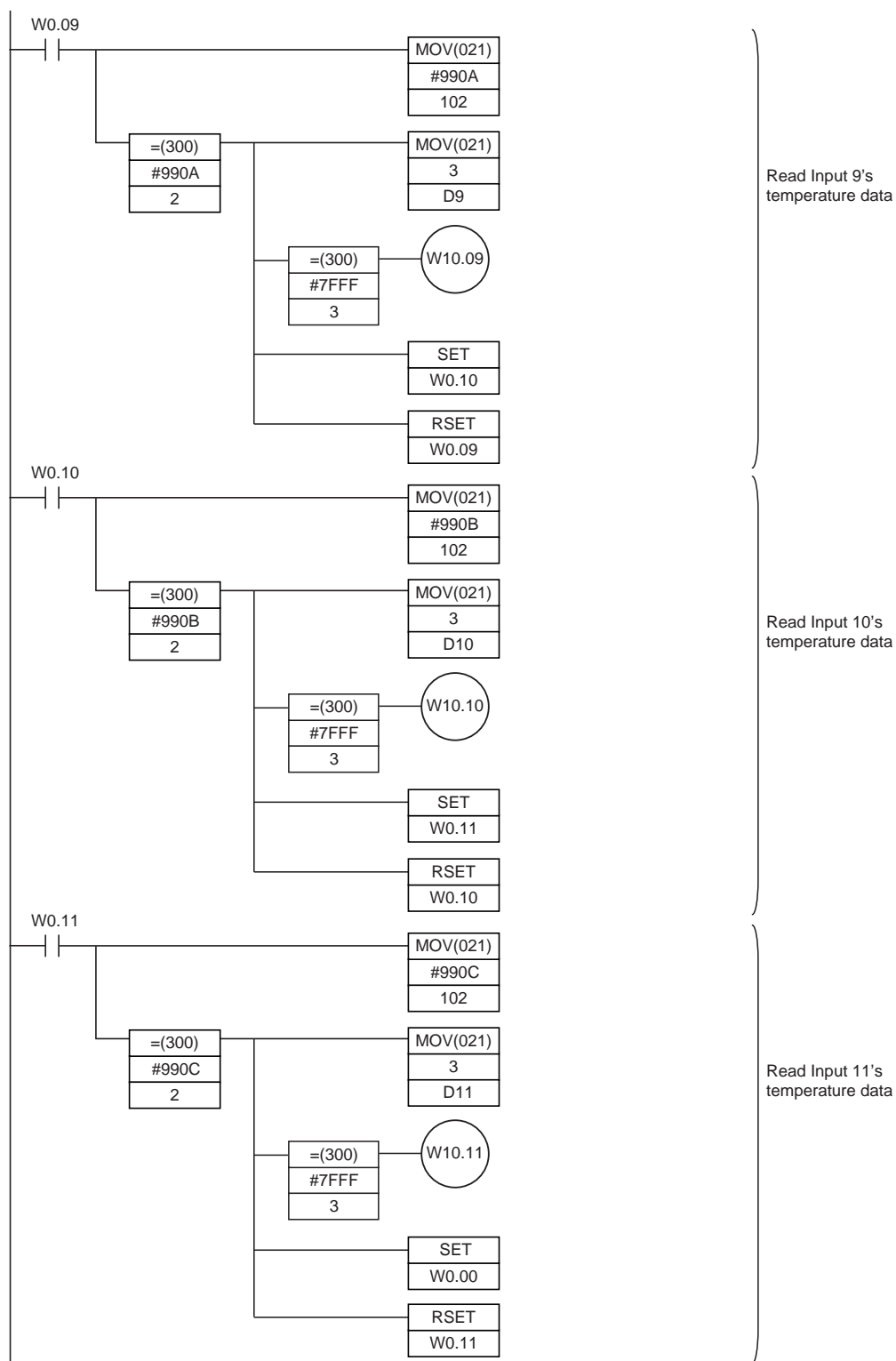
| Input word | Read command<br>CIO n+1 | Temperature data<br>storage address | Open-circuit<br>alarm |
|------------|-------------------------|-------------------------------------|-----------------------|
| Input 0    | #9901                   | D0                                  | W0.00                 |
| Input 1    | #9902                   | D1                                  | W0.01                 |
| Input 2    | #9903                   | D2                                  | W0.02                 |
| Input 3    | #9904                   | D3                                  | W0.03                 |
| Input 4    | #9905                   | D4                                  | W0.04                 |
| Input 5    | #9906                   | D5                                  | W0.05                 |
| Input 6    | #9907                   | D6                                  | W0.06                 |
| Input 7    | #9908                   | D7                                  | W0.07                 |
| Input 8    | #9909                   | D8                                  | W0.08                 |
| Input 9    | #990A                   | D9                                  | W0.09                 |
| Input 10   | #990B                   | D10                                 | W0.10                 |
| Input 11   | #990C                   | D11                                 | W0.11                 |





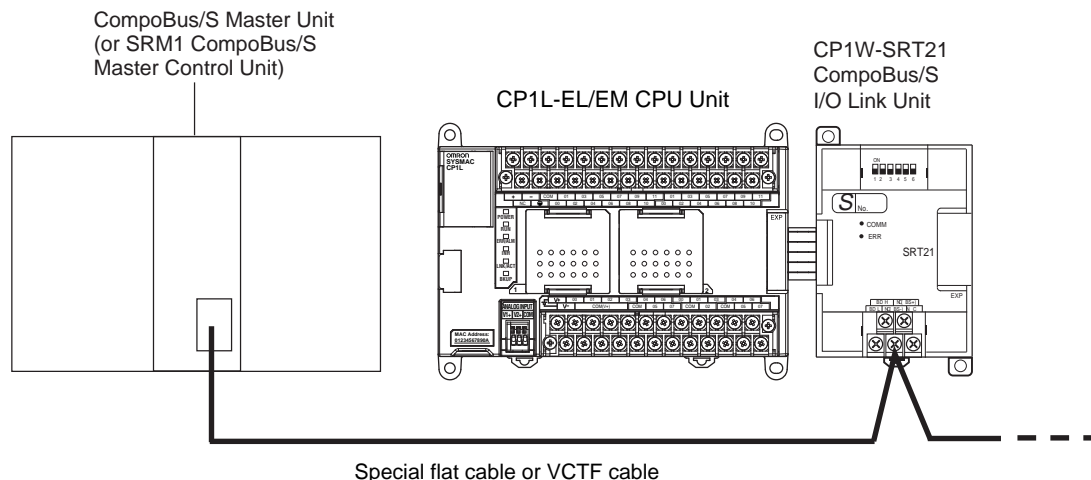




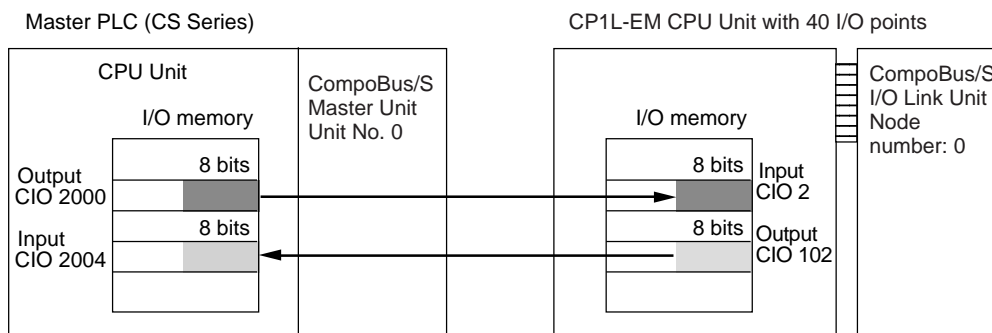


## 9-6 CompoBus/S I/O Link Units

The CP1L-EL/EM can function as a slave to a CompoBus/S Master Unit (or SRM1 CompoBus/S Master Control Unit) when a CP1W-SRT21 CompoBus/S I/O Link Unit is connected. The CompoBus/S I/O Link Unit establishes an I/O link of 8 inputs and 8 outputs between the Master Unit and the PLC. Up to three CompoBus/S I/O Link Units, including other Expansion I/O Units, can be connected to a CP1L-EL/EM CPU Unit.



From the standpoint of the CP1L-EL/EM CPU Unit, the 8 input bits and 8 output bits allocated to the CompoBus/S I/O Link Unit are identical to input and output bits allocated to Expansion I/O Units even though the CompoBus/S I/O Link Unit does not control actual inputs and outputs. The input and output bits allocated to the CompoBus/S I/O Link Unit are one side of an I/O link between the slave CPU Unit and the CPU Unit to which the Master Unit is connected.



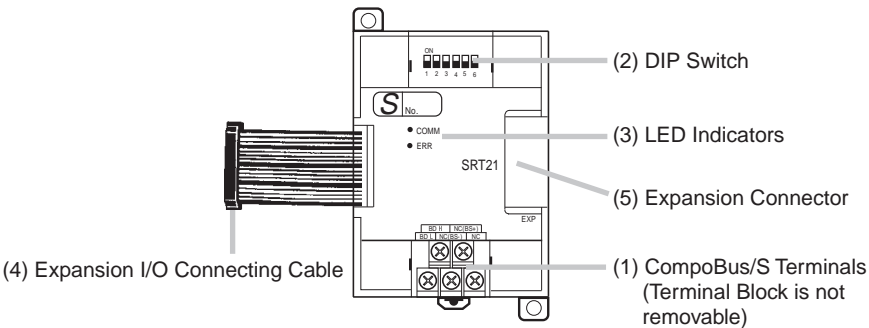
### Specifications

|  |  |
|--|--|
| Model number                                     | CP1W-SRT21   |
| Master/slave                                     | CompoBus/S Slave   |
| Number of I/O points                             | 8 input points, 8 output points  |
| Number of words allocated in CPU Unit I/O memory | 1 input word, 1 output word<br>(Allocated in the same way as Expansion Units and Expansion I/O Units.) |
| Node number setting                              | Set using the DIP switch<br>(Set before turning on the CPU Unit's power supply.)                       |

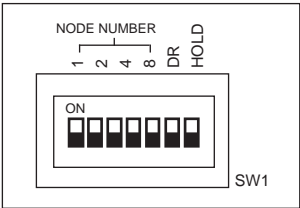
LED Indicators

| Indicator | Name                     | Color  | Meaning   |
|-----------|--------------------------|--------|---|
| COMM      | Communications Indicator | Yellow | ON: Communications in progress.<br>OFF: Communications stopped or error has occurred.         |
| ERR       | Error indicator          | Red    | ON: A communications error has occurred.<br>OFF: Indicates normal communications or stand-by. |

CP1W-SRT21 CompoBus/S I/O Link Unit



- (1) CompoBus/S Terminals
- The following CompoBus/S terminals are provided: CompoBus/S communications data high/low terminals, NC terminals for communications power supply plus (+) and minus (–), and an NC terminal. (Power is supplied internally for this Unit, so the NC terminals for communications power supply can be used as relay terminals.)
- (2) DIP Switch
- Used to specify the node number for the CompoBus/S I/O Link Unit. (Refer to the following table.)



| Pin labels | Contents            |   |   |   |   |
|------------|---------------------|---|---|---|---|
| 1          | Node Number Setting | SW1   |   |   |   |
| 2          |                     | 8   | 4 | 2 | 1 |
| 4          |                     | 0   | 0 | 0 | 0 |
| 8          |                     | 1   | 0 | 0 | 1 |
|            |                     | 2   | 0 | 0 | 1 |
|            |                     | 3   | 0 | 0 | 1 |
|            |                     | 4   | 0 | 1 | 0 |
|            |                     | 5   | 0 | 1 | 0 |
|            |                     | 6   | 0 | 1 | 1 |
|            |                     | 7   | 0 | 1 | 1 |
|            |                     | 8   | 1 | 0 | 0 |
|            |                     | 9   | 1 | 0 | 1 |
|            |                     | 10  | 1 | 0 | 1 |
|            |                     | 11  | 1 | 0 | 1 |
|            |                     | 12  | 1 | 1 | 0 |
|            |                     | 13  | 1 | 1 | 0 |
|            |                     | 14  | 1 | 1 | 1 |
|            |                     | 15  | 1 | 1 | 1 |
|            | 1 = ON, 0 = OFF     |   |   |   |   |
| DR         | ON                  | Long-distance communications mode (See note.) |   |   |   |
|            | OFF                 | High-speed communications mode                |   |   |   |
| HOLD       | ON                  | Retain inputs after a communications error.   |   |   |   |
|            | OFF                 | Clear inputs after a communications error.    |   |   |   |

**Note:** The long-distance communications mode can be used only when one of the following Master Units is connected: C200HW-SRM21-V1, CQM1-SRM21-V1, or SRM1-C0□-V2.

## (3) LED Indicators

Used to show the CompoBus/S communications status.

| Indicator | Name                     | Color  | Meaning   |
|-----------|--------------------------|--------|---|
| COMM      | Communications indicator | Yellow | ON: Communications in progress.<br>OFF: Communications stopped or error has occurred.         |
| ERR       | Error indicator          | Red    | ON: A communications error has occurred.<br>OFF: Indicates normal communications or stand-by. |

## (4) Expansion I/O Connecting Cable

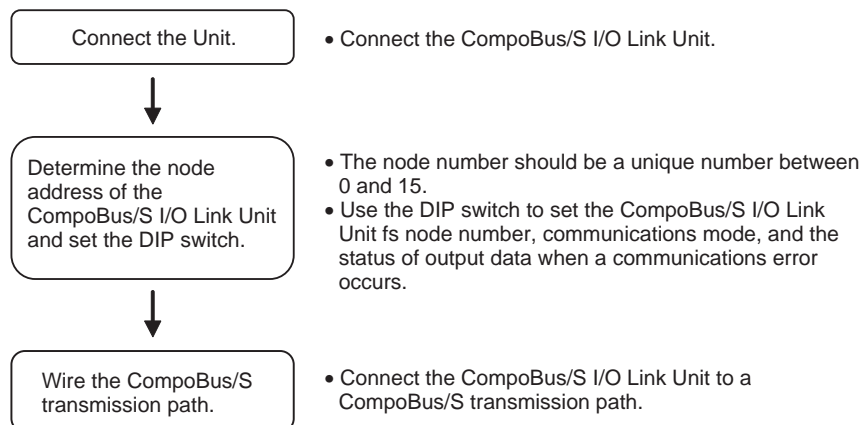
Connected to the expansion connector of a CP1L-EL/EM CPU Unit or a Expansion Unit or Expansion I/O Unit. The cable is provided with the CompoBus/S I/O Link Unit and cannot be removed.

**Note** Do not touch the cables during operation. Static electricity may cause operating errors.

## (5) Expansion Connector

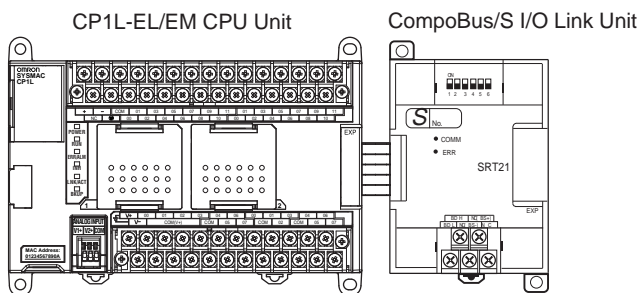
Used to connect Expansion Units or Expansion I/O Units.

## Operating Procedure



## Connecting the CompoBus/S I/O Link Unit

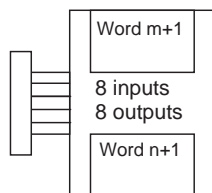
CompoBus/S I/O Link Units are connected to the CP1L-EL/EM CPU Unit. For CP1L EM-type CPU Units, up to three Units can be connected, including any other Expansion Units and Expansion I/O Units. The Units can be connected in any order from the CPU Unit. For CP1L EL-type CPU Units, one Unit can be connected.



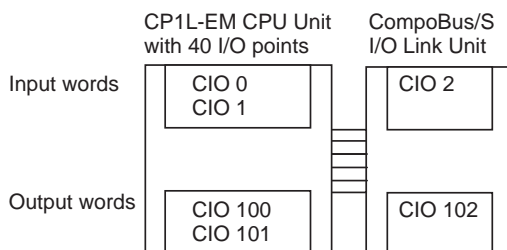
**I/O Allocation**

I/O words are allocated to the CompoBus/S I/O Link Unit in the same way as to other Expansion Units and Expansion I/O Units, i.e., the next available input and output words are allocated. As shown below, when “m” is the last allocated input word and “n” is the last allocated output word, the CompoBus/S I/O Link Unit is allocated “m+1” as its input word and “n+1” as its output word.

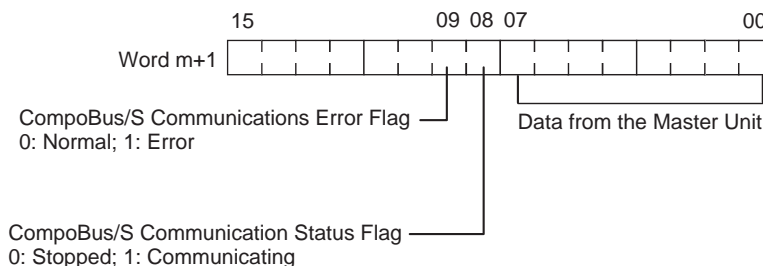
CompoBus/S I/O Link Unit



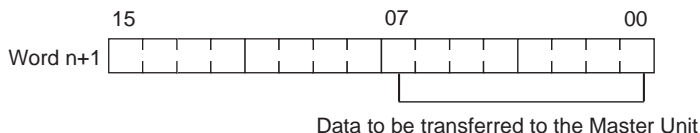
In the following example, a CompoBus/S I/O Link Unit is connected as the first Unit after the CP1L-EM CPU Unit with 40 I/O points.



The input word (m+1) contains the 8 bits of data from the Master Unit and two CompoBus/S communications flags.



Write the data to be transmitted to the Master Unit in the output word (n+1).

**Note**

- (1) The 8 bits of I/O data are not always transmitted simultaneously. In other words, 8 bits of data transmitted from the Master CPU Unit at the same time will not always reach the Slave CPU Unit simultaneously, and 8 bits of data transmitted from the Slave CPU Unit at the same time will not always reach the Master CPU Unit simultaneously. When the 8 bits of input data must be read together, modify the ladder program in the CPU Unit receiving the data. For example, read the input data twice in succession and accept the data only when the two values match.

- (2) Unused bits in the CompoBus/S I/O Link Unit's output word can be used as work bits, but unused bits in the output slaves cannot be used as work bits.
- (3) Unused bits in input word cannot be used as work bits.

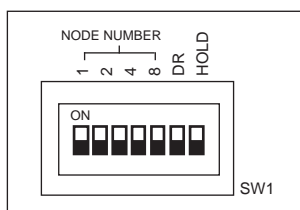
### Determining the Node Number and Making DIP Switch Settings

#### Node Number

- The CompoBus/S I/O Link Unit is a Slave Unit with 8 input bits and 8 output bits. The node number setting is made using the DIP switch; the inputs and outputs share the same node number.
- The range of possible node number settings is determined by the type of PLC the Master Unit is mounted to and the settings on the Master Unit. For details refer to the *CompoBus/S Operation Manual*.

#### DIP Switch Settings

Use the DIP switch to set the CompoBus/S I/O Link Unit's node number, communications mode, and the status of output data when a communications error occurs.



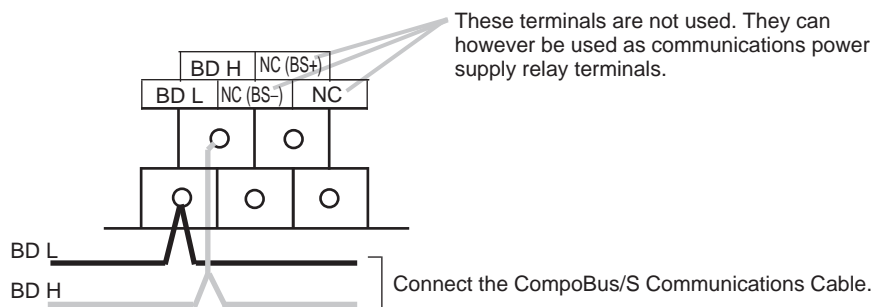
**Note:** The long-distance communications mode can be used only when one of the following Master Units is connected: C200HW-SRM21-V1, CQM1-SRM21-V1, or SRM1-C0□-V2.

| Pin labels | Contents            |   |   |   |   |
|------------|---------------------|---|---|---|---|
| 1          | Node Number Setting | SW1   |   |   |   |
| 2          |                     | 8   | 4 | 2 | 1 |
| 4          |                     | 0   | 0 | 0 | 0 |
| 8          |                     | 1   | 0 | 0 | 1 |
|            |                     | 2   | 0 | 0 | 1 |
|            |                     | 3   | 0 | 0 | 1 |
|            |                     | 4   | 0 | 1 | 0 |
|            |                     | 5   | 0 | 1 | 0 |
|            |                     | 6   | 0 | 1 | 1 |
|            |                     | 7   | 0 | 1 | 1 |
|            |                     | 8   | 1 | 0 | 0 |
|            |                     | 9   | 1 | 0 | 0 |
|            |                     | 10  | 1 | 0 | 1 |
|            |                     | 11  | 1 | 0 | 1 |
|            |                     | 12  | 1 | 1 | 0 |
|            |                     | 13  | 1 | 1 | 0 |
|            |                     | 14  | 1 | 1 | 1 |
|            |                     | 15  | 1 | 1 | 1 |
|            | 1 = ON, 0 = OFF     |   |   |   |   |
| DR         | ON                  | Long-distance communications mode (See note.) |   |   |   |
|            | OFF                 | High-speed communications mode                |   |   |   |
| HOLD       | ON                  | Retain inputs after a communications error.   |   |   |   |
|            | OFF                 | Clear inputs after a communications error.    |   |   |   |

**Note** Always turn OFF the power supply before changing the DIP switch settings.

### Wiring the CompoBus/S Communications Path

Wire the CompoBus/S communications path as shown in the following diagrams.



## SECTION 10

# Analog Input/Output Option Board

This section describes how to use Analog Input/Output Option Board.

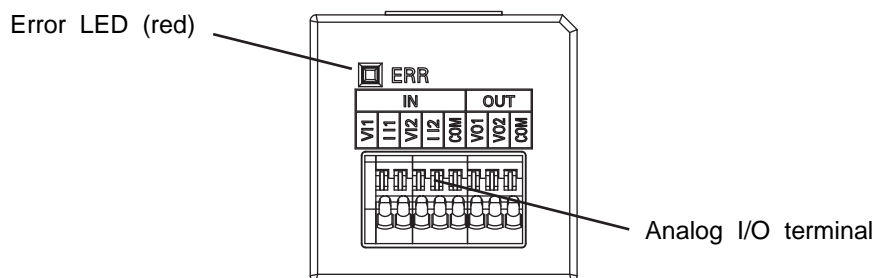
|         |                                      |     |
|---------|--------------------------------------|-----|
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## 10-1 General Specifications

CP1 series analog option board units are non-isolated analog units which allow you to easily realize analog input/output function for CP1L-EL/EM series PLC.

| Analog Option Board        |             | Voltage Input<br>0V~10V<br>(Resolution:1/4000) | Current Input<br>0mA~20mA<br>(Resolution:1/2000) | Voltage Output<br>0V~10V<br>(Resolution:1/4000) |
|----------------------------|-------------|--|--|---|
| Analog I/O Option Board    | CP1W-MAB221 | 2CH  |  | 2CH   |
| Analog Input Option Board  | CP1W-ADB21  | 2CH  |  | ---   |
| Analog Output Option Board | CP1W-DAB21V | ---  |  | 2CH   |

## 10-2 Part Names



Terminal Arrangement for CP1W-ADB21

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| VI1 | II1 | VI2 | II2 | COM |
|-----|-----|-----|-----|-----|

Terminal Arrangement for CP1W-DAB21V

|     |     |     |
|-----|-----|-----|
| VO1 | VO2 | COM |
|-----|-----|-----|

Terminal Arrangement for CP1W-MAB221

|     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|
| VI1 | II1 | VI2 | II2 | COM | VO1 | VO2 | COM |
|-----|-----|-----|-----|-----|-----|-----|-----|

**Note** Two COM are connected in inner circuit.

### LED pattern

| LED | Color | Description               | Status  | Remark  |
|-----|-------|---------------------------|---------|---|
| ERR | Red   | Fault condition indicator | Flash   | A communication error with CPU unit has occurred at the unit. |
|     |       |                           | Lit     | Other errors except the communication error.                  |
|     |       |                           | Not lit | Operation is normal.  |



## 10-3 Installation and Setting

### 10-3-1 Installation

The following processing explains how to install and remove an Analog Option Board.

**⚠ Caution** Always turn OFF the power supply to the CPU unit and wait until all the operation indicators go out before installing or removing the analog option board. Not doing so may result in an unexpected operation.

- 1,2,3...**
1. Press the up/down lock-levers on both sides of the Option Board slot cover at the same time to unlock the cover, and then pull the cover out.
  2. Check the alignment to make the corner cut of the Analog Option Board fit in the Option Board slot, and firmly press the Analog Option Board in until it snaps into place.

### 10-3-2 Setting

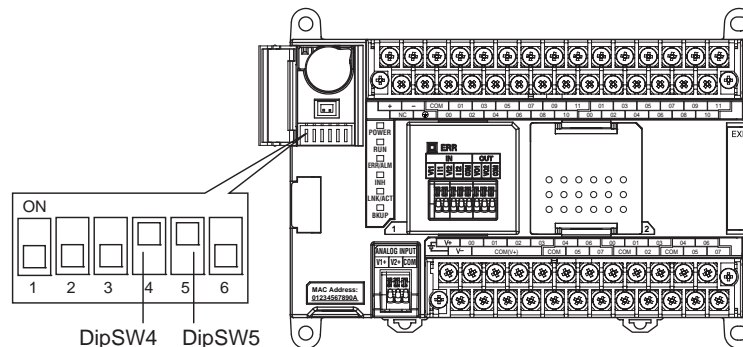
To use the analog option board on CP1L-EL/EM series PLC, firstly, it is necessary to set the serial communication settings of the CPU Unit in one of the following two ways.

**Method1:** Set by Dipswitch on PLC unit.

For CPU Units with 30 and 40 points, switch DipSW4 of the CPU unit to ON, if the Analog Option Board is mounted on the Option Board slot 1 (left side). Switch DipSW5 of the CPU unit to ON, if the Analog Option Board is mounted on the Option Board slot 2 (right side).

For CPU Units with 20 I/O points, switch DipSW4 of the CPU unit to ON.

**Note** DipSW4 and DipSW5 are OFF at shipment.



**Method2:** Set the option port communication parameters by PLC settings.

If DipSW4 or DipSW5 is OFF, the relative option port's communication parameters can also be set by PLC settings in CX-Programmer.

Please set the baud rate of the relative option port at 115200bps in Toolbus mode.

### 10-3-3 Removing

Always turn OFF the power supply to the CPU unit and wait until all the operation indicators go out.

Press the up/down lock-levers on both sides of the Analog Option Board at the same time to unlock the Option Board, and then pull it out.

## 10-4 Memory Allocation

### 10-4-1 CIO Area Allocation

The memory allocation about analog conversion in the CIO area of PLC is shown as the following diagram.

The beginning CIO channel is shown in the following table.

#### CP1L-EL/EM series PLC

| I/O Capacity | Option Port    | Beginning Channel (m) | Channel Range     |
|--------------|----------------|-----------------------|-------------------|
| 20           | Port 1         | CIO2990               | CIO2990 ~ CIO2999 |
| 30/40        | Port 1 (Left)  | CIO2980               | CIO2980 ~ CIO2989 |
|              | Port 2 (Right) | CIO2990               | CIO2990 ~ CIO2999 |

The details of allocated CIO channels are described in the following table.

| Channel    | Contents       |                 |                 |
|------------|----------------|-----------------|-----------------|
|            | CP1W-ADB21     | CP1W-DAB21V     | CP1W-MAB221     |
| m          | Analog Input 1 | ---             | Analog Input 1  |
| m+1        | Analog input 2 | ---             | Analog input 2  |
| m+2 to m+4 | ---            | ---             | ---             |
| m+5        | ---            | Analog Output 1 | Analog Output 1 |
| m+6        | ---            | Analog Output 2 | Analog Output 2 |
| m+7 to m+9 | ---            | ---             | ---             |

### 10-4-2 Auxiliary Area Allocation

#### Analog Option Unit Status Area

Option board status area: A435 (initial value "0000H")

| I/O Capacity | AR Bits | Option Port    | Content                    | Error Process  |
|--------------|---------|----------------|----------------------------|--|
| 20           | A435.15 | Port 1         | I/O option board run state | 0: Initial state or unit abnormality state<br>1: work normally |
| 30/40        | A435.14 | Port 1 (Left)  |                            |  |
|              | A435.15 | Port 2 (Right) |                            |  |

**Note** A435.14 or A435.15 sets on if analog option board already worked normally. Then user can read A/D input data and write D/A output data.

Output off bit: AR500.15

| AR Bits | Content        | Error Process   |
|---------|----------------|---|
| A500.15 | Output Off Bit | 0: output effective<br>1: analog option board DA output clear |

**Note** This bit will also affect other PLC output channels. Please refer to *Appendix D Auxiliary Area Allocations by Address* for more information.

## 10-5 Analog Input Option Board

Each CP1W-ADB21 Analog Input Option Board provides two analog inputs.

- The analog input signal ranges are 0 to 10 V (with a resolution 1/4,000) and 0 to 20 mA (with a resolution 1/2,000).

### Main Analog Input Option Board Specifications

| Item                     | Specifications   |   |
|--------------------------|--|---|
|                          | Voltage Input  | Current Input   |
| Input signal range       | 0 V to 10 V  | 0 mA to 20 mA   |
| Max. rated input         | 0 V to 15 V  | 0 mA to 30 mA   |
| External input impedance | 200 k $\Omega$ min.  | Approx. 250 $\Omega$  |
| Resolution               | 1/4000 (full scale)  | 1/2000 (full scale)   |
| Overall accuracy         | 25°C: $\pm 0.5\%$ (full scale)<br>0 to 55°C: $\pm 1.0\%$ (full scale)                    | 25°C: $\pm 0.6\%$ (full scale)<br>0 to 55°C: $\pm 1.2\%$ (full scale) |
| A/D conversion data      | 0000 to 0FA0 hex   | 0000 to 07D0 hex  |
| Averaging function       | Not supported  |   |
| Conversion time          | Inner sample time 2ms/point<br>Refresh time > 6ms basing on baud rate and PLC cycle time |   |
| Isolation method         | None   |   |
| Current consumption      | 5 VDC: 20 mA max.  |   |

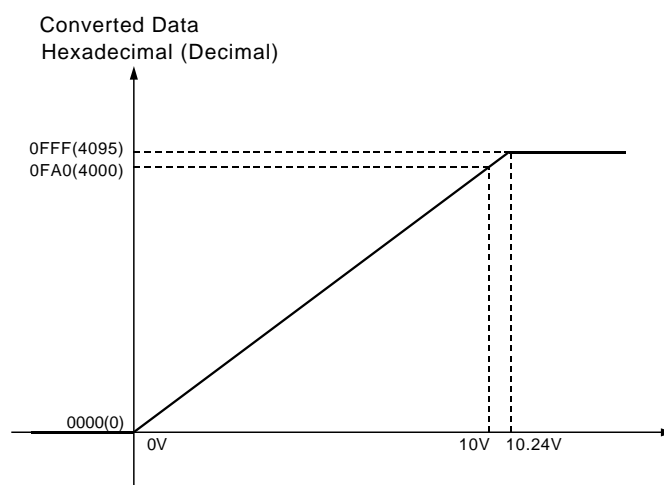
### Analog Input Signal Ranges

Analog input data is digitally converted according to the input signal range as shown below.

**Note** When the input exceeds the specified range, the A/D conversion data will be fixed at either the lower limit or upper limit.

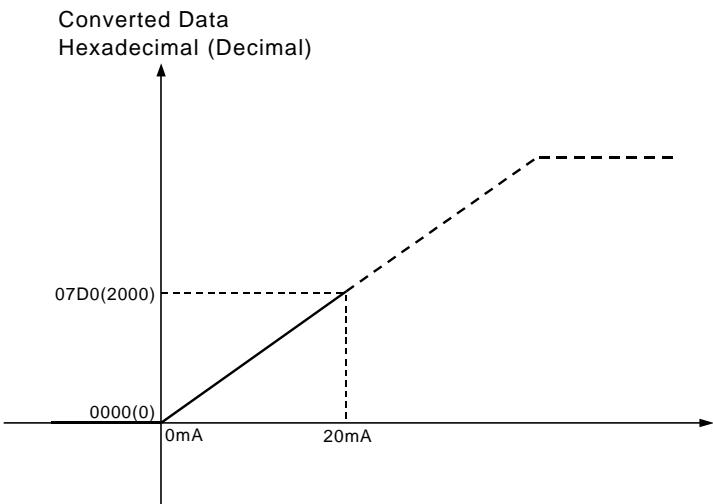
#### ■ 0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 0FA0 (0 to 4000). The entire data range is 0000 to 0FFF (0 to 4095).

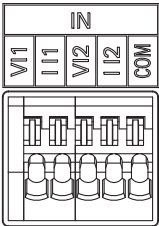


■ 0 to 20 mA

The 0 to 20 mA range corresponds to the hexadecimal values 0000 to 07D0 (0 to 2000). The possible data range is 0000 to 0FFF (0 to 4095). But it is strongly suggested that the input current must not exceed 30 mA.



Analog Input Terminal  
Arrangement

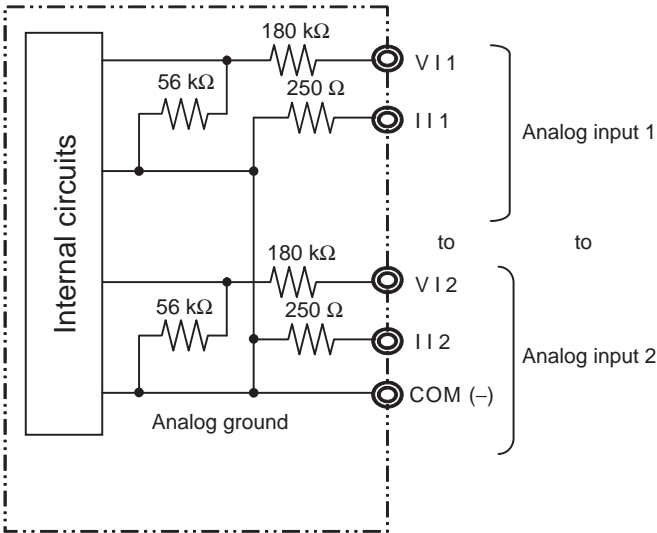


|     |                 |
|-----|-----------------|
| VI1 | Voltage Input 1 |
| II1 | Current Input 1 |
| VI2 | Voltage Input 2 |
| II2 | Current Input 2 |
| COM | Input Common    |

**Note** When using current inputs, voltage input terminals must be short-circuited with current input terminals.

Wiring

Internal Circuits



## Applicable Cables and Terminal Wiring

### ■ Applicable Cables

Solid wire or ferrules can be used.

- Recommended solid wire

| Wire type  | Wire size   |
|------------|---|
| Solid Wire | 0.2mm <sup>2</sup> to 0.5mm <sup>2</sup> (AWG24 to AWG20) |

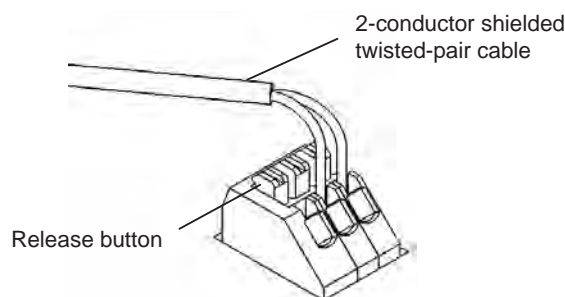
- Recommended ferrules

| Manufacturer    | Model     | Applicable wire            |
|-----------------|-----------|----------------------------|
| Phoenix Contact | AI-0.5-10 | 0.5mm <sup>2</sup> (AWG20) |

**Note** Do not connect bare stranded wires directly to terminals.

### ■ Terminal Wiring

When wiring the analog I/O terminal block, treat either solid or stranded wires directly.

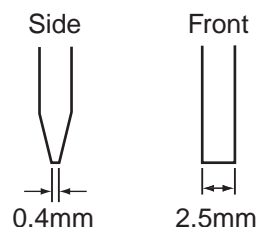


- To make the connection, press the release button in with a small flat blade screwdriver and push the line in while the lock is released. Remove the screwdriver and lock it inside.
- To disconnect the wiring, press the release button in with a small flat blade screwdriver and pull the line out while the lock is released.

- Note**
- (1) Ferrules with/without plastic sleeve cannot be used.
  - (2) When using stranded wire, twist the core so that the barbed wires cannot protrude.
  - (3) Do not solder-plate the end of cable.

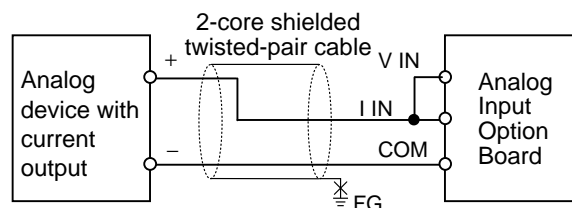
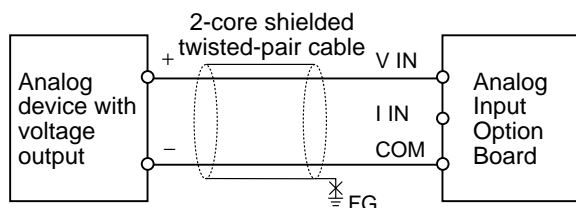
The screwdriver shown below is recommended for wiring.

| Model       | Manufacturer    |
|-------------|-----------------|
| SZS 0.4×2.5 | Phoenix Contact |



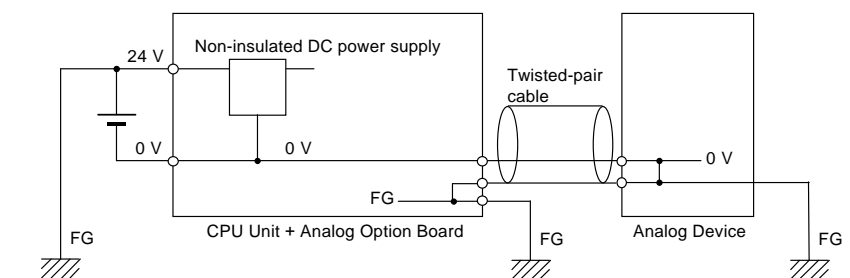
**Wiring for Analog Inputs**

To prevent noise, 2-core shielded twisted-pair cable should be used. And the shield can be connected to the FG terminal if necessary.



- Note**
- (1) If necessary, connect the shield to the FG terminal to prevent noise.
  - (2) When an input is not being used, short the + and – terminals.
  - (3) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
  - (4) When there is noise in the power supply line, install a noise filter on the input section and the power supply.

**Caution** When connecting the analog option board to an outside analog device, either ground the 0 V side of the PLC's external power supply or do not ground the PLC's external power supply at all. Otherwise the PLC's external power supply may be shorted depending on the connection methods of the outside analog device. **DO NOT** ground the 24 V side of the PLC's external power supply, as shown in the following diagram.



## 10-6 Analog Output Option Board

Each CP1W-DAB21V Analog Output Option Board provides two analog outputs.

- The analog output signal range is 0 to 10 V (with a resolution 1/4,000).

### Main Analog Output Option Board Specifications

| Item                                      | Specifications   |                |
|---|--|----------------|
|   | Voltage Output   | Current Output |
| Output signal range                       | 0 V to 10 V  | ---            |
| External output allowable load resistance | 2 k $\Omega$ min.  | ---            |
| External output impedance                 | 0.5 $\Omega$ max.  | ---            |
| Resolution                                | 1/4,000 (full scale)   | ---            |
| Overall accuracy                          | 25°C: $\pm 0.5\%$ 0 to 55°C: $\pm 1.0\%$   | ---            |
| D/A conversion data                       | 0000 to 0FA0 hex   | ---            |
| Conversion time                           | Inner conversion time 2ms/point<br>Refresh time > 6ms basing on baud rate and PLC cycle time |                |
| Isolation method                          | None   |                |
| Current consumption                       | 5 VDC: 60 mA max.  |                |

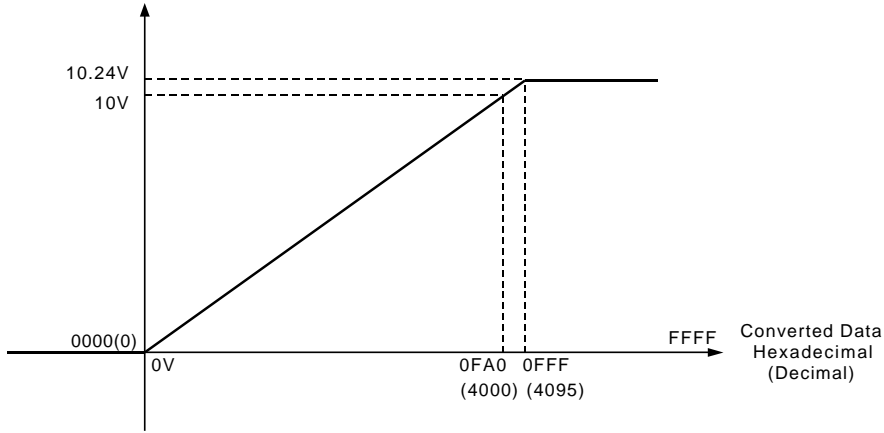
Analog Output Signal Ranges

The analog values depend on the output signal range, as shown in the following diagram.

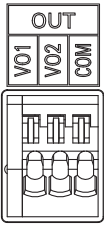
**Note** When the output exceeds the specified range, the output signal will be fixed at either the lower limit or upper limit.

■ 0 to 10 V

The hexadecimal values 0000 to 0FA0 (0 to 4000) correspond to an analog voltage range of 0 to 10 V. The entire output range is 10 to 10.24 V.



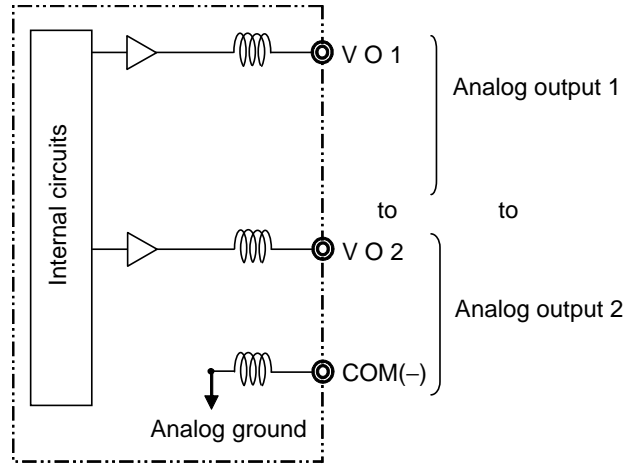
Analog Output Terminal Arrangement



|     |                  |
|-----|------------------|
| VO1 | Voltage Output 1 |
| VO2 | Voltage Output 2 |
| COM | Output Common    |

Wiring

Internal Circuits



## Applicable Cables and Terminal Wiring

### ■ Applicable Cables

Solid wire or ferrules can be used.

- Recommended solid wire

| Wire type  | Wire size   |
|------------|---|
| Solid Wire | 0.2mm <sup>2</sup> to 0.5mm <sup>2</sup> (AWG24 to AWG20) |

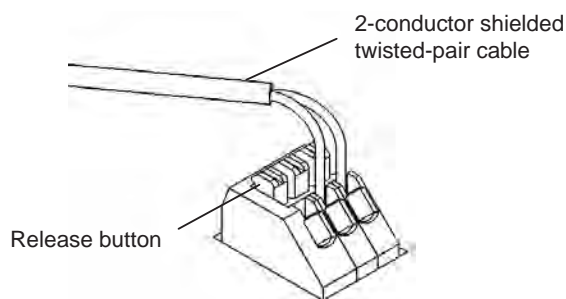
- Recommended ferrules

| Manufacturer    | Model     | Applicable wire            |
|-----------------|-----------|----------------------------|
| Phoenix Contact | AI-0.5-10 | 0.5mm <sup>2</sup> (AWG20) |

**Note** Do not connect bare stranded wires directly to terminals.

### ■ Terminal Wiring

When wiring the analog I/O terminal block, treat either solid or stranded wires directly.

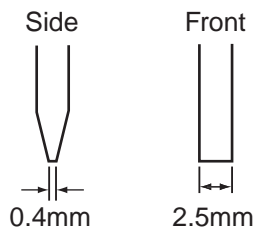


- To make the connection, press the release button in with a small flat blade screwdriver and push the line in while the lock is released. Remove the screwdriver and lock it inside.
- To disconnect the wiring, press the release button in with a small flat blade screwdriver and pull the line out while the lock is released.

- Note**
- (1) Ferrules with/without plastic sleeve cannot be used.
  - (2) When using stranded wire, twist the core so that the barbed wires cannot protrude.
  - (3) Do not solder-plate the end of cable.

The screwdriver shown below is recommended for wiring.

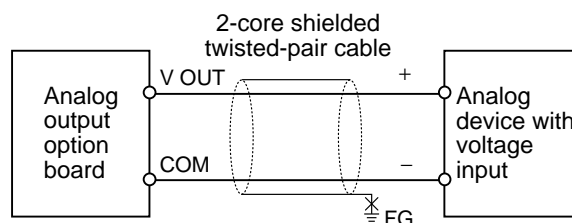
| Model       | Manufacturer    |
|-------------|-----------------|
| SZS 0.4×2.5 | Phoenix Contact |





# Wiring for Analog Outputs

To prevent noise, 2-core shielded twisted-pair cable should be used. And the shield can be connected to the FG terminal if necessary.



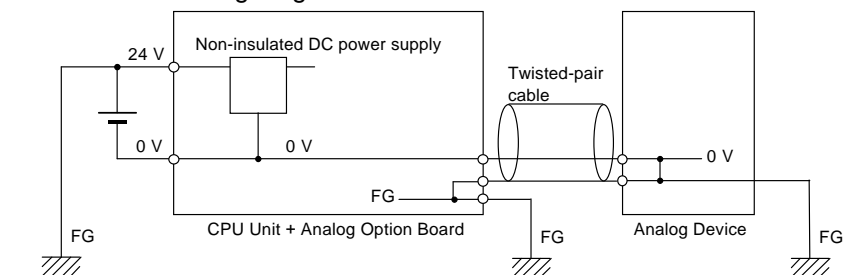
## Note

- (1) If necessary, connect the shield to the FG terminal to prevent noise.
- (2) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- (3) When there is noise in the power supply line, install a noise filter on the input section and the power supply.
- (4) When external power is supplied, or when the power is interrupted, there may be a pulse status analog output of up to 1 ms. If this status is a problem, take the following measures.
  - Turn ON the power to the CP1L-EL/EM CPU Unit, check the operation status, and then turn ON the power at the load.
  - Turn OFF the power to the load and then turn OFF the power to the CP1L-EL/EM CPU Unit.



## Caution

When connecting the analog option board to an outside analog device, either ground the 0 V side of the PLC's external power supply or do not ground the PLC's external power supply at all. Otherwise the PLC's external power supply may be shorted depending on the connection methods of the outside analog device. DO NOT ground the 24 V side of the PLC's external power supply, as shown in the following diagram.



## 10-7 Analog I/O Option Board

Each CP1W-MAB221 Analog I/O Option Board provides two analog inputs and two analog outputs.

- The analog input signal ranges are 0 to 10 V (with a resolution 1/4,000) and 0 to 20 mA (with a resolution 1/2,000).
- The analog output signal ranges are 0 to 10 V (with a resolution 1/4,000).

### Main Analog I/O Option Board Specifications

| Item                  |   | Specifications   |   |
|-----------------------|---|--|---|
|                       |   | Voltage I/O  | Current I/O   |
| Analog Input Section  | Input signal range                        | 0 V to 10 V  | 0 mA to 20 mA   |
|                       | Max. rated input                          | 0 V to 15 V  | 0 mA to 30 mA   |
|                       | External input impedance                  | 200 k $\Omega$ min.  | Approx. 250 $\Omega$  |
|                       | Resolution                                | 1/4,000 (full scale)   | 1/2,000 (full scale)  |
|                       | Overall accuracy                          | 25°C: $\pm 0.5\%$ (full scale)<br>0 to 55°C: $\pm 1.0\%$ (full scale)                              | 25°C: $\pm 0.6\%$ (full scale)<br>0 to 55°C: $\pm 1.2\%$ (full scale) |
|                       | A/D conversion data                       | 0000 to 0FA0 hex   | 0000 to 07D0 hex  |
|                       | Averaging function                        | Not supported  |   |
| Analog Output Section | Output signal range                       | 0 V to 10 V  | ---   |
|                       | External output allowable load resistance | 2 k $\Omega$ min.  | ---   |
|                       | External output impedance                 | 0.5 $\Omega$ max.  | ---   |
|                       | Resolution                                | 1/4,000 (full scale)   | ---   |
|                       | Overall accuracy                          | 25°C: $\pm 0.5\%$ 0 to 55°C: $\pm 1.0\%$   | ---   |
|                       | D/A conversion data                       | 0000 to 0FA0 hex   | ---   |
| Conversion time       |   | Inner conversion time 6ms (4CH total)<br>Refresh time > 6ms basing on baud rate and PLC cycle time |   |
| Isolation method      |   | None   |   |
| Current consumption   |   | 5 VDC: 80 mA max.  |   |

### Analog I/O Signal Ranges

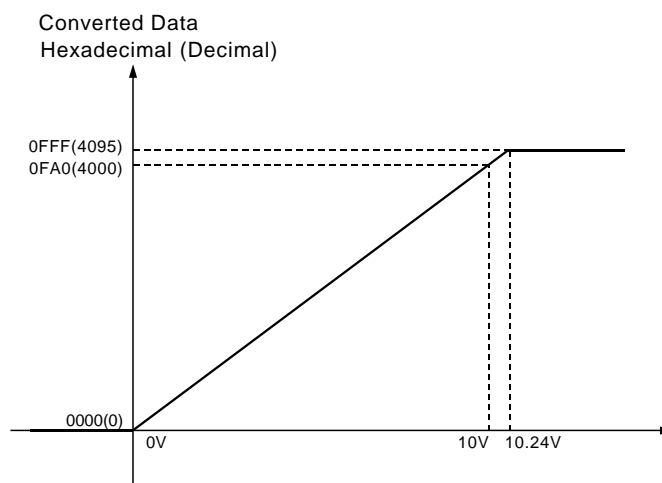
The analog values depend on the I/O signal ranges, as shown in the following diagrams.

- Note** When the input exceeds the specified range, the A/D conversion data will be fixed at either the lower limit or upper limit.  
When the output exceeds the specified range, the output signal will be fixed at either the lower limit or upper limit.

### Analog Input Signal Ranges

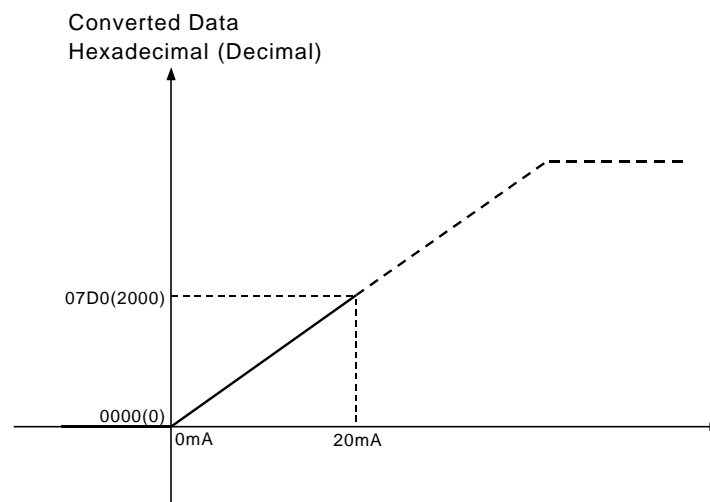
#### ■ 0 to 10 V

The 0 to 10 V range corresponds to the hexadecimal values 0000 to 0FA0 (0 to 4000). The entire data range is 0000 to 0FFF (0 to 4095).



### ■ 0 to 20 mA

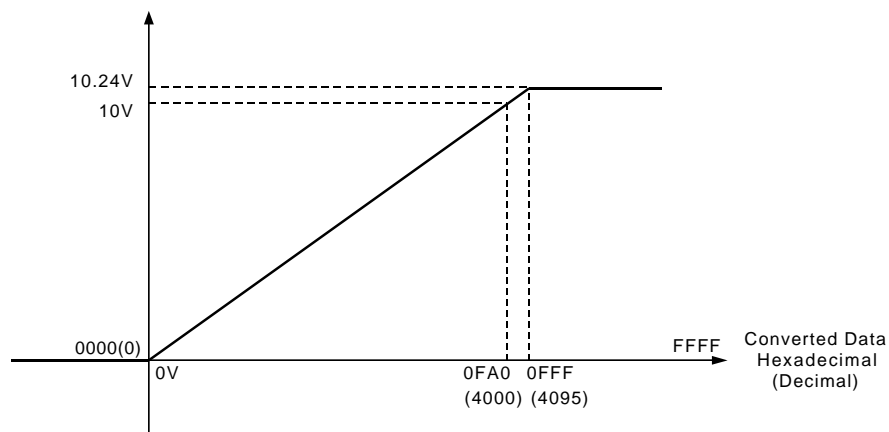
The 0 to 20 mA range corresponds to the hexadecimal values 0000 to 07D0 (0 to 2000). The possible data range is 0000 to 0FFF (0 to 4095). But it is strongly suggested that the input current mustn't exceed 30 mA.



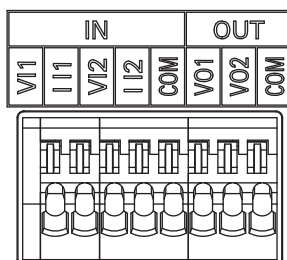
## Analog Input Signal Ranges

### ■ 0 to 10 V

The hexadecimal values 0000 to 0FA0 (0 to 4000) correspond to an analog voltage range of 0 to 10 V. The entire output range is 10 to 10.24 V.



### Analog I/O Terminal Arrangement



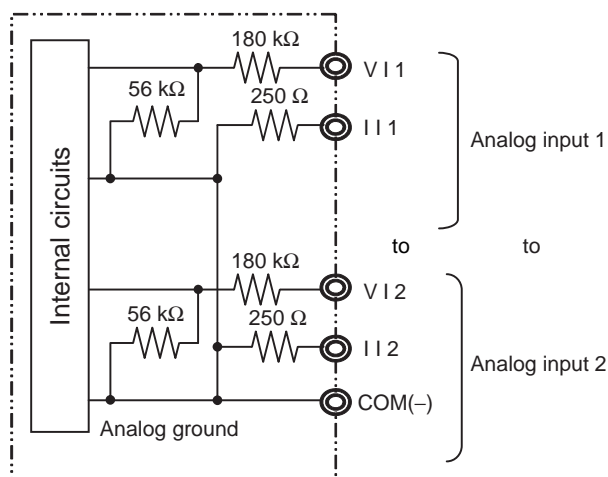
|     |                   |
|-----|-------------------|
| VI1 | Voltage Input 1   |
| II1 | Current Input 1   |
| VI2 | Voltage Input 2   |
| II2 | Current Input 2   |
| COM | Analog I/O Common |
| VO1 | Voltage Output 1  |
| VO2 | Voltage Output 2  |
| COM | Analog I/O Common |

**Note** When using current inputs, voltage input terminals must be short-circuited with current input terminals.

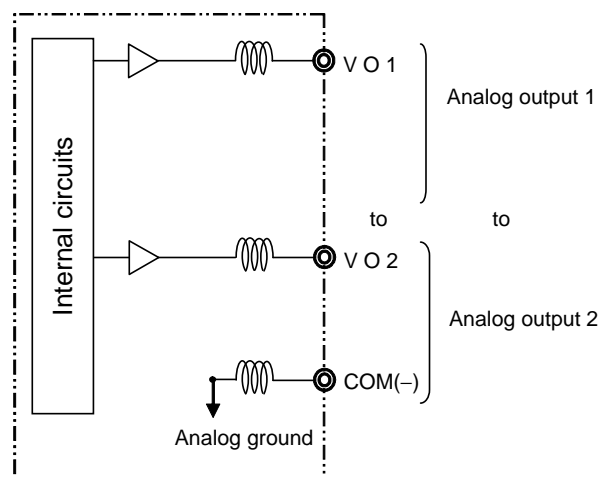
### Wiring

#### Internal Circuits

##### Analog input



##### Analog output



### Applicable Cables and Terminal Wiring

#### ■ Applicable Cables

Solid wire or ferrules can be used.

##### • Recommended solid wire

| Wire type  | Wire size   |
|------------|---|
| Solid Wire | 0.2mm <sup>2</sup> to 0.5mm <sup>2</sup> (AWG24 to AWG20) |

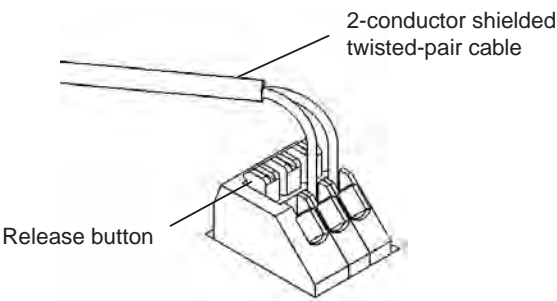
##### • Recommended ferrules

| Manufacturer    | Model     | Applicable wire            |
|-----------------|-----------|----------------------------|
| Phoenix Contact | Al-0.5-10 | 0.5mm <sup>2</sup> (AWG20) |

**Note** Do not connect bare stranded wires directly to terminals.

#### ■ Terminal Wiring

When wiring the analog I/O terminal block, treat either solid or stranded wires directly.

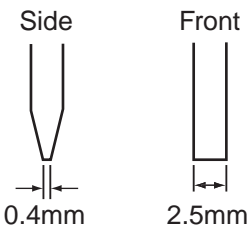


- To make the connection, press the release button in with a small flat blade screwdriver and push the line in while the lock is released. Remove the screwdriver and lock it inside.
- To disconnect the wiring, press the release button in with a small flat blade screwdriver and pull the line out while the lock is released.

- Note**
- (1) Ferrules with/without plastic sleeve cannot be used.
  - (2) When using stranded wire, twist the core so that the barbed wires cannot protrude.
  - (3) Do not solder-plate the end of cable.

The screwdriver shown below is recommended for wiring.

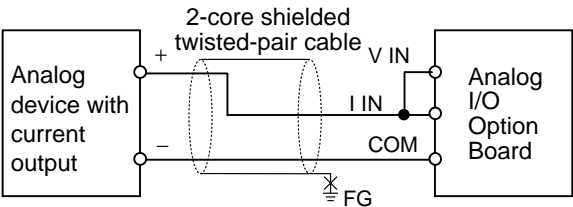
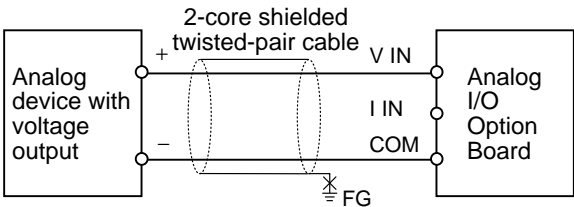
| Model       | Manufacturer    |
|-------------|-----------------|
| SZS 0.4×2.5 | Phoenix Contact |



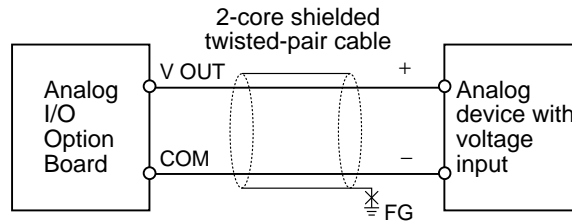
**Wiring for Analog I/O**

To prevent noise, 2-core shielded twisted-pair cable should be used. And the shield can be connected to the FG terminal if necessary.

**Wiring for Analog Inputs**



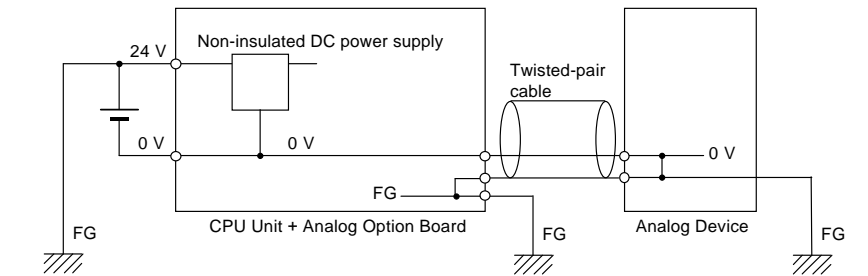
## Wiring for Analog Outputs

**Note**

- (1) If necessary, connect the shield to the FG terminal to prevent noise.
- (2) When an input is not being used, short the + and – terminals.
- (3) Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
- (4) When there is noise in the power supply line, install a noise filter on the input section and the power supply.
- (5) When external power is supplied, or when the power is interrupted, there may be a pulse status analog output of up to 1 ms. If this status is a problem, take the following measures.
  - Turn ON the power to the CP1L-EL/EM CPU Unit, check the operation status, and then turn ON the power at the load.
  - Turn OFF the power to the load and then turn OFF the power to the CP1L-EL/EM CPU Unit.



**Caution** When connecting the analog option board to an outside analog device, either ground the 0 V side of the PLC's external power supply or do not ground the PLC's external power supply at all. Otherwise the PLC's external power supply may be shorted depending on the connection methods of the outside analog device. DO NOT ground the 24 V side of the PLC's external power supply, as shown in the following diagram.



## 10-8 Startup Operation

After the power is turned ON, analog option board starts the initialization process. If the initialization finishes normally, the initialization completed flag in related status area (Refer to *10-4-2 Auxiliary Area Allocation: A435*) will be set. Therefore, status monitor content must be added in ladder. Only when the initialization process has finished, user can use the A/D conversion data or write the output data.

The analog input data will be 0000 until the initial processing is completed.

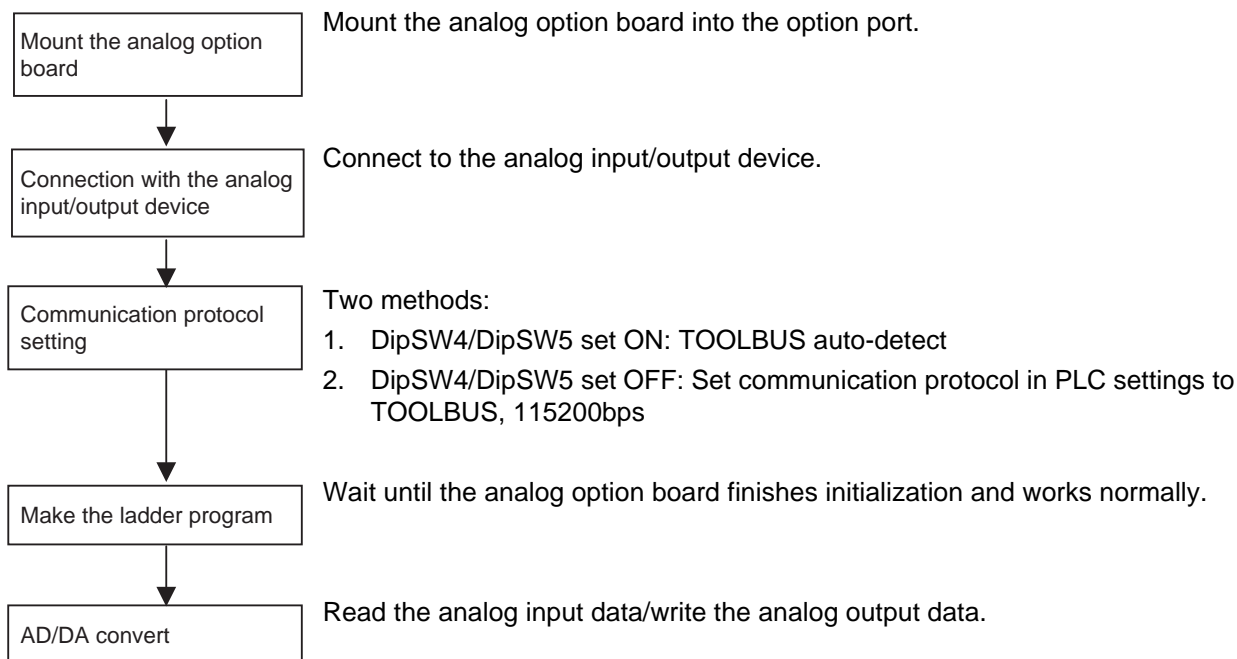
## 10-9 Trouble Shooting

### Trouble-shooting with Indicators

| ERR Indicator | Error                             | Probably Cause   | Correction  | Auxiliary Area Allocations     | AD/DA function   |
|---------------|-----------------------------------|--|---|--------------------------------|--|
| Lit           | CPU Unit service monitoring error | Service from the CPU Unit was not completed within the fixed interval. | Check and correct the CPU Unit's operating environment. Check serial communication setting. | A435.14 or A435.15 will be OFF | AD/DA conversion will stop. The analog input conversion data stops refreshing and the analog output conversion output becomes 0V.  |
|               | Option board error                | An error occurred in the Analog Option Board.                          | Restart the CPU Unit. Replace the Analog Option Board if the error recurs.                  |                                |  |
| Flashing      | Communication error               | The communication between PLC is out of service                        | Check if PLC is running normally.   | A435.14 or A435.15 will be OFF | AD/DA conversion will stop. The analog input conversion data stops refreshing and the analog output conversion output becomes 0V. If the communication recovers from error, the AD/DA conversion will start again. |

## 10-10 The Use of Analog Option Board

### 10-10-1 Procedure



**Note**

- (1) If PLC communication protocol setting is error, the option board will always try to link the PLC, and the error LED will flash.
- (2) Only when the initialization process has finished (AR435.14/15 sets on), user can use the A/D conversion data or write the D/A output data.

## 10-10-2 Program Example

Use the analog option board to carry out 2CH AD inputs and 1CH DA output at the same time.

The ranges of AD/DA are as follows:

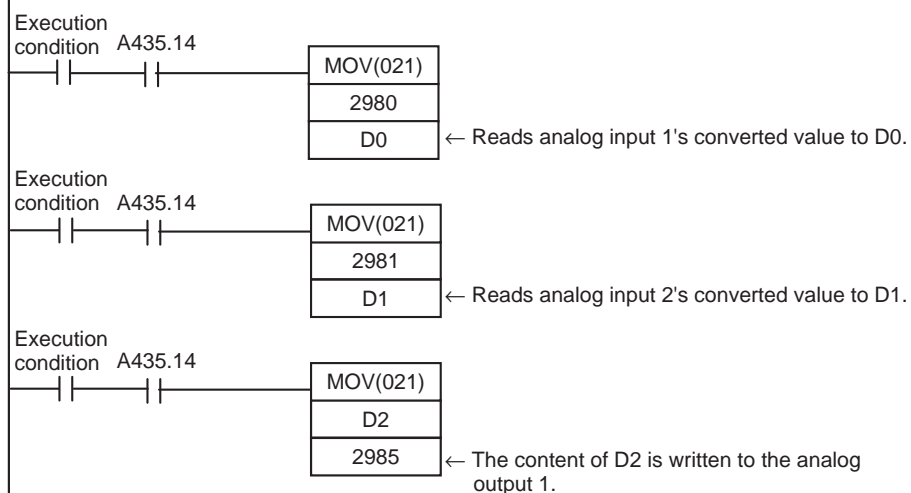
Analog input1: 0~10V

Analog input2: 0~20mA

Analog output1: 0~10V

System composing: CP1L-EM (option port 1) + CP1W-MAB221

A435.14 sets on if the analog option board (mounted in option port 1) works normally.





# SECTION 11

## LCD Option Board

This section gives an outline of the LCD Option Board, explains how to install and remove the LCD Option Board, and describes the functions including how to monitor and make settings for the PLC. It also lists the errors during operation and provides probable causes and countermeasures for troubleshooting.

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## 11-1 Features

LCD Option Board is small but has a wide range of functions and is easy to use.

### **Powerful Display and Setting Functions**

Equipped for easy display and set up of user-specified messages, time or other data of the PLC.

### **User Monitor Screen**

Preset the screen, including I/O memory and text string, which user will monitor frequently. So it is easy for user to acquire his necessary data. It is possible to register up to 16 screens.

### **Timer Switch**

Preset the timer, including Day, Weekly and Calendar Timer. Each timer can execute a trans-day, trans-week or trans-year operation. So a 24-hours control will be effected by one-step setting. It is possible to register up to 16 timers for each kind.

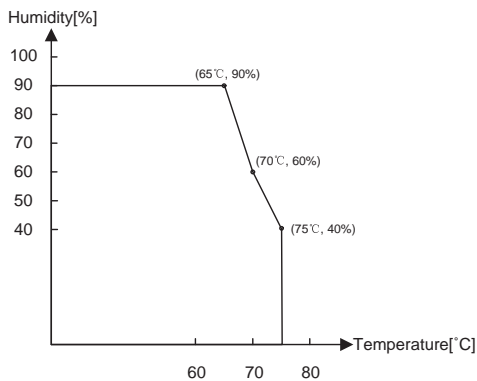
### **Easier to Identify with Backlight**

When PLC error occurs, the red backlight of LCD display screen will begin to blink, quickly altering you of the error.

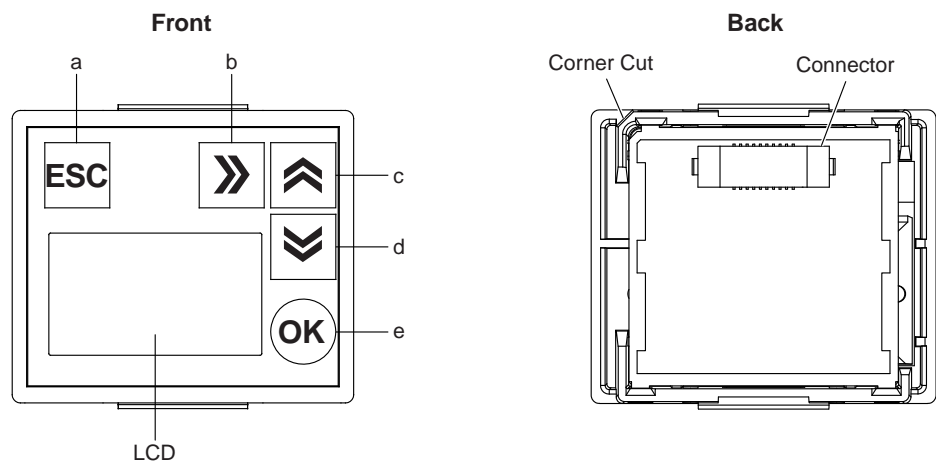
Normally the backlight is green. The automatic cutout time for the backlight can be set to occur from 2 to 30 minutes, or even set permanently to OFF or ON position.

The contrast level can also be adjusted.






## 11-2 Specifications

| Item                          | Specification   |
|-------------------------------|---|
| Model                         | CP1W-DAM01  |
| Type                          | Built-in  |
| Serial port                   | Only port 1   |
| Communication protocol        | Toolbus   |
| DC consumption                | 5V : 40mA<br>24V : 0mA  |
| Dimensions                    | 43×36×23 mm (W×H×D)   |
| Weight                        | 20g max.  |
| Screen size                   | 2.6cm×1.45cm  |
| Total characters on screen    | 4 lines×12 characters   |
| Font size                     | 5×7 dot   |
| Backlight color               | Green / Red   |
| Display language              | English / Japanese (Katakana)   |
| Ambient operating temperature | 0 to 55°C   |
| Ambient operating humidity    | 10% to 90% (with no condensation)   |
| Atmosphere                    | No corrosive gas.   |
| Ambient storage condition     |  <p>(with no condensation)</p> |

11-3 Part Names



Operation Button

| No. | Button  | Function  |
|-----|---|---|
| a   |  ESC     | Cancel the setting and return to the up-level menu.   |
| b   |  Forward | Move the column cursor.<br>Press and hold the button, the column cursor will move forward continuously.   |
| c   |  Up     | Move the line cursor up. Change numerals and parameters.<br>Press and hold the button, the line cursor will move up continuously and the parameters will increase continuously.     |
| d   |  Down  | Move the line cursor down. Change numerals and parameters.<br>Press and hold the button, the line cursor will move down continuously and the parameters will decrease continuously. |
| e   |  OK    | Confirm the setting.  |

Backlight

| Color | Meaning                 |
|-------|-------------------------|
| Green | PLC is normal.          |
| Red   | PLC error has occurred. |

## 11-4 Installation and Removing

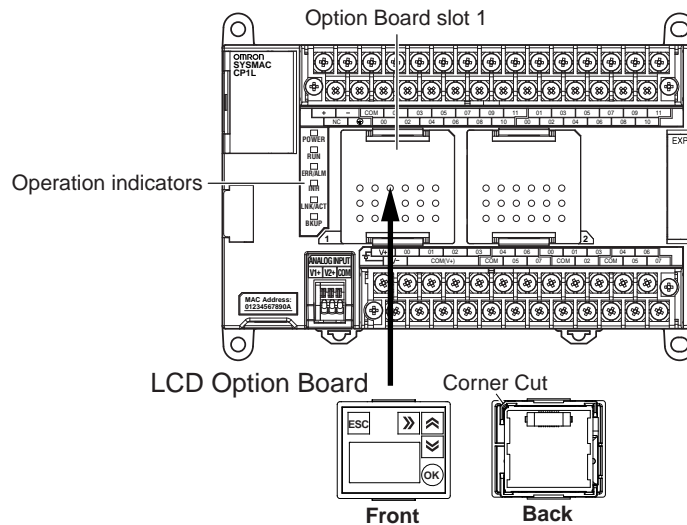
### Installation

The following processing explains how to install and remove a LCD Option Board.

**Caution** Always turn OFF the power supply to the CPU Unit and wait until all the operation indicators go out before installing or removing the LCD Option Board.

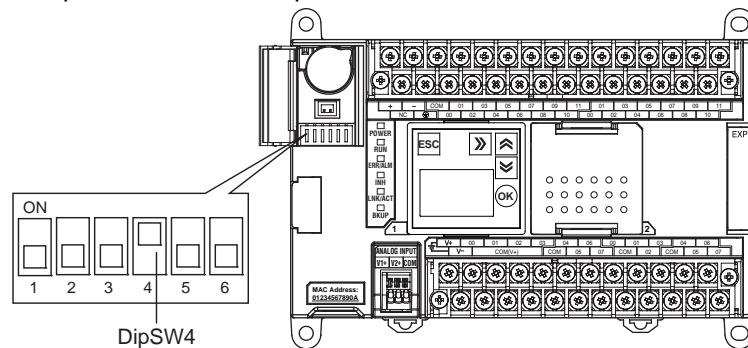
**1,2,3...**

1. Press the up/down lock levers on both sides of the Option Board slot cover 1 at the same time to unlock the cover, and then pull the cover out.
2. Check the alignment to make the corner cut of the LCD Option Board fit in the Option Board slot 1, and firmly press the LCD Option Board in until it snaps into place.



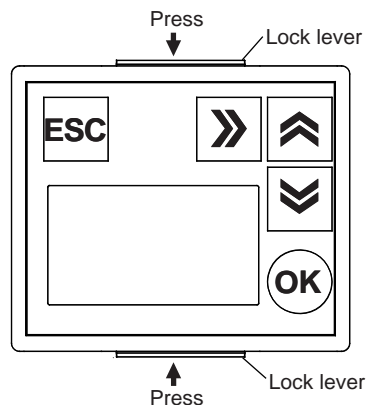
3. Switch DipSW4 of the CPU Unit to ON.

**Note** DipSW4 is OFF at shipment



### Removing

Press the up/down lock levers on both sides of the LCD Option Board at the same time to unlock the Option Board, and then pull it out.



## 11-5 Basic Operation

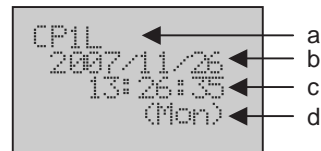
### 11-5-1 Startup

According to the operation status of the LCD Option Board, it will display different screens when the CPU Unit power is turned ON.

#### Normal Startup

When the CPU Unit power is turned ON, the LCD Option Board will initialize hardware and check EEPROM, then check communication between the LCD Option Board and the CPU Unit. If startup is normal, LCD will display Clock Screen as shown below.

#### Clock Screen

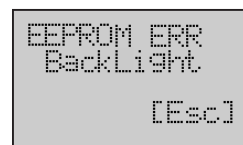


| No. | Description                       |
|-----|-----------------------------------|
| a   | Type of the CPU Unit              |
| b   | Date of the CPU Unit              |
| c   | Time of the CPU Unit              |
| d   | Week abbreviation of the CPU Unit |

#### Startup Failure

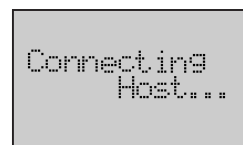
- If EEPROM is faulty, LCD will display EEPROM Error Screen and the red backlight will blink. Refer to *11-7 Trouble Shooting*.

#### EEPROM Error Screen



- If the communication between the LCD Option Board and the CPU Unit has failed, LCD will display NG screen. Refer to *11-7 Trouble Shooting*.

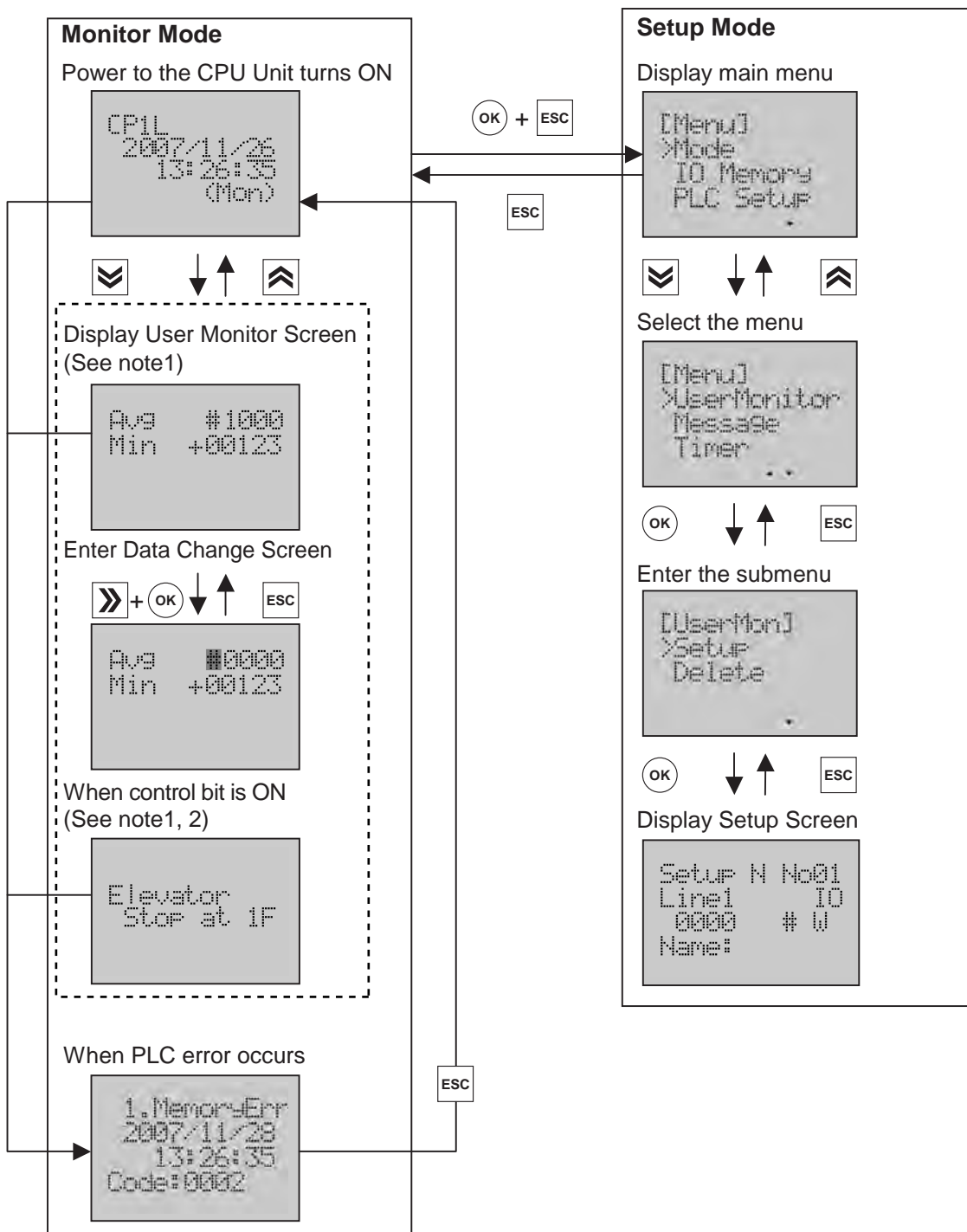
#### NG Screen



**Note** If the LCD Option Board receives no response from the CPU Unit within 3 seconds during operation, it will also display NG screen.

## 11-5-2 Screen Transitions

The screen transition of the LCD Option Board as shown in the following diagram.

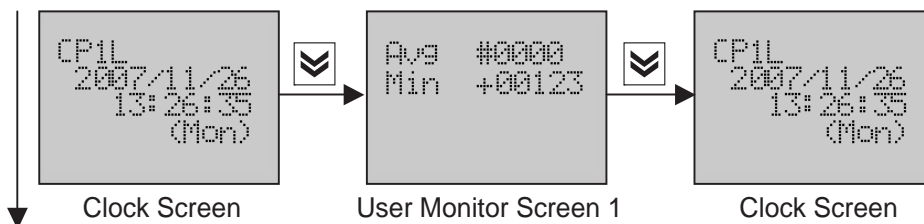


- Note**
1. The screen will be displayed after making settings in the Setup Mode.
  2. The Message Screen will disappeared automatically after control bit is OFF.
  3. In the Setup Mode, if there is no operation for 10 minutes, LCD will automatically switch to the Monitor Mode.

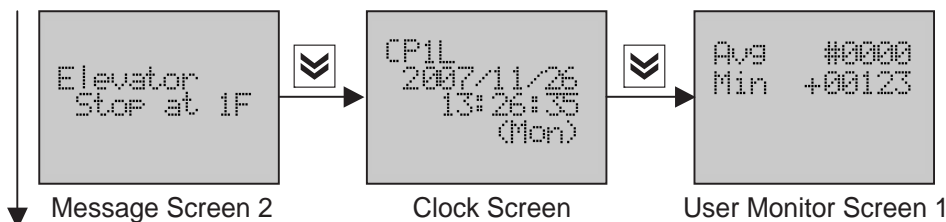
### Screen Transition Example in the Monitor Mode

In this example, User Monitor Screen 1 and Message Screen 2, Message Screen 6 have been set.

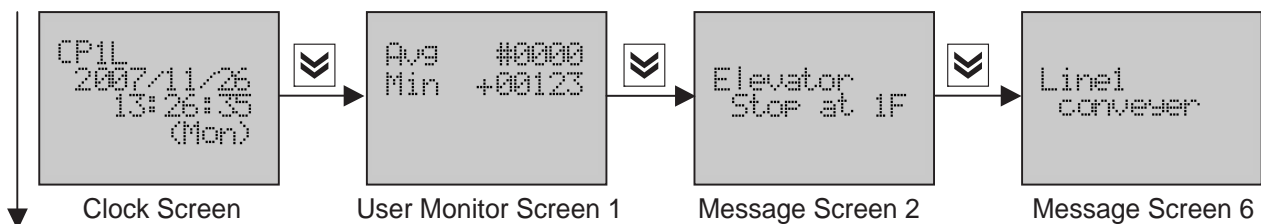
#### Control bit is OFF



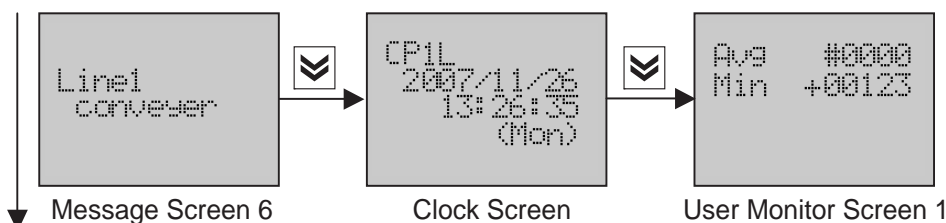
#### Control bit 1 is ON



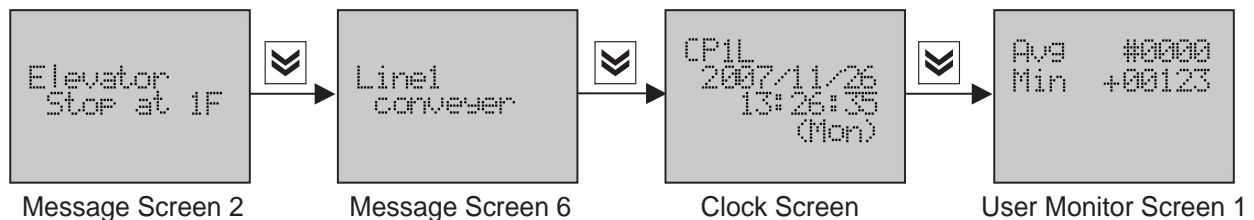
#### Control bit 5 is ON during control bit 1 ON



#### Control bit 1 is OFF



#### Control bit 1 and bit 5 are ON at the same time



#### Note

1. When one control bit is ON, the Clock Screen or the User Monitor Screen will switch to the Message Screen automatically.
2. If another control bit is ON when the Clock Screen or the User Monitor Screen is displayed, the display will switch to another Message Screen.
3. If another control bit is ON when one Message Screen is displayed, the display will not change until one of the control bit is OFF.



4. If another control bit is bigger, the display will switch to another Message Screen after one of the control bit is OFF. If another control bit is smaller, the display will switch to the Clock Screen after one of the control bit is OFF.
5. When no less than one control bit are ON at the same time, the Message Screen whose Screen No. is smaller will be displayed.
6. If one control bit is ON during the period that PLC error occurs, the display remains the Error Screen. Even if the error is eliminated, the display will not switch to the Message Screen, but return to the Clock Screen.

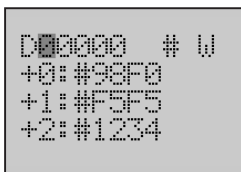
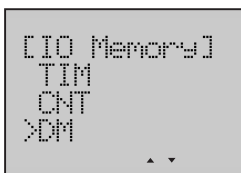
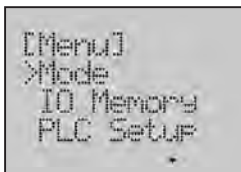
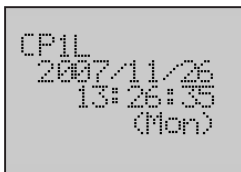
### 11-5-3 Operation Examples

With actual operation examples, the main operation flow of the LCD Option Board as shown below.

#### Menu Selection

Display the Monitor Screen of I/O memory.

1,2,3...



1. Turn on the power to the CPU Unit. Clock Screen will be displayed.
2. Press the **OK + ESC** button simultaneously to switch to the main menu. The line cursor ">" is always displayed on the first line of menu items.
3. Press the **Down** or **Up** button to select the menu item. Move the line cursor to **IO Memory**.
4. Press the **OK** button to enter the submenu.
5. Press the **Down** or **Up** button to select the I/O memory type. Move the line cursor to **DM**.
6. Press the **OK** button to enter the Monitor Screen of I/O memory.

## Displaying I/O Memory

Display any data of I/O memory. In this example, two word data on D10001 to D10002, D10003 to D10004 with unsigned decimal number will be displayed.

1,2,3...

```
D00000 # W
+0:#98F0
+1:#F5F5
+2:#1234
```

```
D10000 # W
+0:#98F0
+1:#F5F5
+2:#1234
```

```
D10001 & W
&1236547890
+2
&1236547890
```

1. Line 1 will display the default address D00000 in I/O memory, Line 2 to 4 will display one word data on D00000, D00001, D00002 with hex number when entering the Monitor Screen of I/O memory.  
The first digit of memory address "0" will flash. The column cursor is at the flashing position.  
The digit under the column cursor can be changed, otherwise it is read only.
2. Use the **Forward** button to move the column cursor to the digit to be set.  
Use the **Down** or **Up** button to change the value of each digit.  
The screen display will be updated immediately after the address is changed.
3. Use the **Forward** button to move the column cursor to another parameter to be set.  
Use the **Down** or **Up** button to select the value of parameter.  
The screen display will be updated immediately after the parameter is changed.

## Changing I/O Memory

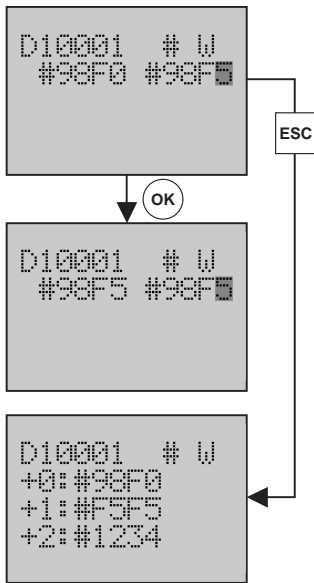
Change any data of I/O memory. In this example, the data of I/O memory on D10001 will be changed.

1,2,3...

```
D10001 # W
+0:#98F0
+1:#F5F5
+2:#1234
```

```
D10001 # W
#98F0 #98F0
```

1. Display I/O memory.
2. Press the **OK** button to enter the Change Screen of I/O memory.  
The column cursor is at the "#" position.  
Use the **Down** or **Up** button to select the value of parameter.



3. Use the **Forward** button to move the column cursor to the data of I/O memory. Use the **Down** or **Up** button to change the value of each digit.

4. Press the **OK** button to save the setting. Press the **ESC** button to return to the previous screen. The data displayed in the Monitor Screen will be changed.

Press the **ESC** button to cancel the setting and return to the previous screen.

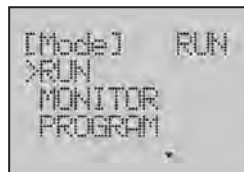
## 11-6 LCD Option Board Function

This section describes the functions of the LCD Option Board including how to monitor and make settings for the PLC.

### 11-6-1 Function Overview

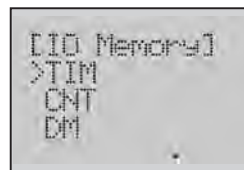
#### PLC Mode

Display the present PLC mode and change the PLC mode. Refer to *Page 584* for details.



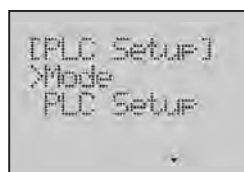
#### I/O Memory Setting

Monitor and change the data of I/O Memory. Refer to *Page 585* for details.



#### PLC Setup

Monitor and change the PLC Setup, especially fast access the CPU Unit Operating Mode. Refer to *Page 590* for details.



**Analog**

Monitor the value from the built-in analog input of the PLC.

**Note** Analog input will be displayed as “AnalogVol”.

Refer to *Page 592* for details.

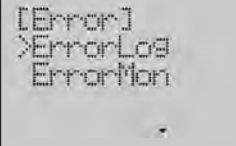


```
[Analog] RUN
>AnalogVol
```

**Error History**

Display the list of error history and the details of each error. It is possible to display up to 20 screens. User can also monitor the occurring errors.

Refer to *Page 594* for details.



```
[Error]
>ErrorLog
ErrorMon
```

**Memory Cassette**

The LCD Option Board can execute any of the following operations.

- Load data from memory cassette to PLC.
- Save data from PLC to memory cassette.
- Compare data between PLC and memory cassette.
- Clear data in memory cassette.

Refer to *Page 596* for details.



```
[MC] PRG
>MC->PLC
PLC->MC
Compare
```

**User Monitor Screen**

Set or delete User Monitor Screen, which includes some elements such as I/O word memory, bit memory or text string. It is possible to register up to 16 screens. User can monitor his necessary data in the User Monitor Screen.

Refer to *Page 600* for details.




```
[UserMon]
>Setup
Delete
```

**Message Screen**

Set or delete Message Screen. It is possible to register up to 16 screens. User can monitor the text message in the Message Screen when control bit is ON.

Refer to *Page 609* for details.

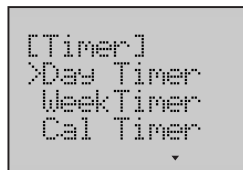


```
[Message]
>Setup
Delete
```

## Timer Switch

Set day, weekly and calendar timers. It is possible to register up to 16 timers for each kind. Each timer can execute a trans-day, trans-week or trans-year operation.

Refer to *Page 614* for details.



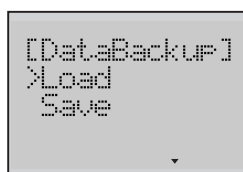
## Data Backup

The LCD Option Board can execute any of the following operations.

- Load user settings from DM area.
- Save user settings to DM area.

So user can save the user settings to the DM area of the PLC from one LCD Option Board and load to other LCD Option Boards from the DM area.

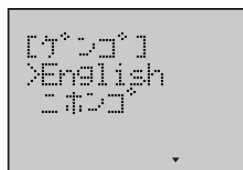
Refer to *Page 620* for details.



## Language

Change the language of the LCD display between English and Japanese.

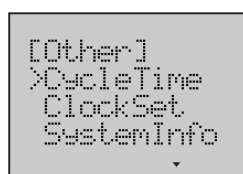
Refer to *page 623* for details.



## Other

- PLC Cycle Time
- PLC Clock Setting
- PLC System Information
- LCD Backlight Setting
- LCD Contrast Setting
- LCD Factory Setting

Refer to *Page 625 to 628* for details.



## 11-6-2 PLC Mode

This function can display the present PLC mode and change the PLC mode.

### Example

Change the PLC Mode from RUN to PRG.

1,2,3...

```
[Menu]
>Mode
IO Memory
PLC Setup
▼
```

```
[Mode]    RUN
>RUN
MONITOR
PROGRAM
▼
```

```
[Mode]    RUN
RUN
MONITOR
>PROGRAM
▲
```

```
[Mode]    PRG
RUN
MONITOR
>PROGRAM
▲
```

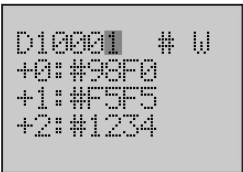
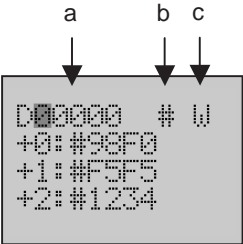
1. Switch to the Setup Mode.
2. Press the **OK** button to enter the Mode Screen.  
There is a choice of 3 PLC modes-RUN/MON/PRG.  
The line cursor will point to the present PLC mode.  
The present mode is ***RUN***.
3. Press the **Down** button to select ***PROGRAM***.
4. Press the **OK** button, then LCD will update the present mode to ***PRG***.

11-6-3 I/O Memory Setting

Displaying I/O Memory

**Example** Monitor two word data on D10001 to D10002, D10003 to D10004 with unsigned decimal number.

1,2,3...



1. Switch to the Setup Mode.
2. Press the **Down** button to select **IO Memory**.
3. Press the **OK** button to enter the I/O Memory menu.
4. Press the **Down** button to select **DM**.
5. Press the **OK** button to enter the Monitor Screen of I/O memory DM.  
The following table shows the setting items.

| No. | Description          |
|-----|----------------------|
| a   | Leading word address |
| b   | Display format       |
| c   | Data length          |

The first digit of the leading word address will be flashing.  
The present setting is the default address.  
Line 2 to 4 will display one word data on D00000, D00001, D00002 with hex number.

6. Use the **Forward** button to move the column cursor to the digit to be set.  
Use the **Up** button to change the leading word address to **10001**.

The following table shows the default address and the setting range for each I/O memory type.

| I/O memory type | Default address | Range          |
|-----------------|-----------------|----------------|
| TIM             | 0000            | 0000 to 4095   |
| CNT             | 0000            | 0000 to 4095   |
| DM              | 00000           | 00000 to 32767 |
| AR              | 000             | 000 to 959     |
| IO              | 0000            | 0000 to 6143   |
| WR              | 000             | 000 to 511     |
| HR              | 000             | 000 to 511     |
| DR              | 00              | 00 to 15       |
| IR              | 00              | 00 to 15       |
| TK              | 00              | 00 to 31       |

**Note**

- (1) LongWord has only five display types, DM, IO, WR, HR and AR.
- (2) Do not specify an address between D10000 and D31999 for a CPU Unit with 20 I/O Points.

```
D10001  W
+0: 832767
+1: 832768
+2: 832769
```

7. Use the **Forward** button to move the column cursor to the display format position.

Press the **Down** or **Up** button to select the display format **&**.  
Select the display format in the following table.

| Display format | Meaning                 |
|----------------|-------------------------|
| #              | Hex number              |
| +              | Signed decimal number   |
| &              | Unsigned decimal number |

8. Use the **Forward** button to move the column cursor to the data length position.

Press the **Down** or **Up** button to select the data length **LW**.  
Select the data length in the following table.

| Data length | Meaning       |
|-------------|---------------|
| W           | One word data |
| LW          | Two word data |

Then it will display two word data on D10001 to D10002, D10003 to D10004 with unsigned decimal number.

**Note**

The screen display will be updated immediately after the address, display format or data length is changed.

```
D10001  & LW
&1234567890
+2
&1234567890
```



## Changing I/O Memory

### Example

First change two word data on W000 to 12345678, then change one word data on W509 to 98F5 and set the control bit 509.05 to OFF.

1,2,3...

```
[Menu]
>Mode
  ID Memory
  PLC Setup
  ▾
```

```
[Menu]
Mode
>ID Memory
  PLC Setup
  ▲ ▾
```

```
[ID Mem]
>TIM
  CNT
  DM
  ▲ ▾
```

```
[ID Mem]
  AR
  IO
  >WR
  ▲ ▾
```

```
W000 # W
+0:#98F0
+1:#F5F5
+2:#1234
```

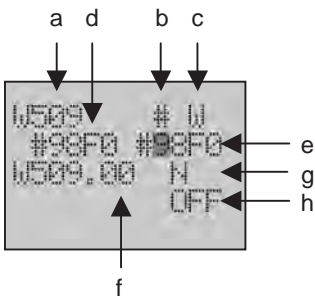
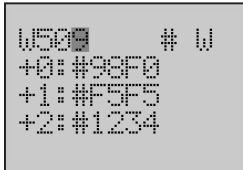
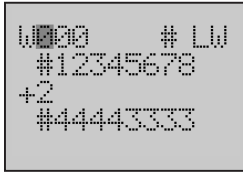
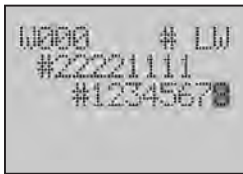
```
W000 # LW
#22221111
+2
#44443333
```

```

1 2 3
↓ ↓ ↓
W000 # LW
#22221111 ← 4
#22221111 ← 5
```

1. Switch to the Setup Mode.
2. Press the **Down** button to select **IO Memory**.
3. Press the **OK** button to enter the I/O Memory menu.
4. Press the **Down** button to select **WR**.
5. Press the **OK** button to enter the Monitor Screen of I/O memory WR.
6. Use the **Forward** button to move the column cursor to the data length position.  
Press the **Down** or **Up** button to select the data length **LW**.
7. Press the **OK** button to enter the Change Screen of I/O memory W000.  
The following table shows the setting items.

| No. | Attributes                                   |
|-----|--|
| 1   | Head channel address (Read only)             |
| 2   | Display format (Read only)                   |
| 3   | Data length (Read only)                      |
| 4   | Data of I/O memory before change (Read only) |
| 5   | Data of I/O memory after change              |



8. Press the **Forward** button to move the column cursor to the digit to be set. Use the **Down** or **Up** button to change the data to **12345678**.

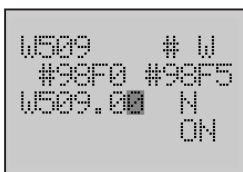
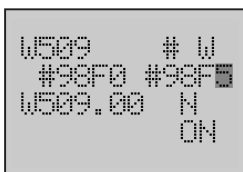
9. Press the **OK** button to save the setting. Press the **ESC** button to return to the previous screen. Then the data on W000 displayed in the Monitor Screen will be 12345678.

10. Change the leading word address to **509** to update the screen display.

11. Press the **OK** button to enter the Change Screen of I/O memory W509. The following table shows the setting items.

| No. | Description                                  |
|-----|--|
| a   | Leading word address(Read only)              |
| b   | Display format(Read only)                    |
| c   | Data length(Read only)                       |
| d   | Data of I/O memory before change (Read only) |
| e   | Data of I/O memory after change              |
| f   | Bit address                                  |
| g   | Bit flag                                     |
| h   | Bit state                                    |

**Note** If the display format is a decimal number (& or +), or the data length is a LongWord, user cannot make a setting for bit.



12. Move the column cursor to the digit to be set. Use the **Up** button to change the data to **98F5**.

13. Use the **Forward** button to move the column cursor to the position of bit address. The present setting is the default address. The range is 00~15.

```

W509      # W
#98F0 #98F5
W509.05  N
          ON

```

```

W509      # W
#98F0 #98F5
W509.05  █
          ON

```

```

W509      # W
#98F0 #98F5
W509.05  N
          █

```

```

W509      # W
#98F0 #98F5
W509.05  N
          OFF

```

```

W509      # W
+0: #98D5
+1: #F5F5
+2: #1234

```

14. Use the **Up** button to change the bit address to **05**.

15. Use the **Forward** button to move the column cursor to the bit flag position.  
The present setting is the default setting.  
Select the bit flag in the following table.

| Bit flag | Meaning        |
|----------|----------------|
| N        | Normal         |
| S        | Force to SET   |
| R        | Force to RESET |

16. Use the **Forward** button to move the column cursor to the bit state position.  
The present state is ON. The state ON or OFF is according to PLC.

17. Press the **Down** or **Up** button to select the bit state **OFF**.

**Note** If bit flag is S or R, the setting of bit state is invalid.

18. Press the **OK** button to save the setting.

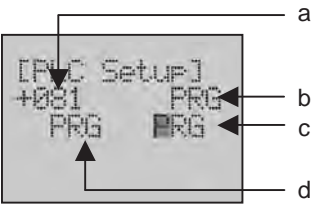
Press the **ESC** button to return to the previous screen.

Then the data on W509 displayed in the Monitor Screen will be 98D5.

11-6-4 PLC Setup

This function can display and change the settings in the PLC Setup.  
Change the CPU Unit Operating Mode from PRG to RUN.

Example 1  
1,2,3...



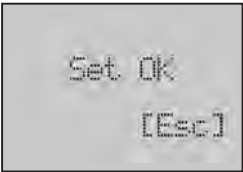
1. Switch to the Setup Mode.
2. Press the **Down** button to select **PLC Setup**.
3. Press the **OK** button to enter the PLC Setup menu.
4. Press the **OK** button to enter the CPU Unit Operating Mode Screen. The following table shows the setting items.

| No. | Attributes   |
|-----|--|
| a   | Address of CPU Unit Operating Mode (Read only)                               |
| b   | Present PLC mode (Read only)   |
| c   | CPU Unit Operating Mode after change (Read only when PLC mode is RUN or MON) |
| d   | CPU Unit Operating Mode before change (Read only)                            |

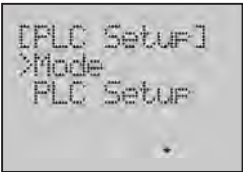
The address of CPU Unit Operating Mode is always 081, so there is no need to change the address.



5. Use the **Up** button to select **RUN**.
- Note** Before changing the CPU Unit Operating Mode, make sure that the present PLC mode is PRG. If PLC is in RUN or MON mode, the CPU Unit Operating Mode is unchangeable.



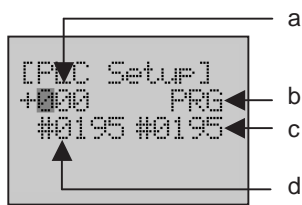
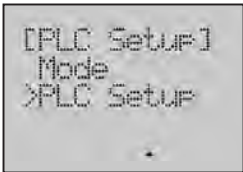
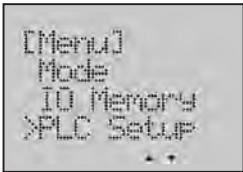
6. Press the **OK** button to save the setting.



7. Press the **ESC** or **OK** button to return to the previous menu.

**Example 2**     Display the value of PLC Setup on 080. Then change the value to 0195.

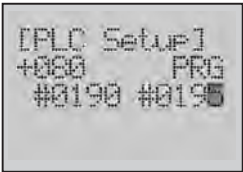
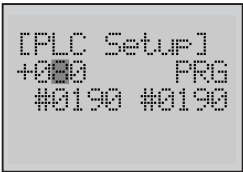
1,2,3...



1. Switch to the Setup Mode.
2. Press the **Down** button to select **PLC Setup**.
3. Press the **OK** button to enter the PLC Setup menu.
4. Press the **Down** button to select **PLC Setup**.
5. Press the **OK** button to enter the PLC Setup Screen  
The following table shows the setting items.

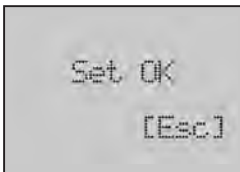
| No. | Description  |
|-----|--|
| a   | Address of PLC Setup   |
| b   | PLC mode (Read only)   |
| c   | Value of PLC Setup after change<br>(Read only when PLC mode is RUN or MON) |
| d   | Value of PLC Setup before change (Read only)                               |

The first digit of PLC Setup address will be flashing. The range of the address is 000 to 511.

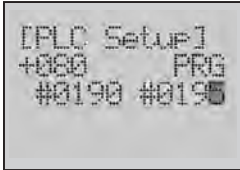


6. Use the **Up** button to change the address to **080**.  
After the address is changed, the value of PLC Setup will be updated immediately.
7. Use the **Forward** button to move the column cursor to the value of PLC Setup.  
Use the **Up** button to change the value to **0195**.

**Note** Before changing the value of PLC Setup, make sure that the PLC mode is PRG. If PLC is in RUN or MON mode, the value is unchangeable.



8. Press the **OK** button to save the setting.



9. Press the **ESC** or **OK** button to return to the PLC Setup Screen.

## 11-6-5 Analog

### Displaying Analog Inputs

**Example** Monitor the built-in analog input with unsigned decimal number.

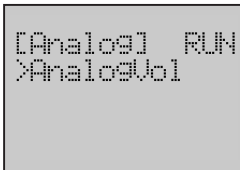
1,2,3...



1. Switch to the Setup Mode.

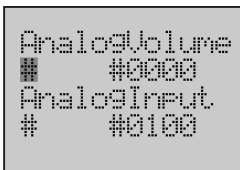


2. Press the **Down** button to select Analog.



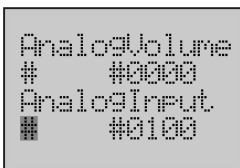
3. Press the **OK** button to enter the Analog menu.

**Note** Analog input will be displayed as "AnalogVol".

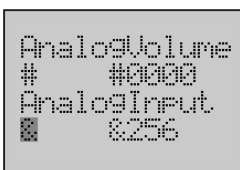


4. Press the **OK** button to enter the Monitor Screen of analog input.  
Line 2 will display the value of analog input 1.  
Line 4 will display the value of analog input 2.  
The display format on line 2 will be flashing.

**Note** Analog input 1 is displayed as "AnalogVolume" instead of "AnalogInput".



5. Use the **Forward** button to move the column cursor to the display format position on line 4.



6. Press the **Down** or **Up** button to change the display format to **&**.

```
[Analog] RUN
>AnalogVol
```

7. Press the **ESC** button to return to the previous screen.

## 11-6-6 Error

This function can display the list of error history and the details of each error. It is possible to display up to 20 screens. User can also monitor the occurring errors in the Error Monitor Screen.

### Displaying and Clearing Error History

**Example** Display the list of error history and then clear it.

1,2,3...

```
[Menu]
>Mode
  IO Memory
  PLC Setup
```

1. Switch to the Setup Mode.

```
[Menu]
>Analog
  Error
  MC
```

2. Press the **Down** button to select **Error**.

```
[Error]
>ErrorLog
  ErrorMon
```

3. Press the **OK** button to enter the Error menu.

```
[ErrorLog]
>MemoryErr
  Bus Unit
  FALS 024
```

4. Press the **OK** button to enter the Error History Screen. Error history will be displayed in this screen.

```
1. MemoryErr
2007/11/22
15:30:02
Code: 0002
```

5. Press the **OK** button to enter the Error Screen details. The following table shows the display items.

| No. | Description             |
|-----|-------------------------|
| a   | Error number(1 to 20)   |
| b   | Error type              |
| c   | The date error occurred |
| d   | The time error occurred |
| e   | Error code              |

```

11. MemoryErr
2007/11/28
13:26:35
Code:0002

```

6. If there is more than one error, press the **Down** button to scroll the screen and display the details of the next error.

```

[ErrorLog]
MemoryErr
>CLR ErrLog

```

7. Press the **ESC** button to return to the Error History Screen.  
Press the **Down** button to select **CLR ErrLog** which is always below the last error.

```

[CLR ErrLog]
>Cancel
OK

```

8. Press the **OK** button to enter the Error Clear Screen.

```

[CLR ErrLog]
Cancel
>OK

```

9. Press the **Down** button to select **OK**.

**Note** Selecting **Cancel** will result in a return to the previous screen.

```

[CLR ErrLog]
Complete

```

10. Press the **OK** button to clear the error history.  
When the clearing is finished, it will display a complete screen.

```

[ErrorLog]

```

11. Press the **ESC** button to return to the Error History Screen.  
All the errors have been cleared.

### Clearing Occurring Error List

**Example** Clear memory error in the list that occurs at the present time.

**1,2,3...**

```

[Menu]
>Mode
IO Memory
PLC Setup

```

1. Switch to the Setup Mode.

```

[Menu]
Analog
>Error
MC

```

2. Press the **Down** button to select **Error**.





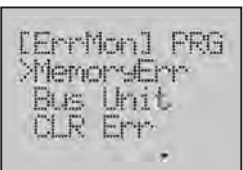
```
[Error]
>ErrorLog
ErrorMon
  ▾
```

3. Press the **OK** button to enter the Error menu.



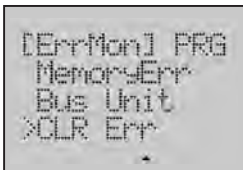
```
[Error]
ErrorLog
>ErrorMon
  ▲
```

4. Press the **Down** button to select **ErrorMon**.



```
[ErrMon] PRG
>MemoryErr
Bus Unit
CLR Err
  ▸
```

5. Press the **OK** button to enter the Error Monitor Screen.  
Max. 2 errors that occur the earliest will be displayed.



```
[ErrMon] PRG
MemoryErr
Bus Unit
>CLR Err
  ▾
```

6. Press the **Down** button to select **CLR Err**.



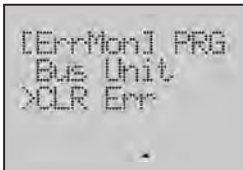
```
[CLR Err]
>Cancel
OK
  ▾
```

7. Press the **OK** button to enter the Error Clear Screen.



```
[CLR Err]
Cancel
>OK
  ▲
```

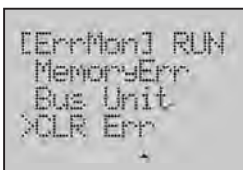
8. Press the **Down** button to select **OK**.



```
[ErrMon] PRG
Bus Unit
>CLR Err
  ▾
```

9. Press the **OK** button to clear the memory error in the list.

**Note** Only one error that occurs the earliest in the list will be cleared one time.



```
[ErrMon] RUN
MemoryErr
Bus Unit
>CLR Err
  ▾
```

10. If the memory error itself has not been eliminated, when the Error Monitor Screen is updated, the error will be displayed again in the screen.

# 11-6-7 Memory Cassette

## Before Operation

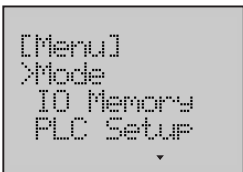
- Memory Cassette should be equipped into the PLC. Otherwise LCD cannot operate Memory Cassette.
- Make sure that the PLC mode is PRG. If the PLC is in RUN or MON mode, the operation of Memory Cassette cannot be executed.

## Loading Data from Memory Cassette to PLC

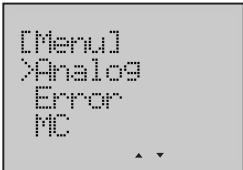
**Example** Load data from Memory Cassette to the PLC.

1,2,3...

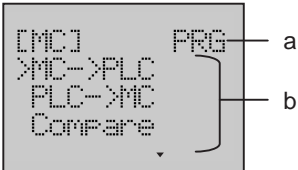
1. Switch to the Setup Mode.



2. Press the **Down** button to select **MC**.



3. Press the **OK** button to enter the Memory Cassette menu. The following table shows the setting items.

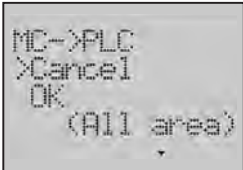


| No. | Description          |
|-----|----------------------|
| a   | PLC mode (Read only) |
| b   | Operation mode       |

Select the operation mode in the following table.

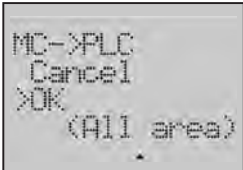
| Operation Mode | Meaning                               |
|----------------|---------------------------------------|
| MC->PLC        | Load data from memory cassette to PLC |
| PLC->MC        | Save data from PLC to memory cassette |
| Compare        | Compare data between PLC and MC       |
| Clear          | Format memory cassette                |

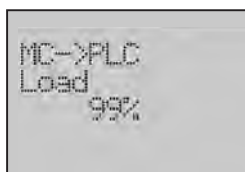
4. Press the **OK** button to enter the "MC->PLC" Operation Screen.



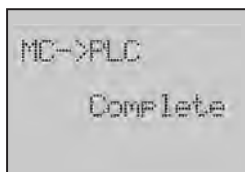
5. Press the **Down** button to select **OK**.

**Note** Selecting **Cancel** will result in a return to the previous menu.





6. Press the **OK** button to start loading.  
A rate of loading will be displayed in the screen.



7. When the rate comes up to 0%, the loading is finished. Then it will display a complete screen.

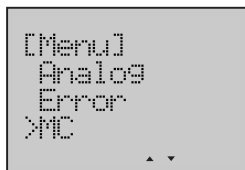
### Saving Data from PLC to Memory Cassette

**Example** Save data from the PLC to Memory Cassette.

**1,2,3...**



1. Switch to the Setup Mode.



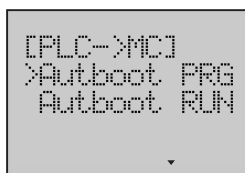
2. Press the **Down** button to select **MC**.



3. Press the **OK** button to enter the Memory Cassette menu.

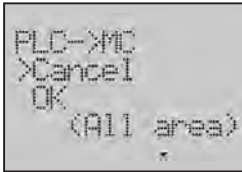


4. Press the **Down** button to select **PLC->MC**.



5. Press the **[OK]** button to enter the "PLC->MC" menu.  
Select the saving mode in the following table.

| Saving Mode  | Meaning  |
|--------------|--|
| Autoboot PRG | If the power turns ON, the operation cannot be executed.   |
| Autoboot RUN | Even if the power turns ON, the operation can be executed. |

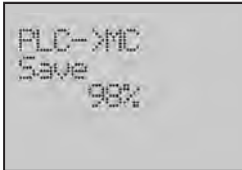


6. Press the **OK** button to enter the "PLC->MC" Operation Screen.

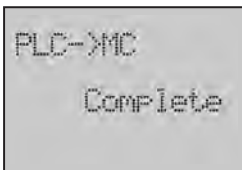


7. Press the **Down** button to select **OK**.

**Note** Selecting **Cancel** will result in a return to the previous menu.



8. Press the **OK** button to start saving.  
A rate of saving will be displayed in the screen.



9. When the rate comes up to 0%, the saving is finished. Then it will display a complete screen.

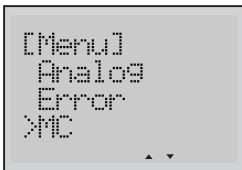
### **Comparing Data between PLC and MC**

**Example** Compare the data between the PLC and Memory Cassette.

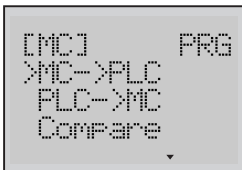
**1,2,3...**



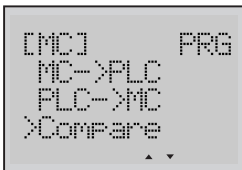
1. Switch to the Setup Mode.



2. Press the **Down** button to select **MC**.



3. Press the **OK** button to enter the Memory Cassette Screen.



4. Press the **Down** button to select **Compare**.



- Press the **OK** button to enter the Compare Operation Screen.

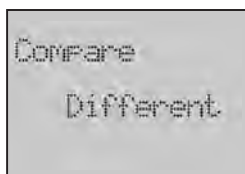


- Press the **Down** button to select **OK**.

**Note** Selecting **Cancel** will result in a return to the previous menu.



- Press the **OK** button to start comparing.  
A rate of comparison will be displayed in the screen.

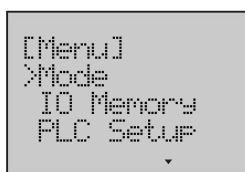


- When the rate comes up to 0%, the comparing is finished. Then it will display a result of comparison.

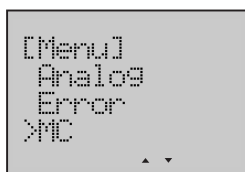
## Clearing Memory Cassette

**Example** Clear the data in Memory Cassette.

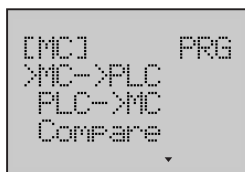
**1,2,3...**



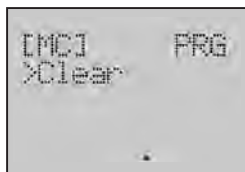
- Switch to the Setup Mode.



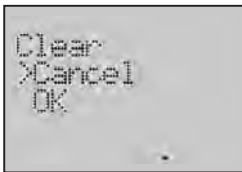
- Press the **Down** button to select **MC**.



- Press the **OK** button to enter the Memory Cassette menu.



- Press the **Down** button to select **Clear**.

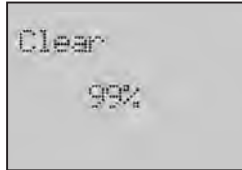


5. Press the **OK** button to enter the Clear Operation Screen.

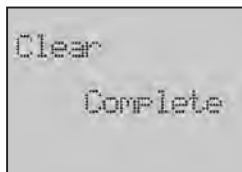


6. Press the **Down** button to select **OK**.

**Note** Selecting **Cancel** will result in a return to the previous menu.



7. Press the **OK** button to start clearing.  
A rate of clearance will be displayed in the screen.



8. When the rate comes up to 0%, the clearing is finished. Then it will display a complete screen.

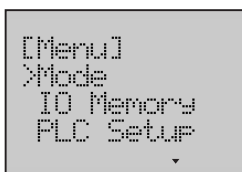
## 11-6-8 User Monitor Screen

This function can set or delete User Monitor Screen. It is possible to register up to 16 screens. User can monitor his necessary data in the User Monitor Screen. Each User Monitor Screen includes 4 lines of content. Each line has three kinds of display type including word memory, bit memory and text string.

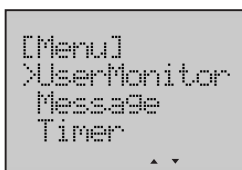
### Creating New User Monitor Screen

**Example 1** Monitor one word data on the word address D09000 with unsigned decimal number through User Monitor Screen 2, displayed on Line 1.

1,2,3...



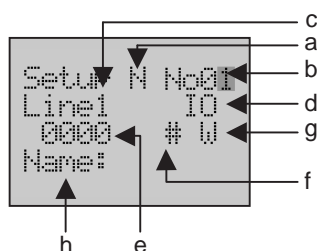
1. Switch to the Setup Mode.



2. Press the **Down** button to select **UserMonitor**.



3. Press the **OK** button to enter the User Monitor menu.



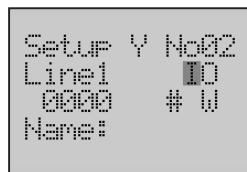
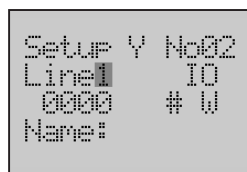
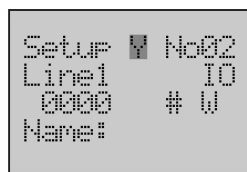
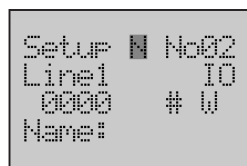
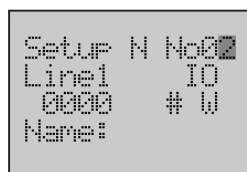
4. Press the **OK** button to enter the User Monitor Setup Screen.

The final digit of the Screen No. will be flashing.

The following table shows the setting items for each display type.

| No. | Description                                  | Display type |     |             |
|-----|--|--------------|-----|-------------|
|     |  | Word         | Bit | Text string |
| a   | Monitor flag                                 | Yes          | Yes | Yes         |
| b   | User Monitor Screen No. (01 to 16)           | Yes          | Yes | Yes         |
| c   | Line No. (1 to 4) of the User Monitor Screen | Yes          | Yes | Yes         |
| d   | Display type                                 | Yes          | Yes | Yes         |
| e   | I/O memory address                           | Yes          | Yes | No          |
| f   | Display format                               | Yes          | No  | No          |
| g   | Date length                                  | Yes          | No  | No          |
| h   | I/O memory name                              | Yes          | Yes | Yes         |

5. Use the **Up** button to change the Screen No. to **2**.



6. Use the **Forward** button to move the column cursor to the monitor flag position. Select the monitor flag in the following table.

| Monitor flag | Meaning                        |
|--------------|--------------------------------|
| Y            | User Monitor Screen in use     |
| N            | User Monitor Screen not in use |

7. Press the **Up** button to select the monitor flag **Y**. Then user can monitor this screen after the setting is complete.

8. Use the **Forward** button to move the column cursor to the Line No. position. The present setting is Line **1**.

9. Use the **Forward** button to move the column cursor to the display type position. The following table shows the display types which can be selected, including the default address and the setting range for each type.

| Display type |                 | Default address | Range              |
|--------------|-----------------|-----------------|--------------------|
| Word         | IO              | 0000            | 0000 to 6143       |
|              | WR              | 000             | 000 to 511         |
|              | HR              | 000             | 000 to 511         |
|              | AR              | 000             | 000 to 959         |
|              | TIM             | 0000            | 0000 to 4095       |
|              | CNT             | 0000            | 0000 to 4095       |
|              | DM              | 00000           | 00000 to 32767     |
|              | DR              | 00              | 00 to 15           |
|              | IR              | 00              | 00 to 15           |
|              | TK              | 00              | 00 to 31           |
|              | TMF(Timer flag) | 0000            | 0000 to 4095       |
|              | CTF(Timer flag) | 0000            | 0000 to 4095       |
| Bit          | IOB             | 0000.00         | 0000.00 to 6143.15 |
|              | WRB             | 000.00          | 000.00 to 511.15   |
|              | HRB             | 000.00          | 000.00 to 511.15   |
|              | ARB             | 000.00          | 000.00 to 959.15   |
| Text string  | STR             | -               | -                  |

**Note** Do not specify an address between D10000 and D31999 for a CPU Unit with 20 I/O Points.

10. Press the **Up** button to select **DM**.

```
Setup Y No02
Line1  DM
D00000 # W
Name:
```

11. Use the **Forward** button to move the column cursor to the memory address position.  
The present setting is the default address.

```
Setup Y No02
Line1  DM
D00000 # W
Name:
```

12. Move the column cursor to the digit to be set.  
Use the **Up** button to change the memory address to **09000**.

```
Setup Y No02
Line1  DM
D09000 # W
Name:
```

13. Use the **Forward** button to move the column cursor to the display format position.  
Select the display format in the following table.

| Display format | Meaning                 |
|----------------|-------------------------|
| #              | Hex number              |
| +              | Signed decimal number   |
| &              | Unsigned decimal number |



```

Setup Y No02
Line1  DM
D09000  W
Name:

```

```

Setup Y No02
Line1  DM
D09000  & W
Name:

```

```

Setup Y No02
Line1  DM
D09000  & W
Name:

```

```

Setup Y No02
Line1  DM
D09000  & W
Name:Counter

```

```

Set OK
[Esc]

```

```

Setup Y No02
Line1  DM
D09000  & W
Name:Counter

```

```

Counter
&12345

```

14. Press the **Down** or **Up** button to select the display format **&**.

15. Use the **Forward** button to move the column cursor to the data length position.  
The present setting is **W**.  
Select the data length in the following table.

| Data length | Meaning       |
|-------------|---------------|
| W           | One word data |
| LW          | Two word data |

16. Use the **Forward** button to move the column cursor to the position of Name.

17. Use the **Down** or **Up** button to select the character of each digit.  
Name the word to **Counter**.

**Note**

1. When selecting the character of the next digit, the leading character will be the character of the digit before.
2. The max length of word or bit name is 7 characters.

18. Press the **OK** button to save the setting.

19. Press the **ESC** or **OK** button to return to the User Monitor Setup Screen.

20. Press the **ESC** button three times to return to the Monitor Mode.  
Switch to the User Monitor Screen 2 with the **Down** button.

**Note**

1. Setting of word or bit name is not necessary. The default name is NULL, and the memory address will be displayed at the name position in the User Monitor Screen.
2. One line setting will take 1 or 2 lines of space. If word or bit name length is more than 5 characters or data length is a LongWord, it will take 2 lines of space.
3. One screen only has 4 lines of space available. If one line setting has already taken 2 lines of space, the next line setting will be invalid. If the setting of line 4 takes 2 lines of space, its setting will be invalid.

**Example 2** Display a text string "elevator" on the User Monitor Screen 2, Line 4, after the setting in example 1.

1,2,3...

```
[Menu]
>Mode
IO Memory
PLC Setup
▼
```

1. Switch to the Setup Mode.

```
[Menu]
>UserMonitor
Message
Timer
▲ ▼
```

2. Press the **Down** button to select **UserMonitor**.

```
[UserMon]
>Setup
Delete
▼
```

3. Press the **OK** button to enter the User Monitor menu.

```
Setup N No01
Line1 IO
0000 # U
Name:
```

4. Press the **OK** button to enter the User Monitor Setup Screen.

```
Setup Y No02
Line1 DM
D0900 & W
Name:Counter
```

5. Use the **Up** button to change the Screen No. to **2**.  
The setting in example 1 will be displayed.

```
Setup Y No02
Line4 IO
0000 # U
Name:
```

6. Use the **Forward** button to move the column cursor to the Line No. position.  
Use the **Up** button to change the Line No. to **4**.

```
Setup Y No02
Line4 STR
```

7. Use the **Forward** button to move the column cursor to the display type position.  
Press the **Up** button to select **STR**.

```
Setup Y No02
Line4 STR
■
```

8. Use the **Forward** button to move the column cursor to the position of String Name.

```
Setup Y No02
Line4 STR
elevator
```

9. Use the **Down** or **Up** button to select the character of each digit.  
Name the text string to **elevator**.

```
Set OK
[Esc]
```

10. Press the **OK** button to save the setting.

```
Setup Y No02
Line4 STR
elevator
```

11. Press the **ESC** or **OK** button to return to the User Monitor Setup Screen.

```
Counter:
&12345
elevator
```

12. Press the **ESC** button three times to return to the Monitor Mode.  
Switch to the User Monitor Screen 2.

**Note**

1. The default text string is NULL.
2. The max length of text string is 12 characters.

**Changing User Monitor Screen**

User can not only change the date displayed in the User Monitor Screen in the Setup Mode, but also in the Monitor Mode.

**Example 1**

Change the average to 0100 and the minimum to -00123.

1,2,3...

```
Avg #1000
Min +00123
Max
&00000009999
```

1. Display the User Monitor Screen.

```
Avg ##1000
Min +00123
Max
&00000009999
```

2. Press the **Forward + OK** button simultaneously to enter the Data Change Screen.  
The column cursor will be flashing on the digit before the value.

```
Avg #11000
Min +00123
Max
&00000009999
```

3. Use the **Forward** button to move the column cursor to the digit to be set.

```

Avg   #0100
Min   +00123
Max
800000009999

```

```

Avg   ##0100
Min   +00123
Max
800000009999

```

```

Avg   #0100
Min   ■+00123
Max
800000009999

```

```

Avg   #0100
Min   ■00123
Max
800000009999

```

```

Avg   #0100
Min   ■-00123
Max
800000009999

```

```

Avg   #0100
Min   +00123
Max
800000009999

```

4. Use the **Up** button to change the value to **0100**.

5. Press the **OK** button to save the setting.  
The column cursor will return to the digit before the value.

6. Use the **Down** button to move the cursor to line 2.

**Note** Only when the cursor is on the digit before the value, press the **Down** or **Up** button to move the cursor to other lines.

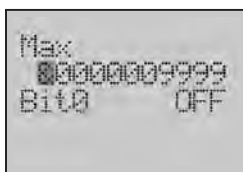
7. Use the **Forward** button to move the column cursor to the sign position.  
Press the **Down** or **Up** button to change the sign to -.

8. Press the **OK** button to save the setting.  
If the setting is invalid, the screen display will have no change.

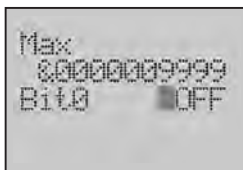
9. Press the **ESC** button to return to the User Monitor Screen.  
The average has been changed to 0100, but the minimum is still +00123.

**Example 2** Change bit0 from OFF to ON.

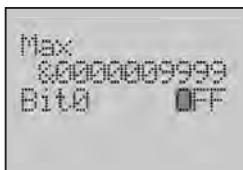
1,2,3...



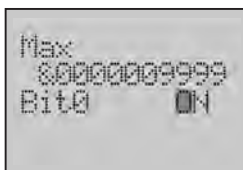
1. Press the **Forward + OK** button simultaneously to enter the Data Change Screen.



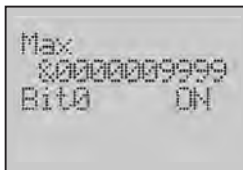
2. Use the **Down** button to move the cursor to line 2.



3. Use the **Forward** button to move the column cursor to the bit state position.



4. Press the **Down** or **Up** button to change the bit state to **ON**.

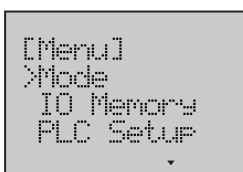


5. Press the **OK** button to save the setting.  
Press the **ESC** button to return to the User Monitor Screen.

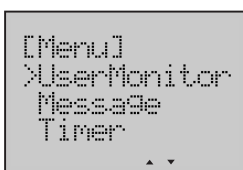
### Deleting User Monitor Screen

**Example** Delete the User Monitor Screen 2.

1,2,3...



1. Switch to the Setup Mode.



2. Press the **Down** button to select **UserMonitor**.



3. Press the **OK** button to enter the User Monitor menu.



```
[UserMon]
Setup
>Delete
^
```

4. Press the **Down** button to select **Delete**.



```
[UserMon]
Delete No00
```

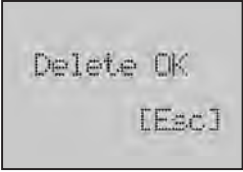
5. Press the **OK** button to enter the User Monitor Delete Screen.  
The final digit of the Screen No. will be flashing.



```
[UserMon]
Delete No02
```

6. Use the **Up** button to change the Screen No. to **2**.

**Note** Press and hold the **UP** button until the Screen No. changes to **ALL**, all the User Monitor Screen will be deleted if the setting is confirmed.



```
Delete OK
[Esc]
```

7. Press the **OK** button to delete the screen.



```
[UserMon]
Setup
>Delete
^
```

8. Press the **ESC** or **OK** button to return to the previous menu.

## 11-6-9 Message Screen

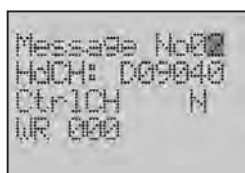
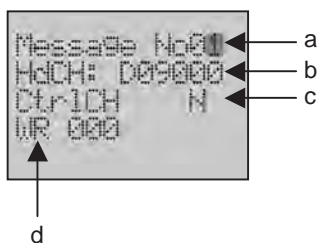
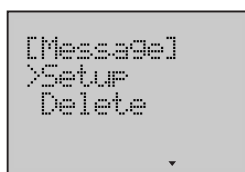
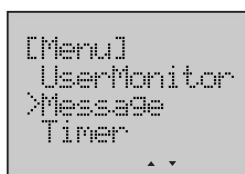
This function can set or delete Message Screen. It is possible to register up to 16 screens. User can monitor the text message in the Message Screen when control bit is ON.

### Creating New Message Screen

#### Example

When control bit W100.01 is ON, the Message Screen 2 will display the data on the word address D09040 to D09075.

1,2,3...



1. Switch to the Setup Mode.
2. Press the **Down** button to select **Message**.
3. Press the OK button to enter the Message menu.
4. Press the **OK** button to enter the Message Setup Screen.  
The final digit of the Screen No. will be flashing.  
The following table shows the setting items.

| No. | Description                           |
|-----|---------------------------------------|
| a   | Message Screen No. (01 to 16)         |
| b   | Leading word (Only DM) address        |
| c   | Message flag                          |
| d   | Word (Only WR) address of control bit |

5. Use the **Up** button to change the Screen No. to **2**.  
The following table shows the relation between the Screen No. and the control bit when the word address is W000.

| Screen No. | Control bit |
|------------|-------------|
| 01         | W000.00     |
| 02         | W000.01     |
| 03         | W000.02     |
| 04         | W000.03     |
| ...        | ...         |
| 16         | W000.15     |

```

Message No02
HdCH: D09040
Ctr-ICH  N
WR 000

```

6. Use the **Forward** button to move the column cursor to the position of leading word address.  
The present setting is the default address.  
The following table shows the default address and the setting range for each screen when the leading word address is D09000.

| Screen No. | Default address | Range          |
|------------|-----------------|----------------|
| 01         | 09000 to 09035  | 00000 to 32732 |
| 02         | 09040 to 09075  |                |
| 03         | 09080 to 09115  |                |
| 04         | 09120 to 09155  |                |
| ...        | ...             |                |
| 16         | 09600 to 09635  |                |

7. Use the **Forward** button to move the column cursor to the message flag position.  
Select the message flag in the following table.

| Message flag | Meaning                   |
|--------------|---------------------------|
| Y            | Message Screen in use     |
| N            | Message Screen not in use |

8. Press the **Up** button to select the message flag **Y**.  
The setting is available for all the screens.
9. Use the **Forward** button to move the column cursor to the position of word address.  
The present setting is the default address. The range of the address is 000 to 511.

10. Use the **Up** button to change the word address to **100**.

11. Press the **OK** button to save the setting.

12. Press the **ESC** or **OK** button to return to the Message Setup Screen.

13. Press the **ESC** button three times to return to the Monitor Mode.  
Switch to the Message Screen 2 when control bit W100.01 is ON.

```

Message No02
HdCH: D09040
Ctr-ICH  N
WR 000

```

```

Message No02
HdCH: D09040
Ctr-ICH  N
WR 000

```

```

Message No02
HdCH: D09040
Ctr-ICH  Y
WR 000

```

```

Message No02
HdCH: D09040
Ctr-ICH  Y
WR 100

```

```

Set OK
[Esc]

```

```

Message No02
HdCH: D09040
Ctr-ICH  Y
WR 100

```

```

Elevator
Stop at 1F

```



**DM Area Settings**

The text message is stored in the DM area. One character is 1 byte and one DM word is 2 bytes, so 24 DM words need to be used to store one screen message. But not all of the area can be used. Do not specify an address between D10000 and D31999 for a CPU Unit with 20 I/O Points.

The following table shows the setting area for each screen when the leading word address is D09000.

| Screen No. | Word   | 0  |    | 1  |    | 2  |    | 3  |    | 4  |    | 5  |    | 6           | 7 | 8 | 9 |
|------------|--------|----|----|----|----|----|----|----|----|----|----|----|----|-------------|---|---|---|
| 01         | D09000 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |             |   |   |   |
|            | D09010 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |             |   |   |   |
|            | D09020 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |             |   |   |   |
|            | D09030 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |             |   |   |   |
| 02         | D09040 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |             |   |   |   |
|            | D09050 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |             |   |   |   |
|            | D09060 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | Do not use. |   |   |   |
|            | D09070 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |             |   |   |   |
| ...        |        |    |    |    |    |    |    |    |    |    |    |    |    |             |   |   |   |
| 16         | D09600 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |             |   |   |   |
|            | D09610 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |             |   |   |   |
|            | D09620 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |             |   |   |   |
|            | D09630 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |             |   |   |   |

In this example, "Elevator Stop at 1F" is displayed on the Message Screen 2.

The data can be set in the DM area with the CX-Programmer.

The settings show as below.

| Line No. | Word   | Setting | Character |   |
|----------|--------|---------|-----------|---|
| 1        | D09040 | 2020    |           |   |
|          | D09041 | 2020    |           |   |
|          | D09042 | 2020    |           |   |
|          | D09043 | 2020    |           |   |
|          | D09044 | 2020    |           |   |
|          | D09045 | 2020    |           |   |
| 2        | D09050 | 456C    | E         | l |
|          | D09051 | 6576    | e         | v |
|          | D09052 | 6174    | a         | t |
|          | D09053 | 6F72    | o         | r |
|          | D09054 | 2020    |           |   |
|          | D09055 | 2020    |           |   |
| 3        | D09060 | 2053    |           | S |
|          | D09061 | 746F    | t         | o |
|          | D09062 | 7020    | p         |   |
|          | D09063 | 6174    | a         | t |
|          | D09064 | 2031    |           | 1 |
|          | D09065 | 4620    | F         |   |
| 4        | D09070 | 2020    |           |   |
|          | D09071 | 2020    |           |   |
|          | D09072 | 2020    |           |   |
|          | D09073 | 2020    |           |   |
|          | D09074 | 2020    |           |   |
|          | D09075 | 2020    |           |   |

Select the character codes in the following table.

| Upper bits<br>Lower bits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|--------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 3                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 7                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 8                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| A                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| B                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| C                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| D                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| E                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| F                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Deleting Message Screen**

**Example** Delete the Message Screen 1.

**1,2,3...**

```
[Menu]
>Mode
  IO Memory
  PLC Setup
  ▼
```

1. Switch to the Setup Mode.

```
[Menu]
  UserMonitor
  >Message
  Tiner
  ▲ ▼
```

2. Press the **Down** button to select **Message**.

```
[Message]
>Setup
Delete
  ▼
```

3. Press the **OK** button to enter the Message menu.

```
[Message]
  Setup
  >Delete
  ▲
```

4. Press the **Down** button to select **Delete**.

```
[Message]
Delete No.01
```

5. Press the **OK** button to enter the Message Delete Screen.  
The present setting is Screen **01**.

**Note** Press and hold the **UP** button until the Screen No. changes to **ALL**, all the User Monitor Screen will be deleted if the setting is confirmed.

```
Delete OK
      [ESC]
```

6. Press the **OK** button to delete the screen.

```
[Message]
  Setup
  >Delete
  ▲
```

7. Press the **ESC** or **OK** button to return to the previous menu.

## 11-6-10 Timer Switch

There are 3 kinds of timer, including Day, Weekly and Calendar Timer. It is possible to register up to 16 timers for each kind.

| Type           | Description  |
|----------------|--|
| Day timer      | Sometime in a day, set the related control bit to ON.  |
| Weekly timer   | Sometime in a week, set the related control bit to ON. |
| Calendar timer | Sometime in a year, set the related control bit to ON. |

### Setting Day Timer

**Example** 8:30 to 17:15 from Monday to Friday, control bit W509.15 is ON.

1,2,3...

```
[Menu]
>Mode
  IO Memory
  PLC Setup
  ▼
```

```
[Menu]
  UserMonitor
  Message
  >Timer
  ▲ ▼
```

```
[Timer]
>Day Timer
  WeekTimer
  Cal Timer
  ▼
```

```
Day N No00
ON :00:00 Mo
OFF:00:00 Mo
IO 0100
  ▲   ▲
  e   f
```

a ← Day N No00  
b ← ON :00:00 Mo  
c ← OFF:00:00 Mo  
d ← IO 0100

```
Day N No15
ON :00:00 Mo
OFF:00:00 Mo
IO 0100
```

1. Switch to the Setup Mode.

2. Press the **Down** button to select **Timer**.

3. Press the **OK** button to enter the Timer Switch menu.

4. Press the **OK** button to enter the Day Timer Screen. The final digit of the Timer No. will be flashing. The following table shows the setting items.

| No. | Description          |
|-----|----------------------|
| a   | Timer flag           |
| b   | Timer No. (01 to 16) |
| c   | ON time of PLC       |
| d   | OFF time of PLC      |
| e   | Word type            |
| f   | Word address         |

5. Use the **Up** button to change the Timer No. to **16**. The following table shows the relation between the Timer No. and the control bit when the word address is W001.

| Timer No. | Control bit |
|-----------|-------------|
| 01        | W001.00     |
| 02        | W001.01     |
| 03        | W001.02     |
| 04        | W001.03     |
| ...       | ...         |
| 16        | W001.15     |

```

Day  [ ] No16
ON :00:00 Mo
OFF:00:00 Mo
IO  0100

```

```

Day  Y No16
ON :08:30 Mo
OFF:00:00 Mo
IO  0100

```

```

Day  Y No16
ON :08:30 M[ ]
OFF:00:00 Mo
IO  0100

```

```

Day  Y No16
ON :08:30 Mo
OFF:17:15 Mo
IO  0100

```

```

Day  Y No16
ON :08:30 Mo
OFF:17:15 F[ ]
IO  0100

```

```

Day  Y No16
ON :08:30 Mo
OFF:17:15 Fr
IO  0100

```

```

Day  Y No16
ON :08:30 Mo
OFF:17:15 Fr
WR  0000

```

6. Use the **Forward** button to move the column cursor to the timer flag position. Press the **Up** button to select the timer flag **Y**. Select the timer flag in the following table.

| Timer flag | Meaning          |
|------------|------------------|
| Y          | Timer in use     |
| N          | Timer not in use |

7. Use the **Forward** button to move the column cursor to the ON time position. Use the **Up** button to change time to **08:30**.

8. Use the **Forward** button to move the column cursor to the ON week position. The present setting is **Monday**.

9. Use the **Forward** button to move the column cursor to the OFF time position. Use the **Up** button to change time to **17:15**.

10. Use the **Forward** button to move the column cursor to the OFF week position. Press the **Down** or **Up** button to select **Friday**.

11. Use the **Forward** button to move the column cursor to the position of control bit.

12. Press the **Up** button to select **WR**. The following table shows the word type which can be selected, including the default address and the setting range for each type.

| Timer          | Word | Default address | Range        |
|----------------|------|-----------------|--------------|
| All            | IO   | 0100            | 0100 to 6143 |
| Day timer      | WR   | 001             | 001 to 511   |
| Weekly timer   | WR   | 002             | 002 to 511   |
| Calender timer | WR   | 003             | 003 to 511   |
| All            | HR   | 000             | 000 to 511   |
| All            | AR   | 448             | 448 to 959   |

```

Day  Y  No16
ON  :08:30 Mo
OFF:17:15 Fr
WR   W000

```

13. Use the **Forward** button to move the column cursor to the position of word address.  
The present setting is the default address.

```

Day  Y  No16
ON  :08:30 Mo
OFF:17:15 Fr
WR   W500

```

14. Move the column cursor to the digit to be set.  
Use the **Up** button to change the word address to **509**.

```

Set OK
[Esc]

```

15. Press the **OK** button to save the setting.

```

Day  Y  No16
ON  :08:30 Mo
OFF:17:15 Fr
WR   W509

```

16. Press the **ESC** or **OK** button to return to the Day Timer Screen.

## Setting Calendar Timer

### Example

From 1<sup>st</sup> June to 1<sup>st</sup> October, control bit H209.05 is ON.

### 1,2,3...

```

[Menu]
>Mode
  IO Memory
  FLC Setup
  ▼

```

1. Switch to the Setup Mode.

```

[Menu]
  UserMonitor
  Message
  >Timer
  ▲ ▼

```

2. Press the **Down** button to select **Timer**.

```

[Timer]
>Day Timer
  WeekTimer
  Cal Timer
  ▼

```

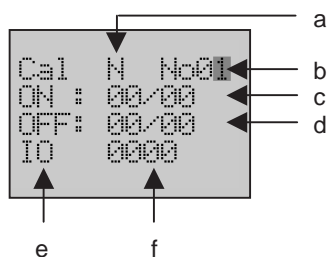
3. Press the **OK** button to enter the Timer menu.

```

[Timer]
  Day Timer
  WeekTimer
  >Cal Timer
  ▲

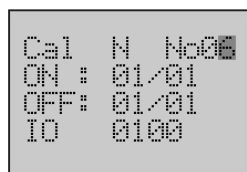
```

4. Press the **Down** button to select **Cal Timer**.

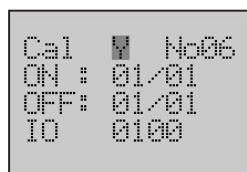


5. Press the **OK** button to enter the Calendar Timer Screen.  
The final digit of the Timer No. will be flashing.  
The following table shows the setting items.

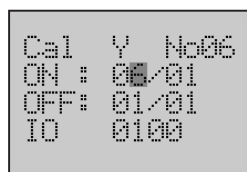
| No. | Description          |
|-----|----------------------|
| a   | Timer flag           |
| b   | Timer No. (01 to 16) |
| c   | ON date of PLC       |
| d   | OFF date of PLC      |
| e   | Word type            |
| f   | Word address         |



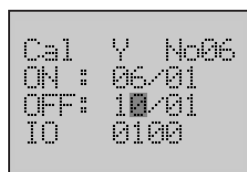
6. Use the **Up** button to change the Timer No. to **6**.



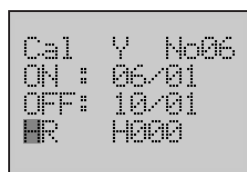
7. Use the **Forward** button to move the column cursor to the timer flag position.  
Press the **Up** button to select the timer flag **Y**.



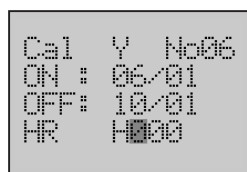
8. Use the **Forward** button to move the column cursor to the ON date position.  
Use the **Up** button to change the date to **06/01**.



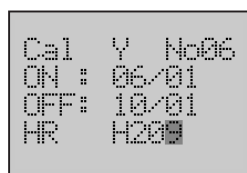
9. Use the **Forward** button to move the column cursor to the OFF date position.  
Use the **Up** button to change the date to **10/01**.



10. Use the **Forward** button to move the column cursor to the position of control bit.  
Press the **Up** button to select **HR**.



11. Use the **Forward** button to move the column cursor to the position of word address.  
The present setting is default address.



12. Move the column cursor to the digit to be set.  
Use the **Up** button to change the word address to **209**.



13. Press the **OK** button to save the setting.



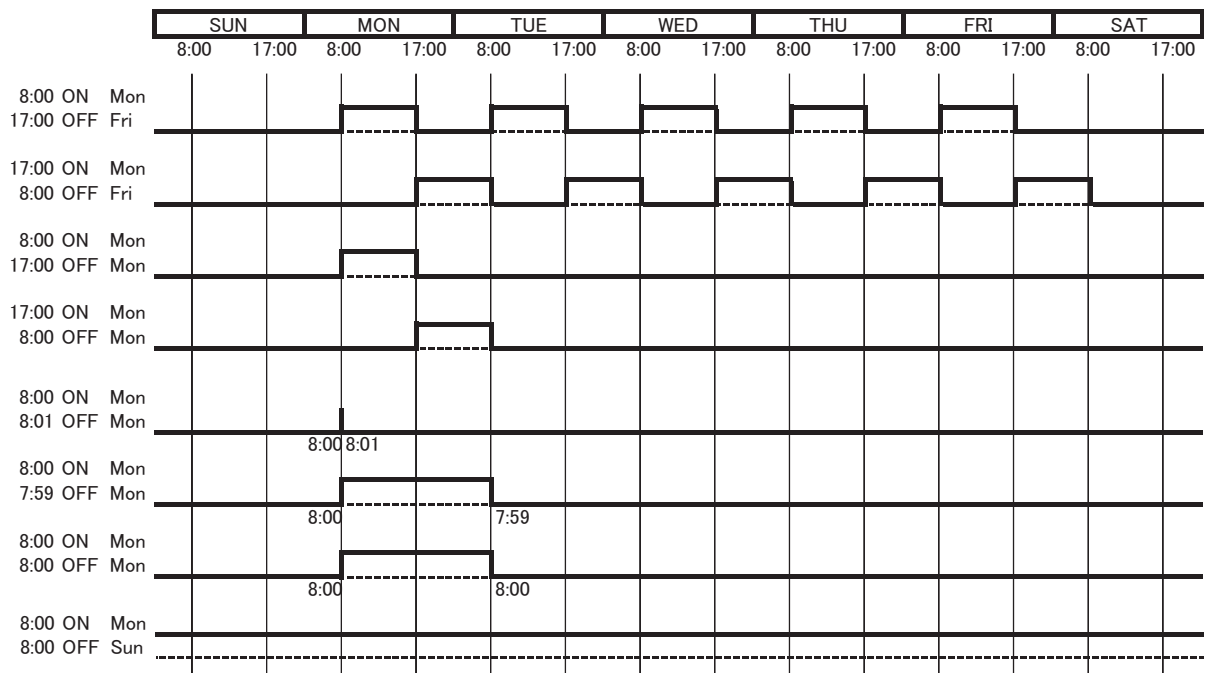
14. Press the **ESC** or **OK** button to return to the Calander Timer Screen.

- Note**
1. If a timer is in use, when the timer switch turns ON, the LCD Option Board will send command to PLC one time every 1 second to make control bit ON, when the timer switch turns OFF, the LCD Option Board will send command to PLC one time every 1 second to make control bit OFF.
  2. Move the LCD Option Board from one PLC to another, the result of timer operation will be different if the time of two PLCs is not the same.

## Timing Curve

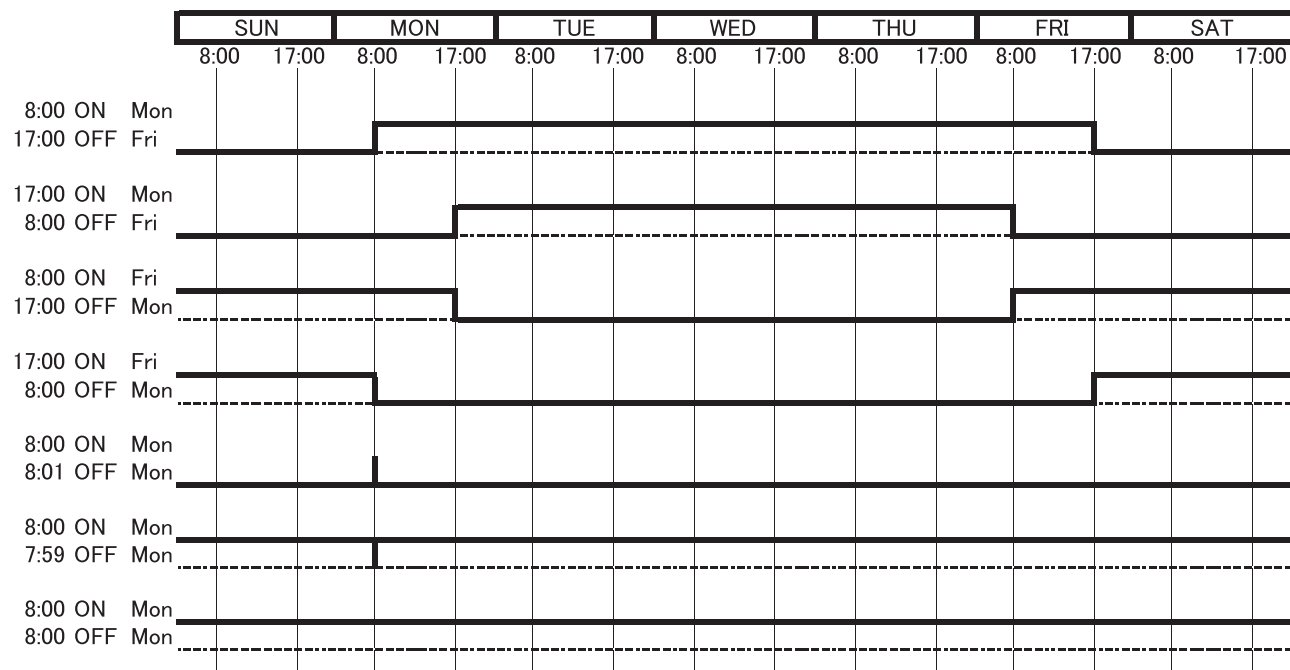
Each timer can execute a trans-day, trans-week or trans-year operation. The operation period will be shown in the following curve.

### Day Timer

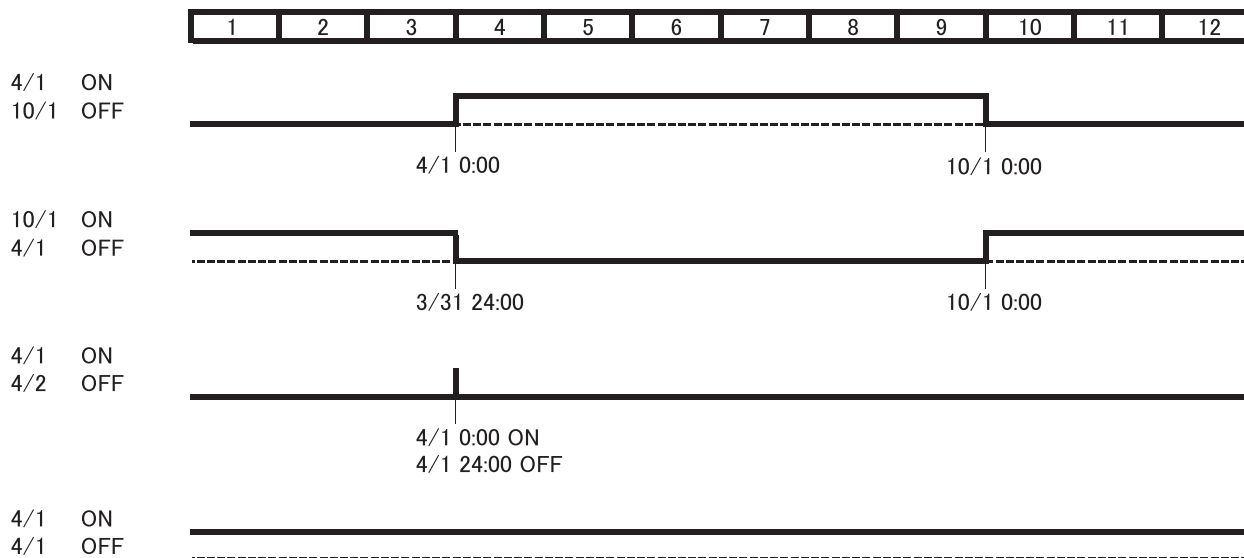




## Weekly Timer



## Calendar Timer



**Note** Set the OFF date to 1<sup>st</sup> October, the Calendar Timer will turn OFF at 24:00 31<sup>st</sup> September.

## 11-6-11 Data Backup

User can save the user settings to DM memory area from one LCD Option Board and load to other LCD Option Boards from the DM memory area.

**Note** Please do not take the DM area (D8000 to D8999) for other use.

User settings which can be backed up as shown below.

| User setting        |           | Quantity      |
|---------------------|-----------|---------------|
| User Monitor screen |           | 16 screens    |
| Message screen      |           | 16 screens    |
| Timer Switch        |           | 16 × 3 timers |
| Other               | Language  | 1             |
|                     | Backlight | 1             |
|                     | Contrast  | 1             |

### Loading User Setting

**Example** Load user settings from DM memory area.

1,2,3...

```
[Menu]
>Mode
  IO Memory
  PLC Setup
  ▾
```

1. Switch to the Setup Mode.

```
[Menu]
>DataBackup
  実行
  Other
  ▾
```

2. Press the **Down** button to select **DataBackup**.

```
[DataBackup]
>Load
  Save
  ▾
```

3. Press the **OK** button to enter the Data Backup menu.

```
[Load]
>Cancel
  OK (All)
  ▾
```

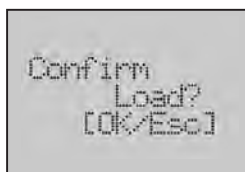
4. Press the **OK** button to enter the Load Operation Screen. Select the operation mode in the following table.

| Operation Mode | Meaning                        |
|----------------|--------------------------------|
| Load           | Load user setting from DM area |
| Save           | Save user setting into DM area |

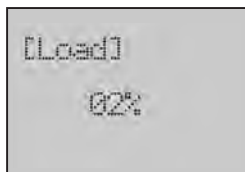
```
[Load]
  Cancel
>OK (All)
  ▴
```

5. Press the **Down** button to select **OK**.

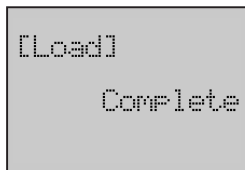
**Note** Selecting **Cancel** will result in a return to the previous menu.



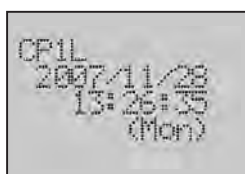
6. Press the **OK** button to display a load confirming screen.



7. Press the **OK** button to start loading.  
A rate of loading will be displayed in the screen.



8. When the rate comes up to 100%, the loading is finished. Then it will display a complete screen.



9. Press the **ESC** or **OK** button to restart the LCD Option Board.

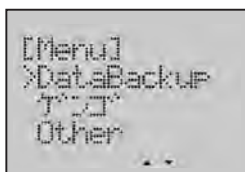
## **Saving User Setting**

**Example** Save user settings to DM memory area.

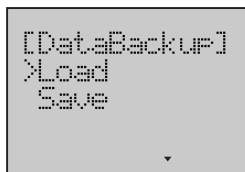
**1,2,3...**



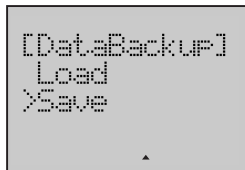
1. Switch to the Setup Mode.



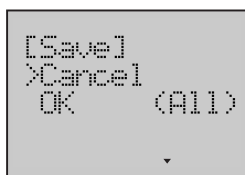
2. Press the **Down** button to select **DataBackup**.



3. Press the **OK** button to enter the Data Backup menu.

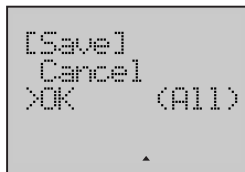


4. Press the **Down** button to select **Save**.



```
[Save]
>Cancel
OK      (All)
      ^
```

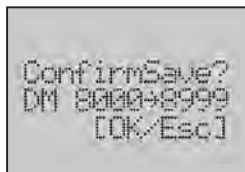
5. Press the **OK** button to enter the Save Operation Screen.



```
[Save]
Cancel
>OK      (All)
      ^
```

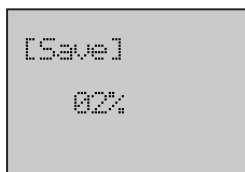
6. Press the **Down** button to select **OK**.

**Note** Selecting **Cancel** will result in a return to the previous menu.



```
ConfirmSave?
DM 8000+8999
[OK/Esc]
```

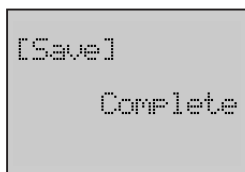
7. Press the **OK** button to display a save confirming screen.



```
[Save]

02%
```

8. Press the **OK** button to start saving.  
A rate of saving will be displayed in the screen.



```
[Save]

Complete
```

9. When the rate comes up to 100%, the saving is finished. Then it will display a complete screen.

## 11-6-12 Language Selection

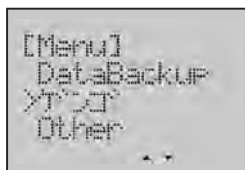
Display for the LCD Option Board is available in 2 languages - English and Japanese.

**Example** Change the display language from English to Japanese.

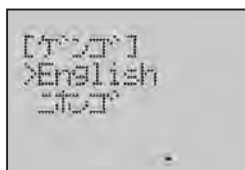
1,2,3...



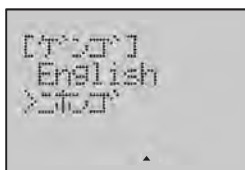
1. Switch to the Setup Mode.



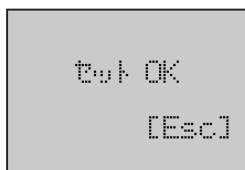
2. Press the **Down** button to select ゲンゴ .



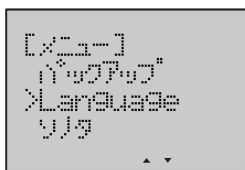
3. Press the **OK** button to enter the Language Setup Screen.  
The present language is English.



4. Press the **Down** button to select ニホンゴ .



5. Press the **OK** button to save the setting.



6. Press the **ESC** or **OK** button return to the previous menu.  
The display language will change to Japanese.

## 11-6-13 PLC Cycle Time

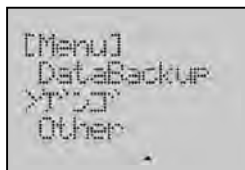
This function can display the cycle time of the CPU Unit. The operation method will be shown in the following example.

1,2,3...



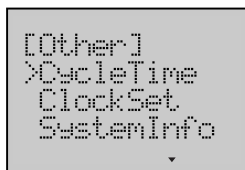
```
[Menu]
>Mode
IO Memory
PLC Setup
  ▲ ▼
```

1. Switch to the Setup Mode.



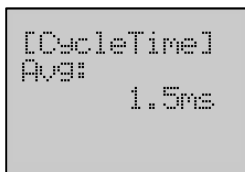
```
[Menu]
DataBackup
>PLC
Other
  ▲
```

2. Press the **Down** button to select **Other**.



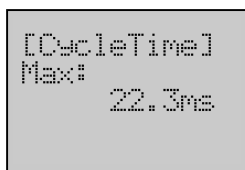
```
[Other]
>CycleTime
ClockSet
SystemInfo
  ▼
```

3. Press the **OK** button to enter the Other menu.



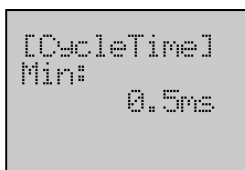
```
[CycleTime]
Avg:
    1.5ms
```

4. Press the **OK** button to enter the Cycle Time Screen.  
The average cycle time of the CPU Unit will be displayed.



```
[CycleTime]
Max:
    22.3ms
```

5. Press the **Down** button to display the max. cycle time of the CPU Unit.



```
[CycleTime]
Min:
    0.5ms
```

6. Press the **Down** button to display the min. cycle time of the CPU Unit.

## 11-6-14 PLC Clock Setting

This function can change the setting of the built-in clock in the CPU Unit.

### Example

Change PLC time to 12:00:00, PLC week to Saturday.

1,2,3...

```
[Menu]
>Mode
IO Memory
PLC Setup
```

1. Switch to the Setup Mode.

```
[Menu]
DataBackup
>PLC
Other
```

2. Press the **Down** button to select **Other**.

```
[Other]
>CycleTime
ClockSet
SystemInfo
```

3. Press the **OK** button to enter the Other menu.

```
[Other]
CycleTime
>ClockSet
SystemInfo
```

4. Press the **Down** button to select **ClockSet**.

```
[ClockSet]
2007/12/01
12:05:30
(Mon)
```

5. Press the **OK** button to enter the Clock Setup Screen.  
The present date, time and week of the CPU Unit will be displayed.

```
[ClockSet]
2007/12/01
12:00:00
(Mon)
```

6. Use the **Forward** button to move the column cursor to the position of PLC time.  
Use the **Down** or **Up** button to change the time to **12:00:00**.

```
[ClockSet]
2007/12/01
12:00:00
(Sat)
```

7. Use the **Forward** button to move the column cursor to the position of PLC week.  
Use the **Down** or **Up** button to select **Sat**.

```
Set OK
[Esc]
```

8. Press the **OK** button to save the setting.

```
[Other]
CycleTime
>ClockSet
SystemInfo
```

9. Press the **ESC** or **OK** button to return to the previous menu.

10. Press the **ESC** button to return to the Monitor Mode.

```

CP1L
2007/12/01
12:00:00
(Sat)

```

## 11-6-15 PLC System Information

This function can display the system information of the CPU Unit. The operation method will be shown in the following example.

1,2,3...

1. Switch to the Setup Mode.

```

[Menu]
>Mode
IO Memory
PLC Setup

```

2. Press the **Down** button to select **Other**.

```

[Menu]
DataBackup
>PLC
Other

```

3. Press the **OK** button to enter the Other menu.

```

[Other]
>CycleTime
ClockSet
SystemInfo

```

4. Press the **Down** button to select **SystemInfo**.

```

[Other]
CycleTime
ClockSet
>SystemInfo

```

5. Press the **OK** button to enter the System Information Screen.  
Line 1 to 3 will display the CPU Unit model, line 4 the lot No.

```

CP1H
-X40DR-A
LotNo. 29905

```

6. Press the **Down** button to display the CPU Unit version.

```

[SystemInfo]
UnitVer
1.2

```



11-6-16 LCD Backlight Setting

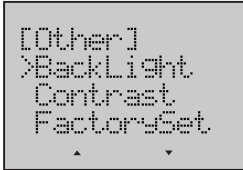
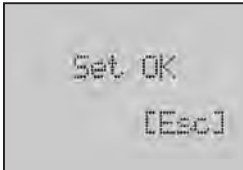
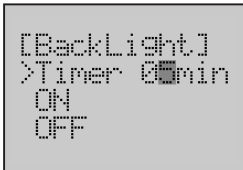
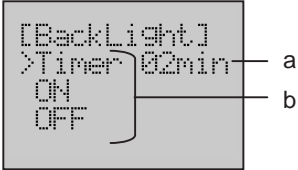
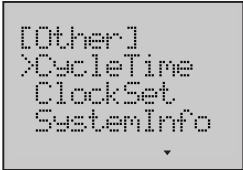
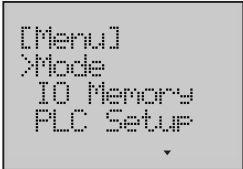
This function can make a setting for the LCD backlight.  
The backlight turns off after LCD has not been used for 5 minutes.

Example  
1,2,3...

- 1. Switch to the Setup Mode.
- 2. Press the **Down** button to select **Other**.
- 3. Press the **OK** button to enter the Other menu.
- 4. Press the **Down** button to select **BackLight**.
- 5. Press the **OK** button to enter the Backlight Screen.  
The following table shows the setting items.

| No. | Description    |       | Meaning  |
|-----|----------------|-------|--|
| a   | Timer interval |       | The range is 02 to 30 minutes.   |
| b   | Backlight mode | Timer | Backlight will turn OFF if LCD has not been used for the timer interval. |
|     |                | ON    | Backlight is always ON.  |
|     |                | OFF   | Backlight is always OFF.   |

- 6. Use the **Forward** button to move the column cursor to the position of timer interval.  
Use the **Up** button to change the timer interval to **05**.
- 7. Press the **OK** button to save the setting.
- 8. Press the **ESC** or **OK** button to return to the previous menu.



## 11-6-17 LCD Contrast Setting

This function can make a setting for the LCD contrast.

### Example

Change the contrast of LCD display to 8.

1,2,3...

```
[Menu]
>Mode
IO Memory
PLC Setup
▼
```

1. Switch to the Setup Mode.

```
[Menu]
DataBackup
>PLC
Other
▲
```

2. Press the **Down** button to select **Other**.

```
[Other]
>CycleTime
ClockSet
SystemInfo
▼
```

3. Press the **OK** button to enter the Other menu.

```
[Other]
BackLight
>Contrast
FactorySet
▲ ▼
```

4. Press the **Down** button to select **Contrast**.

```
[Contrast]
Level1:01
```

5. Press the **OK** button to enter the Contrast Screen.  
The contrast level of LCD display is 1 to 16.

```
[Contrast]
Level1:08
```

6. Use the **Up** button to change the level to **08**.

```
Set OK
[Esc]
```

7. Press the **OK** button to save the setting.

```
[Other]
BackLight
>Contrast
FactorySet
▲ ▼
```

8. Press the **ESC** or **OK** button to return to the previous menu.

## 11-6-18 LCD Factory Setting

This function can initialize the factory setting of the LCD Option Board. The operation method will be shown in the following example.

1,2,3...

```
[Menu]
>Mode
  IO Memory
  PLC Setup
```

```
[Menu]
DataBackup
>Factory
Other
```

```
[Other]
>CycleTime
ClockSet
SystemInfo
```

```
[Other]
BackLight
Contrast
>FactorySet
```

```
[FactorySet]
>Cancel
OK
```

```
[FactorySet]
Cancel
>OK
```

```
Initializing
0640
```

```
Finish to
initialize
[Esc]
```

```
CP1L
2007/11/28
13:26:35
(Mon)
```

1. Switch to the Setup Mode.
2. Press the **Down** button to select **Other**.
3. Press the **OK** button to enter the Other menu.
4. Press the **Down** button to select **FactorySet**.
5. Press the **OK** button to enter the Factory Setting Screen.
6. Press the **Down** button to select **OK**.  
**Note** Selecting **Cancel** will result in a return to the previous menu.
7. Press the **OK** button to start initializing.
8. When the initializing is finished, it will display a complete screen.
9. Press the **ESC** or **OK** button to restart the LCD Option Board.

## 11-7 Trouble Shooting

### 11-7-1 Symptom at Power ON or during Operation

| Symptom  | Probable cause                                    | Possible solution   |
|--|---|---|
| No LCD display   | LCD connection error or no power supply from PLC. | Check if LCD is connected correctly and the PLC power supply is normal.   |
|  | Still in startup waiting time.                    | It's not error. Just wait a moment.   |
| Display EEPROM Error Screen and blinking red backlight | EEPROM is damaged.                                | Replace the LCD Option Board.   |
|  | User settings in EEPROM are corrupted.            | Press the ESC button to exit the screen. User settings backed up in EEPROM will be replaced by default settings. Then proceed to reset the screens. (See 11-7-3 for details.) |
| Display NG Screen                                      | LCD connection error.                             | Check if LCD is connected correctly.  |
|  | Communication error between LCD and PLC.          | Check the communication setting of PLC, switching DipSW4 to ON.   |
| Display Error Screen and blinking red backlight        | PLC error   | Check PLC according to error code and eliminate the error.  |
| Button unresponsive                                    | Button is damaged.                                | Replace the LCD Option Board.   |
|  | User setting error.                               | Check the settings and change it.   |
|  | Noise disturbing.                                 | Retry after the noise is reduced.   |
| Display too faint                                      | Backlight is damaged.                             | Replace the LCD Option Board.   |
|  | Contrast level is too low or too high.            | Reset the contrast level.   |

**Note** Do not repair the LCD Option Board by yourself.

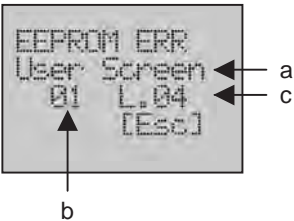
### 11-7-2 Communication Error Message during Operation

When communication error occurs, the error message will be displayed at the LCD Option Board and the red backlight will blink.

| Error message                                  | Probable cause  | Possible solution   |
|--|---|---|
| Parity Error or Framing Error or Overrun Error | Communication parameters or conditions of PLC are changed.            | Check the communication setting of PLC.   |
|  | LCD connection error.   | Check if LCD is still connected correctly.  |
|  | Noise disturbing.   | <ul style="list-style-type: none"> <li>Return to normal automatically when the noise is reduced.</li> <li>If the display cannot return to normal, press the ESC button to restart LCD.</li> </ul> |
| FCS Error(Sum check)                           | Noise disturbing.   | <ul style="list-style-type: none"> <li>Return to normal automatically when the noise is reduced.</li> <li>If the display cannot return to normal, press the ESC button to restart LCD.</li> </ul> |
| Buffer overflow                                | The length of receiving data is beyond the range of receiving memory. | Press the ESC button to restart LCD.  |
|  | Noise disturbing.   |   |
| Connecting Host...                             | LCD connection error.   | Check if LCD is still connected correctly.  |
|  | The communication between PLC and LCD is out of service.              | Check if PLC is running normally.   |
| Response code Error                            | Operation mistake.  | Refer to CJ/CS Communication Manual for solutions according to an end code.   |
|  | Noise disturbing.   | <ul style="list-style-type: none"> <li>Return to normal automatically if the noise is reduced.</li> <li>Press the ESC button to exit the screen.</li> </ul>                                       |
|  | CX-Programmer and LCD execute some function at the same time.         | Press the ESC button to exit the screen.<br>Execute this function by either CX-Programmer or LCD.   |

11-7-3 Deleting EEPROM Error

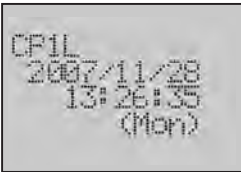
1,2,3...



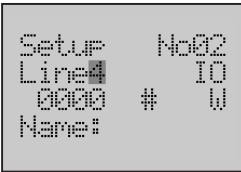
1. A flashing error screen will be displayed when an error occurs. The following table shows the display items.

| No. | Description |                            |
|-----|-------------|----------------------------|
| a   | Error type  | User Monitor setting error |
|     |             | Message setting error      |
|     |             | Timer Switch setting error |
|     |             | Language setting error     |
|     |             | Backlight setting error    |
|     |             | Contrast setting error     |
| b   | Screen No.  |                            |
| c   | Line No.    |                            |

According to the error message, the setting of User Monitor Screen 2, line 4 is corrupted.



2. Press the **ESC** button to exit the screen. Once the EEPROM Error Screen has disappeared, the display will return to normal.



3. Enter the User Monitor Setup Screen 2, line 4. User settings backed up in EEPROM are replaced by default settings. Then reset the screen.



## SECTION 12

### Troubleshooting

This section provides information on hardware and software errors that occur during CPIL-EL/EM operation.

|        |   |     |
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## 12-1 Error Classification and Confirmation

### Error Categories

Errors in CP1L-EL/EM CPU Units can be broadly divided into the following four categories.

| Category        | Comments   |
|-----------------|--|
| CPU Error       | A WDT (watchdog timer) error is generated in the CPU Unit, the CPU Unit will malfunction, and operation will stop. |
| CPU Standby     | The CPU will go on standby because conditions for starting operation have not yet been met.                        |
| Fatal Error     | Operation cannot continue. Operation will stop due to a serious problem.   |
| Non-fatal Error | A minor problem has occurred. Operation will continue  |

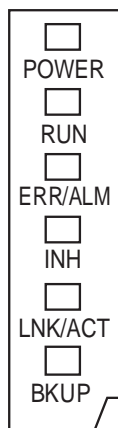
### Confirming Errors

There are two sources of information on errors that have occurred.

- CPU Unit indicators
- Auxiliary Area

### CPU Unit Indicators

These indicators show the operating status of the CPU Unit.



|                              |          |   |
|------------------------------|----------|---|
| POWER (green)                | Lit      | Power is ON.  |
|                              | Not lit  | Power is OFF.   |
| RUN (green)                  | Lit      | The CPU Unit is executing a program in either RUN or MONITOR mode.  |
|                              | Not lit  | Operation is stopped in PROGRAM mode or due to a fatal error.   |
| ERR/ALM (red)                | Lit      | A fatal error or CPU error (WDT error) has occurred. operation will stop and all outputs will be turned OFF.  |
|                              | Flashing | A non-fatal error has occurred. Operation will continue.  |
|                              | Not lit  | Operation is normal.  |
| INH (orange)                 | Lit      | The Output OFF Bit (A500.15) was turned ON. All outputs will be turned OFF.   |
|                              | Not lit  | Operation is normal.  |
| LNK/ACT (orange)             | Lit      | A valid link is detected.   |
|                              | Flashing | Communications (either sending or receiving) are in progress through the Ethernet port.   |
|                              | Not lit  | Other than the above.   |
| BKUP (orange)<br>(See note.) | Lit      | <ul style="list-style-type: none"> <li>• The user program, parameters, or DM Area data is being written to or accessed in the built-in flash memory (backup memory).</li> <li>• The user program, parameters, DM Area data, or DM initial values are being written to or accessed in a Memory Cassette.</li> <li>• The BKUP indicator also lights while the user program is being restored when the power supply is turned ON.</li> </ul> |
|                              | Not lit  | Other than the above.   |

**Note** Do not turn OFF the CPU Unit power supply when this indicator is lit.



## CPU Unit Indicators and Error Meanings in RUN or MONITOR Mode

| Indicator | CPU error | CPU standby | Fatal error | Non-fatal error | Output OFF Bit turned ON |
|-----------|-----------|-------------|-------------|-----------------|--------------------------|
| POWER     | Lit       | Lit         | Lit         | Lit             | Lit                      |
| RUN       | Not lit   | Not lit     | Not lit     | Lit             | Lit                      |
| ERR/ALM   | Lit       | Not lit     | Lit         | Flashing        | ---                      |
| INH       | Not lit   | ---         | ---         | ---             | Lit                      |
| LNK/ACT   | ---       | ---         | ---         | ---             | ---                      |
| BKUP      | ---       | ---         | ---         | ---             | ---                      |

Auxiliary Area■ **Error Code Storage Word**

The error code is stored in A400 when an error occurs. If two or more errors occur at the same time, the most serious error will be stored.

■ **Error Flags**

Flags that indicate the type of error are allocated in the Auxiliary Area.

■ **Error Information**

This area indicates specific information on the meaning of error flags and provides information on error location and error details.

■ **Fatal Errors**

| Error                     | Error code (A400)              | Error flag | Error information              |              |
|---------------------------|--------------------------------|------------|--------------------------------|--------------|
|                           |                                |            | Meaning                        | Address      |
| Memory error              | 80F1                           | A401.15    | Memory error location          | A403         |
| I/O bus error             | 80C0 to 80C7, 80CA, 80CE, 80CF | A401.14    | I/O bus error details          | A404         |
| Too many I/O error        | 80E1                           | A401.11    | Details for too many I/O error | A407         |
| Program error             | 80F0                           | A401.09    | Program error details          | A294 to A299 |
| Cycle time too long error | 809F                           | A401.08    | ---                            | ---          |
| FALS instruction executed | C101 to C2FF                   | A401.06    | ---                            | ---          |
| Ethernet address error    | 80F6                           | A401.04    | ---                            | ---          |

## ■ Non-fatal Errors

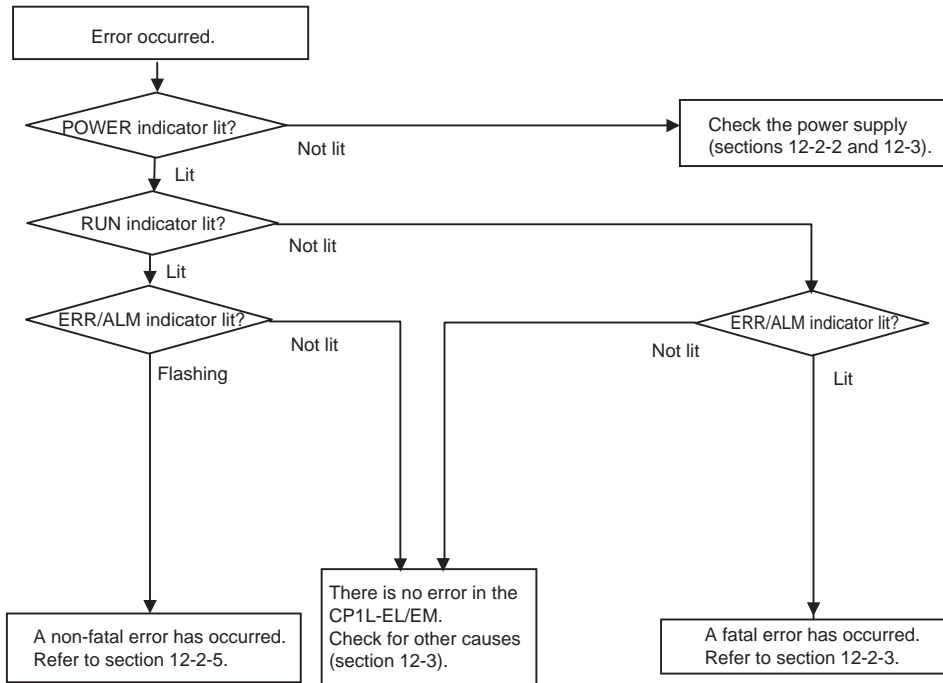
| Error                         | Error code (A400) | Error flag | Error information   |              |
|-------------------------------|-------------------|------------|---|--------------|
|                               |                   |            | Meaning   | Address      |
| FAL instruction executed      | 4101 to 42FF      | A402.15    | Executed FAL number   | A360 to A391 |
| Flash memory error            | 00F1              | A315.15    | ---   | ---          |
| Interrupt task error          | 008B              | A402.13    | Interrupt task error unit number  | A426         |
| PLC Setup error               | 009B              | A402.10    |   | A406         |
| Option Board error            | 00D1, 00D2        | A315.13    | Error Option Board Flags  | A424         |
| Battery error                 | 00F7              | A402.04    | ---   | ---          |
| Logic errors in setting table | 021A              | A315.11    | Routing tables error or Ethernet address tables error   | A313         |
| Built-in Ethernet error       | 03C0              | A315.10    | FINS/TCP connection setup error. An error in TCP connection setup including FINS/TCP connection setup | A313         |
|                               | 03C1              |            | Server setup error. An error in server setup, including DNS server and SNTP server                    |              |
|                               | 03C4              |            | Server connection error. An error in connecting with server, including DNS server and SNTP server     |              |

## 12-2 Troubleshooting

Use the following procedure to check error details and remove the cause of the error if the CPU Unit does not operate when the power supply is ON, operation suddenly stops and the error indicator (ERR/ALM indicator) lights, or if the error indicator (ERR/ALM indicator) flashes during operating.

### 12-2-1 Error Processing Flowchart

Confirm the error category by referring to the status of the CPU Unit indicators, investigate the cause for the error in the error tables, and take corrective actions.



### 12-2-2 No Operation When Power Is Supplied

First confirm that the POWER indicator (green) is lit.

#### POWER Indicator Not Lit

The power supply may not match the Unit rating, wiring may not be correct, or the Unit may be faulty.

- 1,2,3...**
1. Confirm the Unit rating (i.e., is it 24 VDC?) and see if the supply power matches the rating.
  2. Check the wiring to see if it is correct and that nothing is disconnected.
  3. Check the voltage at the power supply terminals. If the voltage is normal and the POWER indicator is not lit, the Unit may be faulty. In that case, replace the Unit.

#### POWER Indicator Turns OFF and ON

There may be fluctuations in the power supply voltage, disconnected wiring, or poor contacts. Check the power supply system and wiring.

#### POWER Indicator Lit but No Operation

Check the RUN indicator if the POWER indicator is lit but the CPU Unit does not operate. The CPU Unit may be on standby if the RUN indicator is not lit.

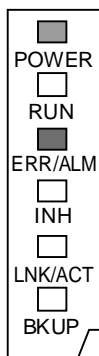
### ■ CPU Standby

Detection of Special I/O Units and CPU Bus Units has not been completed.

- If a CPU Bus Unit has not started normally, check the Unit Setup.
- If a Special I/O Unit is not detected, replace the Special I/O Unit.

## 12-2-3 Fatal Errors

### ■ CPU Unit Indicators



|         |         |
|---------|---------|
| POWER   | Lit     |
| RUN     | Not lit |
| ERR/ALM | Lit     |
| INH     | ---     |
| LNK/ACT | ---     |
| BKUP    | ---     |

There may be a CPU error or a fatal error if operation stops (i.e., the RUN indicator turns OFF) and the ERR/ALM indicator lights.

Data on fatal errors is displayed on the Error Tab Page of the CX-Programmer's PLC Error Window.

Take corrective actions after checking error details based on the CX-Programmer display message together with the Auxiliary Area Error Flags and error information.

#### Note

1. Errors are listed in order with the most serious errors first.
2. If two or more errors occur at the same time, the most serious error code will be stored in A400.
3. I/O memory will be cleared if a fatal error occurs (except those created with FALS instructions).
4. I/O memory will be held when the I/O Memory Hold Bit is ON, but outputs will be turned OFF.

## Memory Errors

| Probable cause  |   | Possible remedy  |
|---|---|--|
| Automatic transfer from the Memory Cassette at startup failed because the required data is not on the Memory Cassette.                  |   | Store the required data on the Memory Cassette.  |
| An error has occurred in memory. One or more bits in A403 will turn ON to indicate where the error has occurred. See below for details. |   | See below.   |
| <ul style="list-style-type: none"> <li>Memory Error Location</li> </ul>   |   |  |
| A403.00 is ON   | A checksum error has occurred in the user program.<br>The power supply was turned OFF when backing up the user program to flash memory. | Transfer the user program again.   |
| A403.04 is ON   | A checksum error has occurred in the PLC Setup.   | Transfer the PLC Setup again.  |
| A403.07 is ON   | A checksum error has occurred in the routing tables.  | Transfer the routing tables again.   |
| A403.09 is ON   | The contents of a Memory Cassette could not be normally read to the CPU Unit when power was turned ON.                                  | Check to see if the files required for automatic transfer at startup are present on the Memory Cassette. |
| A403.10 is ON   | There is a problem with flash memory.   | A hardware error has occurred in the CPU Unit. Replace the CPU Unit.                                     |
| A403.11 is ON   | A checksum error has occurred in IP address table.  | Transfer the IP address table again.   |
| A403.12 is ON   | A checksum error has occurred in IP router table.   | Transfer the IP router table again.  |

### ■ Reference Information

|                   |                             |
|-------------------|-----------------------------|
| Error flag        | Memory Error Flag, A401.15  |
| Error code (A400) | 80F1                        |
| Error information | Memory Error Location, A403 |

## I/O Bus Errors

An I/O bus error occurs in data transfer between the CPU Units and Units connected to the I/O bus. Cycle the power supply. If operation is not restored when the power supply has been cycled, turn OFF the power supply and check that connections are proper and that there is no damage.

| Probable cause   | Possible remedy   |
|--|---|
| An error occurred in data transfer between the CPU Unit and an Expansion Unit or Expansion I/O Unit.<br><b>Note</b> 0A0A hex will be stored in A404. | Try cycling the power supply.<br>If the problem persists, turn OFF the power supply and check the Connecting Cables between the Units to see if they are connected properly.<br>Check the Unit connections to be sure they are ok (e.g., that there is no damage).<br>After correcting the problem, turn ON the power to the Units again. |

### ■ Reference Information

|                   |                                    |
|-------------------|------------------------------------|
| Error flag        | I/O Bus Error Flag, A401.14        |
| Error code (A400) | 80C0, 80CA, 80CE, 80CF             |
| Error information | I/O bus error details, A404 (0A0A) |

## Too Many I/O Points

The number of CP1W-series Expansion Units and Expansion I/O Units connected exceeds the restriction for the number of Units or words for the system configuration. Turn OFF the power supply and reconfigure the system within the restrictions.

| Probable cause   | Possible remedy  |
|--|--|
| The number of CP1W-series Expansion Units and Expansion I/O Units exceeds the restriction. | <ul style="list-style-type: none"> <li>Connect a maximum of three Expansion Units and Expansion I/O Units to the CP1L-EM40D□-□ or CP1L-EM30D□-□.</li> <li>Connect a maximum of one Expansion Unit or Expansion I/O Unit to the CP1L-EL20D□-□.</li> </ul> |

### ■ Reference Information

|                   |                                   |
|-------------------|-----------------------------------|
| Error flag        | Too Many I/O Points Flag, A401.11 |
| Error code (A400) | 80E1                              |
| Error information | Too Many I/O Points Details, A407 |

## Program Error

A program error indicates a problem with the user program. Refer to the error information, check the program, and correct the mistakes. Clear the error once the problem has been corrected.

| Probable cause  | Possible remedy   |
|---|---|
| Instruction Processing Error<br>If the PLC Setup has been set to stop operation for an instruction error, the Error Flag will be turned ON when an instruction cannot be executed due to a problem in the operand data.                                     | Refer to A298 and A299 (instruction program address when the program fails), check the specifications for the relevant instruction, and set the correct operand data.<br>Alternatively, set the PLC Setup to not stop operation for an instruction error.   |
| Indirect DM Addressing BCD Error<br>If the PLC Setup has been set to stop operation for an indirect DM BCD error, the Access Error Flag will turn ON when the content of an indirectly addressed DM operand is not BCD although BCD mode has been selected. | Refer to A298 and A299 (instruction program address when the program fails), and correctly set the content for the indirectly addressed DM operand (BCD mode) to BCD or change the specified destination.<br>Alternatively, change the indirect addressing to binary mode or set the PLC Setup to not stop operation for an indirect DM addressing BCD error. |

| Probable cause   | Possible remedy  |
|--|--|
| <p>Illegal Area Access Error</p> <p>If the PLC Setup has been set to stop operation for an illegal access error, the Access Error Flag will turn ON when an illegal access error has occurred.</p> <p>The following operations are considered illegal access:</p> <ul style="list-style-type: none"> <li>• Reading/writing the parameter area</li> <li>• Writing to an area without memory installed</li> <li>• Writing to a write-protected area</li> <li>• Indirect DM addressing BCD error</li> </ul> | <p>Refer to A298 and A299 (instruction program address when the program fails) and take corrective actions so that illegal area access errors will not occur. Alternatively, set the PLC Setup so that PLC operation will not stop when an instruction error occurs.</p> |
| <p>No END Error</p> <p>This error occurs when there is not an END(001) instruction in the program within a task.</p>   | <p>Insert an END(001) instruction at the end of the program allocated to the task stored in A294 (task number when the program fails).</p>   |
| <p>Task Error</p> <p>This error is generated by any of the following conditions.</p> <ol style="list-style-type: none"> <li>1. There is not an executable cyclic task (active).</li> <li>2. There is no specified interrupt task when an interrupt is generated (input interrupt, high-speed counter interrupt, scheduled interrupt, or external interrupt).</li> </ol>  | <ol style="list-style-type: none"> <li>1. Check the properties of the executable cyclic task and set at least one task to start when operation starts.</li> <li>2. Create a task for the number stored in A294 (task number when the program fails).</li> </ol>          |
| <p>Differentiation Overflow Error</p> <p>Differentiation instructions were repeatedly inserted or deleted using the online editor and the system restriction was exceeded.</p>   | <p>Change the operating mode to PROGRAM mode and then return to MONITOR mode.</p>  |
| <p>Illegal Instruction Error</p> <p>Execution of an unexecutable instruction was attempted.</p> <p>For a CPU Unit with 20 I/O Points, the instruction operand will be given in D10000 to D31999.</p>   | <p>Check the program, correct the problem, and transfer the program to the CPU Unit again.</p>   |
| <p>UM Overflow Error</p> <p>An attempt was made to execute a program that exceeds the user program capacity.</p>   | <p>Transfer the program again using the CX-Programmer.</p>   |

■ Reference Information

|                   |                                     |
|-------------------|-------------------------------------|
| Error flag        | Program Error Flag, A401.09         |
| Error code (A400) | 80F0                                |
| Error information | Program error details, A294 to A299 |

## Cycle Time Too Long

| Probable cause   | Possible remedy   |
|--|---|
| <p>This error occurs when the cycle time PV exceeds the maximum cycle time set in the PLC Setup.</p> | <p>Review the program to decrease the cycle time or change the maximum cycle time set in the PLC Setup.</p> <p>Refer to the Maximum Interrupt Task Processing Time (A440) and study the maximum cycle time.</p> <p>The cycle time can be decreased using the following methods.</p> <ul style="list-style-type: none"> <li>• Separate instructions not being executed into different tasks.</li> <li>• Consider using jump instructions for areas in the task that are not executed.</li> <li>• Prohibit cycle refreshing with Special I/O Units that do not require exchange of cycle data.</li> </ul> |

■ Reference Information

|                   |                                    |
|-------------------|------------------------------------|
| Error flag        | Cycle Time Too Long Error, A401.08 |
| Error code (A400) | 809F                               |
| Error information | ---                                |

## Errors Created with FALS Instructions

| Probable cause                              | Possible remedy  |
|---|--|
| FALS instruction executed (FALS number 001) | C100 hex will be added to the FALS number (001 to 1FF hex) and the result will be stored in A400 as the error code (C100 to C2FF hex).<br>Check the conditions for executing FALS instructions and remove any causes for the user-defined error. |

### ■ Reference Information

|                   |                          |
|-------------------|--------------------------|
| Error flag        | FALS Error Flag, A401.06 |
| Error code (A400) | C101 to C2FF             |
| Error information | ---                      |

## Ethernet Controller Stop Error

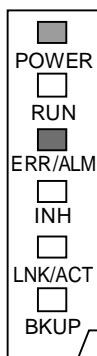
| Probable cause   | Possible remedy  |
|--|--|
| ON when the Ethernet controller stops because of sum value of MAC address error or controller error. | Cycle the power supply. The Unit may be faulty. Consult your OMRON representative. |

### ■ Reference Information

|                   |   |
|-------------------|---|
| Error flag        | Ethernet Controller Stop Address Error, A401.04 |
| Error code (A400) | 80F6  |
| Error information | ---   |

## 12-2-4 CPU Errors

### ■ CPU Unit Indicators



|         |         |
|---------|---------|
| POWER   | Lit     |
| RUN     | Not lit |
| ERR/ALM | Lit     |
| INH     | ---     |
| BKUP    | ---     |
| LNK/ACT | ---     |

A CPU error or fatal error may have occurred if the ERR/ALM indicator lights during operation (RUN mode or MONITOR mode), the RUN indicator turns OFF, and operation stops.

## CPU Errors

| Probable cause  | Possible remedy  |
|---|--|
| A WDT (watchdog) error occurred in the CPU Unit. (This does not occur in normal use.) | Cycle the power supply. The Unit may be faulty. Consult your OMRON representative. |

### ■ Reference Information

|                   |      |
|-------------------|------|
| Error flag        | None |
| Error code (A400) | None |
| Error information | None |

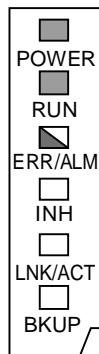


**Note** Just as when a CPU error occurs, the RUN indicator will turn OFF and the ERR/ALM indicator will light when a fatal error occurs. Connecting the CX-Programmer, however, is possible for fatal errors but not for CPU errors. If the CX-Programmer cannot be connected (online), a CPU error has probably occurred.

## 12-2-5 Non-fatal Errors

A non-fatal error has occurred if both the RUN indicator and the ERR/ALM indicator are lit during operation (i.e., in RUN or MONITOR mode).

### ■ CPU Unit Indicators



|         |          |
|---------|----------|
| POWER   | Lit      |
| RUN     | Lit      |
| ERR/ALM | Flashing |
| INH     | ---      |
| BKUP    | ---      |
| LNK/ACT | ---      |

Information on the non-fatal error can be obtained from the Error Tab Page of the CX-Programmer's PLC Error Window. Take corrective actions after checking error details using the display messages and the Auxiliary Area Error Flags and error information.

- Errors are listed in the following table in order, with the most serious ones first.
- If two or more errors occur at the same time, the most serious error code will be stored in A400.

### Errors Created with for FAL Instructions

A FAL instruction was executed in the program to create a non-fatal error.

| Probable cause   | Possible remedy  |
|--|--|
| The executed FAL number 001 to 511 will be stored in A360 to A391. The number 4 will be added to the front of 101 to 2FF (which correspond to executed FAL numbers 001 to 511) and the result will be stored in A400 as error code 4101 to 42FF. | Check the conditions for executing FAL instructions and remove any causes of the user-defined error. |

### ■ Reference Information

|                   |                         |
|-------------------|-------------------------|
| Error flag        | FAL Error Flag, A402.15 |
| Error code (A400) | 4101 to 42FF            |
| Error information | None                    |

### Flash Memory Errors

| Probable cause  | Possible remedy  |
|---|--|
| A315.15 will turn ON when writing to the internal flash memory fails. | Replace the CPU Unit when the internal flash memory has been written to more than 100,000 times. |

■ **Reference Information**

|                   |  |
|-------------------|--|
| Error flag        | Flash Memory Error Flag, A315.15<br>Other non-fatal flags, A402.00 |
| Error code (A400) | None   |
| Error information | None   |

**Interrupt Task Errors**

| Probable cause   | Possible remedy   |
|--|---|
| An interrupt task error occurs when the <i>Detect Interrupt task errors setting</i> in the PLC Setup is set to <i>Detect</i> and an attempt is made to refresh a Special I/O Unit from an interrupt task with IORF(097) while the Unit's I/O is being refreshed by cyclic refreshing (duplicate refreshing). | Review the program to see whether detecting interrupt task errors can be disabled or avoided. |

■ **Reference Information**

|                   |                                    |
|-------------------|------------------------------------|
| Error flag        | Interrupt Task Error Flag, A402.13 |
| Error code (A400) | 008B                               |
| Error information | Interrupt Task Error, A426         |

**PLC Setup Errors**

| Probable cause   | Possible remedy                            |
|--|--|
| A set value error occurred in the PLC Setup.<br>The address of the error is stored in A406 in 16-bit binary. | Correct the PLC Setup with correct values. |

■ **Reference Information**

|                   |                                |
|-------------------|--------------------------------|
| Error flag        | PLC Setup Error Flag, A402.10  |
| Error code (A400) | 009B                           |
| Error information | PLC Setup error location, A406 |

**Option Board Errors**

| Probable cause   | Possible remedy  |
|--|--|
| A315.13 will turn ON if the Option Board is removed while the power is being supplied. | Turn OFF the power supply and then install the Option Board again. |

■ **Reference Information**

|                   |   |
|-------------------|---|
| Error flags       | Option Board Error Flag, A315.13<br>Other Non-fatal Error Flag, A402.00 |
| Error code (A400) | ---   |
| Error information | ---   |

**Battery Error**

| Probable cause  | Possible remedy  |
|---|--|
| If the PLC Setup is set to detect battery errors, this error will occur when there is an error in the battery in the CPU Unit (i.e., the voltage is low or a battery is not mounted). | Check the battery connections.<br>When using battery-free operation, disable connecting battery errors in the PLC Setup. |

■ **Reference Information**

|                   |                             |
|-------------------|-----------------------------|
| Error flag        | Battery Error Flag, A402.04 |
| Error code (A400) | 00F7                        |
| Error information | ---                         |

**Logic Errors in Setting Table**

| Probable cause   | Possible remedy                    |
|--|------------------------------------|
| An error occurs in routing table, IP address table, or IP router table | Transfer the relative setup again. |

■ **Reference Information**

|                          |  |      |
|--------------------------|--|------|
| Error flag               | Setting Table Logic Error Flag, A315.11<br>Other Non-fatal Flag, A402.00 |      |
| Error code (A400)        | 021A   |      |
| Error information (A313) | Error in Routing Tables  | 0003 |
|                          | Error in Ethernet Address Tables   | 0004 |

**Built-in Ethernet error**

| Probable cause   |  | Possible remedy                                  |
|--|--|--|
| A Built-in Ethernet error has occurred. A315.10 will turn ON to indicate where the error has occurred. See below for details.<br>• Error Information |  | See below.                                       |
| A315.10 is ON<br>Error code (A400): 03C0   | FINS/TCP Connection Setup Error<br>When there is an error in TCP connection setup including FINS/TCP connection setup, the error occurs. | Confirm the connection setup and transfer again. |
| A315.10 is ON<br>Error code (A400): 03C1   | Server Setup Error<br>When there is an error in server setup, including DNS server and SNTP server, the error occurs.                    | Transfer the server setup again.                 |
| A315.10 is ON<br>Error code (A400): 03C4   | Server Connection Error<br>When there is an error in connecting with server, including DNS server and SNTP server, the error occurs.     | Confirm the connection between the servers.      |

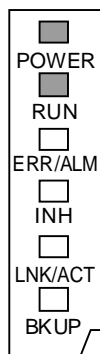
■ **Reference Information**

|                          |  |            |
|--------------------------|--|------------|
| Error flag               | Built-in Ethernet Error Flag, A315.10<br>Other Non-fatal Flag, A402.00                                   |            |
| Error code (A400)        | 03C0, 03C1, 03C4   |            |
| Error information (A313) | Leftmost byte: connection type and number FINS/TCP connection (01 to 03)<br>Rightmost byte: error causes | 03C0       |
|                          | Leftmost byte: server type<br>Rightmost byte: error causes   | 03C1, 03C4 |

## 12-2-6 Other Errors

### Communications Errors

#### ■ CPU Unit Indicators



|         |         |
|---------|---------|
| POWER   | Lit     |
| RUN     | Lit     |
| ERR/ALM | ---     |
| INH     | ---     |
| LNK/ACT | ---     |
| BKUP    | Not lit |

| Probable cause  | Possible remedy   |
|---|---|
| An error has occurred in the communications between the Ethernet port and connected device.           | Confirm that the Ethernet port settings in the PLC Setup are correct.<br>Check the Ethernet cable and replace it if necessary.  |
| An error has occurred in the communications between the serial port and connected device.             | Confirm that the serial port 1/2 settings in the PLC Setup are correct. Check the cable wiring. If a host computer is connected, check the serial port settings and program in the host computer.   |
| An error has occurred in the CX-Programmer's Response monitoring time if the cycle time was too long. | Modify the CX-Programmer's response monitoring time longer according to the following method.<br><br>Start the CX-Programmer. Select <b>Change Model</b> from the <b>PLC</b> Menu. The <b>Change PLC</b> Dialog Box will be displayed. Click the <b>Settings</b> Button on the right side of <b>Network Type</b> . The <b>Network Settings [USB]</b> Dialog Box will be displayed. Click the <b>Network</b> Tab and increase the value in <b>Response Time-out(s)</b> . |

## Ethernet Communication Error

When Ethernet Communication Error occurs during FINS communication service by built-in Ethernet port, the error code, error contents and error's time will be stored in A40 to A44.

The detail information of error code and error contents show as the following table.

| Error code<br>(Hex) | Error content   | Detailed information   |  |
|---------------------|---|--|--|
|                     |   | 1st byte   | 2nd byte   |
| 0105                | Node address setting error (send failed)                | <b>Commands</b><br>Bit 15: OFF<br>Bits 08 to 14: SNA<br>Bits 00 to 07: SA1<br><br><b>Responses</b><br>Bit 15: ON<br>Bits 08 to 14: DNA<br>Bits 00 to 07: DA1         |  |
| 0107                | Remote node not in network (send failed)                |  |  |
| 0108                | No unit with specified unit address (send failed)       |  |  |
| 010D                | Destination address not in routing tables (send failed) |  |  |
| 010E                | No routing table entry (send failed)                    |  |  |
| 010F                | Routing table error (send failed)                       |  |  |
| 0111                | Command too long (send failed)                          |  |  |
| 0112                | Header error (send failed)                              |  |  |
| 0117                | Internal buffers full; packet discarded                 |  |  |
| 0118                | Illegal packet discarded                                |  |  |
| 0119                | Local node busy (send failed)                           |  |  |
| 0120                | Unexpected routing error                                |  |  |
| 0121                | No setting in IP address table; packet discarded        |  |  |
| 03C3                | FINS/UDP packet discarded                               |  |  |
| 03C2                | FINS/TCP packet discarded                               | 01 to 03:<br>Connection number   | 02:<br>Reopened because remote node closed<br><br>03:<br>Reopened because of reception error<br><br>04:<br>Reopened because of transmission error<br><br>05:<br>Reopened because RST received from remote node<br><br>06:<br>Reopened because of no keep-alive response<br><br>07:<br>Illegal FINS/TCP procedure<br><br>08:<br>Insufficient memory during server processing<br><br>09:<br>Insufficient memory during client processing<br><br>0A:<br>Insufficient memory during node switching |
| 03C6                | Clock data write error                                  | 0001: Clock data cannot be refreshed because of a CPU Unit error.<br><br>0002: Clock data cannot be refreshed because the current CPU mode do not support operation. |  |

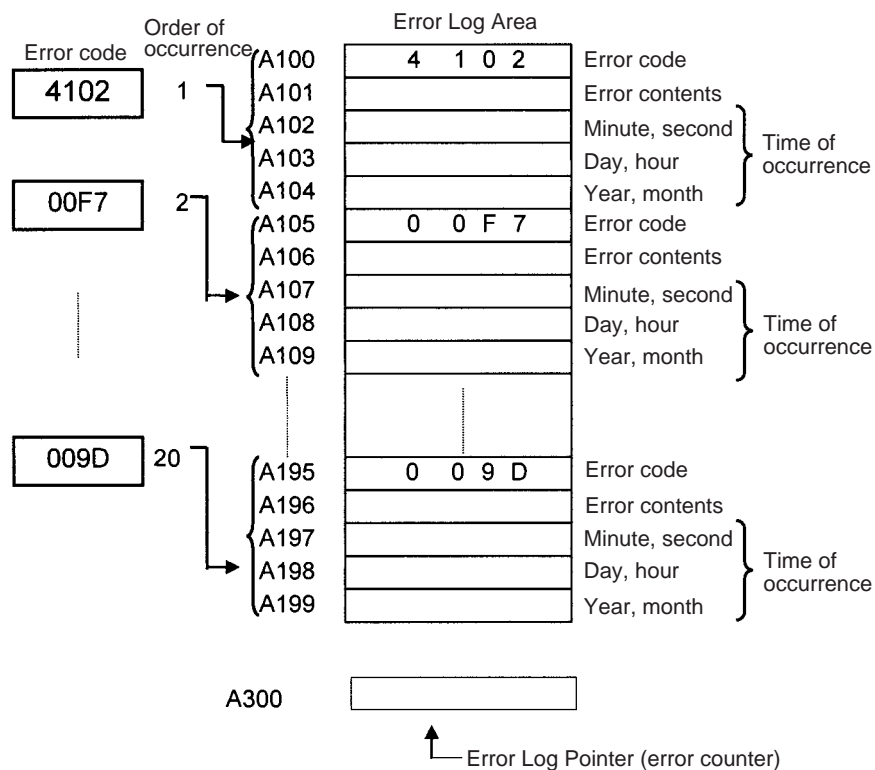
## 12-3 Error Log

Each time an error occurs, the CPU Unit stores error information in the Error Log Area of the Auxiliary Area (A100 to A199). The error information includes the error code (stored in A400), error contents, and time that the error occurred. Up to 20 records can be stored in the Error Log.

In addition to system-generated errors, the CPU Unit records user-defined errors, making it easier to track the operating status of the system.

When more than 20 errors occur, the oldest error data (stored in A100 to A104) is deleted, the 19 errors stored in A105 to A199 shift one record, and the newest record is stored in A195 to A199.

The number of records stored in the error log is stored in the Error Log Pointer (A300). The Error Log Pointer is not incremented after 20 records have been stored.



## 12-4 Troubleshooting Unit Errors

### CPU Unit

| Symptom                                   | Cause                                     | Remedy           |
|---|---|------------------|
| POWER indicator is not lit.               | PCB short-circuited or damaged.           | Replace Unit.    |
| RUN indicator is not lit.                 | (1) Error in program (fatal error)        | Correct program. |
|   | (2) Power line is faulty.                 | Replace Unit.    |
| RUN indicator on the CPU Unit is lit.     | Internal circuitry in the Unit is faulty. |                  |
| Bits do not operate past a certain point. |   |                  |
| Error occurs in units of 8 or 16 points.  |   |                  |
| I/O bit turns ON.                         |   |                  |
| All bits in one Unit do not turn ON.      |   |                  |

### Inputs

| Symptom  | Cause  | Remedy  |
|--|--|---|
| Not all inputs turn ON or indicators are not lit.                          | (1) External power is not supplied for the input.  | Supply power  |
|  | (2) Supply voltage is low.   | Adjust supply voltage to within rated range.  |
|  | (3) Terminal block mounting screws are loose.  | Tighten screws.   |
|  | (4) Faulty contact of terminal block connector.  | Replace terminal block connector.   |
| Not all inputs turn ON even though the indicator is lit.                   | Input circuit is faulty. (There is a short at the load or something else that caused an over-current to flow.) | Replace Unit.   |
| Not all inputs turn OFF.   | Input circuit is faulty.   | Replace Unit.   |
| Specific bit does not turn ON.   | (1) Input device is faulty.  | Replace input devices.  |
|  | (2) Input wiring disconnected.   | Check input wiring  |
|  | (3) Terminal block screws are loose.   | Tighten screws  |
|  | (4) Faulty terminal block connector contact.   | Replace terminal block connector.   |
|  | (5) Too short ON time of external input.   | Adjust input device   |
|  | (6) Faulty input circuit   | Replace Unit.   |
|  | (7) Input bit number is used for output instruction.   | Correct program.  |
| Specific bit does not turn OFF.  | (1) Input circuit is faulty.   | Replace Unit.   |
|  | (2) Input bit number is used for output instruction.   | Correct program.  |
| Input irregularly turns ON/OFF.  | (1) External input voltage is low or unstable.   | Adjust external input voltage to within rated range.  |
|  | (2) Malfunction due to noise.  | Take protective measures against noise, such as:<br>• Install surge suppressor.<br>• Install insulation transformer.<br>Install shielded cables between the Input Unit and the loads. |
|  | (3) Terminal block screws are loose.   | Tighten screws  |
|  | (4) Faulty terminal block connector contact.   | Replace terminal block connector.   |
| Error occurs in units of 8 points or 16 points, i.e., for the same common. | (1) Common terminal screws are loose.  | Tighten screws  |
|  | (2) Faulty terminal block connector contact.   | Replace terminal block connector.   |
|  | (3) Faulty data bus  | Replace Unit.   |
|  | (4) Faulty CPU   | Replace CPU Unit.   |
| Input indicator is not lit in normal operation.                            | Faulty indicator or indicator circuit.   | Replace Unit.   |

## Outputs

| Symptom  | Cause  | Remedy  |
|--|--|---|
| Not all outputs turn ON  | (1) Load is not supplied with power.   | Supply power  |
|  | (2) Load voltage is low.   | Adjust voltage to within rated range.   |
|  | (3) Terminal block screws are loose.   | Tighten screws  |
|  | (4) Faulty terminal block connector contact.   | Replace terminal block connector.   |
|  | (5) An overcurrent (possibly caused by a short at the load) resulted in a blown fuse for the output or the Unit is faulty. | Replace fuse or Unit.   |
|  | (6) Faulty I/O bus connector contact.  | Replace Unit.   |
|  | (7) Output circuit is faulty.  | Replace Unit.   |
|  | (8) If the INH indicator is lit, the Output OFF Bit (A500.15) is ON.   | Turn A500.15 OFF.   |
| Not all outputs turn OFF   | Output circuit is faulty.  | Replace Unit.   |
| Output of a specific bit number does not turn ON or indicator is not lit   | (1) Output ON time too short because of a mistake in programming.  | Correct program to increase the time that the output is ON.   |
|  | (2) Bit status controlled by multiple instructions.  | Correct program so that each output bit is controlled by only one instruction.  |
|  | (3) Faulty output circuit.   | Replace Unit.   |
| Output of a specific bit number does not turn ON (indicator lit).          | (1) Faulty output device.  | Replace output device.  |
|  | (2) Break in output wiring.  | Check output wiring.  |
|  | (3) Loose terminal block screws.   | Tighten screws.   |
|  | (4) Faulty terminal block connector faulty.  | Replace terminal block connector.   |
|  | (5) Faulty output bit (relay output only).   | Replace Unit.   |
|  | (6) Faulty output circuit (relay output only).   | Replace Unit.   |
| Output of a specific bit number does not turn OFF (indicator is not lit).  | (1) Faulty output bit.   | Replace Unit.   |
|  | (2) Bit does not turn OFF due to leakage current or residual voltage.  | Replace external load or add dummy resistor.  |
| Output of a specific bit number does not turn OFF (indicator lit).         | (1) Bit status controlled by multiple instructions.  | Correct program.  |
|  | (2) Faulty output circuit.   | Replace Unit.   |
| Output irregularly turns ON/OFF.   | (1) Low or unstable load voltage.  | Adjust load voltage to within rated range   |
|  | (2) Bit status controlled by multiple instructions.  | Correct program so that each output bit is controlled by only one instruction.  |
|  | (3) Malfunction due to noise.  | Protective measures against noise:<br>• Install surge suppressor.<br>• Install insulation transformer.<br>• Use shielded cables between the output terminal and the load. |
|  | (4) Terminal block screws are loose.   | Tighten screws.   |
|  | (5) Faulty terminal block connector contact.   | Replace terminal block connector.   |
| Error occurs in units of 8 points or 16 points, i.e., for the same common. | (1) Loose common terminal screw.   | Tighten screws.   |
|  | (2) Faulty terminal block connector contact.   | Replace terminal block connector.   |
|  | (3) An overcurrent (possibly caused by a short at the load) resulted in a blown fuse for the output or the Unit is faulty. | Replace fuse or Unit.   |
|  | (4) Faulty data bus.   | Replace Unit.   |
|  | (5) Faulty CPU.  | Replace CPU Unit.   |
| Output indicator is not lit (operation is normal).                         | Faulty indicator.  | Replace Unit.   |



# SECTION 13

## Inspection and Maintenance

This section provides inspection and maintenance information.

|        |  |     |
|--------|--|-----|
| 13-1   | Inspections .....                      | 652 |
| 13-1-1 | Inspection Points.....                 | 652 |
| 13-1-2 | Unit Replacement Precautions .....     | 653 |
| 13-2   | Replacing User-serviceable Parts ..... | 654 |

## 13-1 Inspections

Daily or periodic inspections are required in order to maintain the PLC's functions in peak operating condition.

### 13-1-1 Inspection Points

Although the major components in CP-series PLCs have an extremely long life time, they can deteriorate under improper environmental conditions. Periodic inspections are thus required to ensure that the required conditions are being kept.

Inspection is recommended at least once every six months to a year, but more frequent inspections will be necessary in adverse environments.

Take immediate steps to correct the situation if any of the conditions in the following table are not met.

| No. | Item                | Inspection   | Criteria   | Action   |
|-----|---------------------|--|--|--|
| 1   | Source Power Supply | Check for voltage fluctuations at the power supply terminals.                              | The voltage must be within the allowable voltage fluctuation range.<br>(See note.) | Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring voltage fluctuations within limits. |
| 2   | I/O Power Supply    | Check for voltage fluctuations at the I/O terminals.                                       | Voltages must be within specifications for each Unit.                              | Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring voltage fluctuations within limits. |
| 3   | Ambient environment | Check the ambient temperature (inside the control panel if the PLC is in a control panel). | 0 to 55°C  | Use a thermometer to check the temperature and ensure that the ambient temperature remains within the allowed range of 0 to 55°C.  |
|     |                     | Check the ambient humidity (inside the control panel if the PLC is in a control panel).    | Relative humidity must be 10% to 90% with no condensation.                         | Use a hygrometer to check the humidity and ensure that the ambient humidity remains within the allowed range.                      |
|     |                     | Check that the PLC is not in direct sunlight.  | Not in direct sunlight   | Protect the PLC if necessary.  |
|     |                     | Check for accumulation of dirt, dust, salt, metal filings, etc.                            | No accumulation  | Clean and protect the PLC if necessary.  |
|     |                     | Check for water, oil, or chemical sprays hitting the PLC.                                  | No spray on the PLC  | Clean and protect the PLC if necessary.  |
|     |                     | Check for corrosive or flammable gases in the area of the PLC.                             | No corrosive or flammable gases  | Check by smell or use a sensor.  |
|     |                     | Check the level of vibration or shock.   | Vibration and shock must be within specifications.                                 | Install cushioning or shock absorbing equipment if necessary.  |
|     |                     | Check for noise sources near the PLC.  | No significant noise sources   | Either separate the PLC and noise source or protect the PLC.   |

| No. | Item                    | Inspection   | Criteria   | Action   |
|-----|-------------------------|--|--|--|
| 4   | Installation and wiring | Check that each Unit is connected securely and locked in place.                  | No looseness   | Press the connectors together completely and lock them with the sliders.                       |
|     |                         | Check that the Option Boards and cable connectors are fully inserted and locked. | No looseness   | Correct any improperly installed connectors.   |
|     |                         | Check for loose screws in external wiring.                                       | No looseness   | Tighten loose screws with a Phillips screwdriver.  |
|     |                         | Check crimp connectors in external wiring.                                       | Adequate spacing between connectors  | Check visually and adjust if necessary.  |
|     |                         | Check for damaged external wiring cables.  | No damage  | Check visually and replace cables if necessary.  |
| 5   | User-serviceable parts  | Check whether the battery has reached its service life.<br>CJ1W-BAT01 Battery    | Service life expectancy is 5 years at 25°C, less at higher temperatures.<br>(From 0.75 to 5 years depending on model, power supply rate, and ambient temperature.) | Replace the battery when its service life has passed even if a battery error has not occurred. |

**Note** The following table shows the allowable voltage fluctuation ranges for source power supplies.

| CPU Unit                       | Supply voltage | Allowable voltage range          |
|--------------------------------|----------------|----------------------------------|
| CP1L-EM□□D□-D<br>CP1L-EL□□D□-D | 24 V DC        | 20.4 to 26.4 V DC<br>(+10%/–15%) |

## Tools Required for Inspections

### Required Tools

- Phillips screwdrivers
- Voltage tester or digital voltmeter
- Industrial alcohol and clean cotton cloth

### Tools Required Occasionally

- Synchroscope
- Oscilloscope with pen plotter
- Thermometer and hygrometer

## 13-1-2 Unit Replacement Precautions

Check the following when replacing any faulty Unit.

- Do not replace a Unit until the power is turned OFF.
- Check the new Unit to make sure that there are no errors.
- If a faulty Unit is being returned for repair, describe the problem in as much detail as possible, enclose this description with the Unit, and return the Unit to your OMRON representative.
- For poor contact, take a clean cotton cloth, soak the cloth in industrial alcohol, and carefully wipe the contacts clean. Be sure to remove any lint prior to remounting the Unit.

**Note** When replacing a CPU Unit, be sure that not only the user program but also all other data required for operation is transferred to or set in the new CPU Unit before starting operation, including DM Area and HR Area settings. If data area and other data are not correct for the user program, unexpected accidents may occur.

## 13-2 Replacing User-serviceable Parts

The following parts should be replaced periodically as preventative maintenance. The procedures for replacing these parts are described later in this section.

- Battery (backup for the CPU Unit's internal clock and RAM)

### Battery Functions

The battery maintains the internal clock and the following data of the CPU Unit's RAM while the main power supply is OFF.

- Retained regions of I/O memory (such as the Holding Area and DM Area)

If the battery is not installed or battery voltage drops too low, the internal clock will stop and the data in RAM will be lost when the main power supply goes OFF.

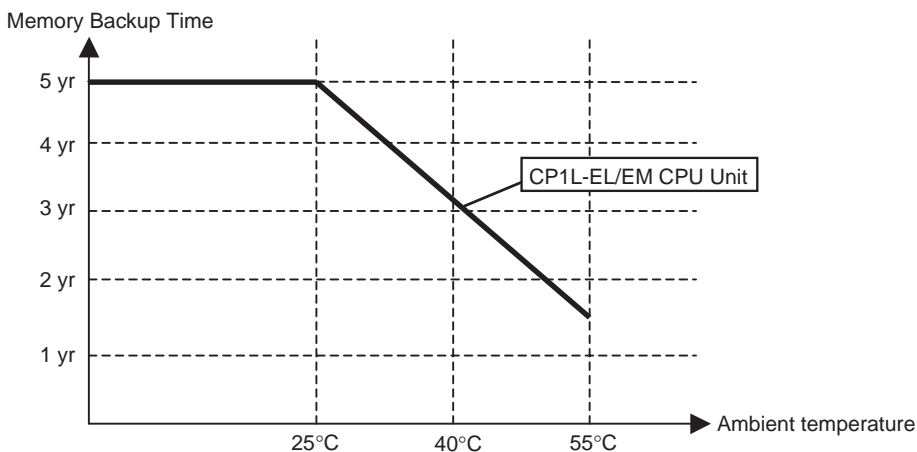
### Battery Service Life and Replacement Period

At 25°C, the maximum service life for batteries is five years whether or not power is supplied to the CPU Unit while the battery is installed. The battery's lifetime will be shorter when it is used at higher temperatures.

The following table shows the approximate minimum lifetimes and typical lifetimes for the backup battery (total time with power not supplied).

| Model         | Approx. maximum lifetime | Approx. minimum lifetime (See note.) | Typical lifetime (See note.)   |
|---------------|--------------------------|--------------------------------------|--------------------------------|
| CP1L-EM□□D□-D | 5 years                  | 13,000 hours (approx. 1.5 years)     | 43,000 hours (approx. 5 years) |
| CP1L-EL□□D□-D |                          |                                      |                                |

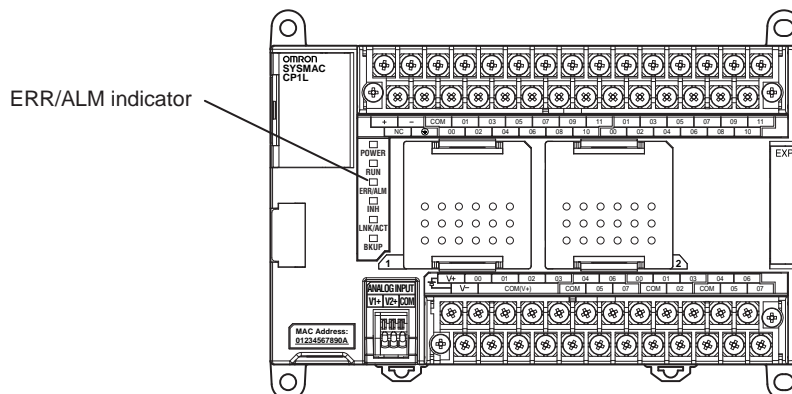
**Note** The minimum lifetime is the memory backup time at an ambient temperature of 55°C. The typical lifetime is the memory backup time at an ambient temperature of 25°C.



This graphic is for reference only.

**Low Battery Indications**

The ERR/ALM indicator on the front of the CPU Unit will flash when the battery is nearly discharged.



When the ERR/ALM indicator flashes, connect the CX-Programmer to the peripheral port and read the error messages. If a low battery message appears on the CX-Programmer (see note 1) and the Battery Error Flag (A402.04) is ON (see note 1), first check whether the battery is properly connected to the CPU Unit. If the battery is properly connected, replace the battery as soon as possible.

Once a low-battery error has been detected, it will take 5 days before the battery fails assuming that power has been supplied at least once a day (see note 2). Battery failure and the resulting loss of data in RAM can be delayed by ensuring that the CPU Unit power is not turned OFF until the battery has been replaced.

**Note**

1. The PLC Setup must be set to detect a low-battery error (Detect Low Battery). If this setting has not been made, the BATT LOW error message will not appear on the CX-Programmer and the Battery Error Flag (A402.04) will not go ON when the battery fails.
2. The battery will discharge faster at higher temperatures, e.g., 4 days at 40°C and 2 days at 55°C.

**Replacement Battery**

Use the CJ1W-BAT01 Battery Set. Be sure to install a replacement battery within two years of the production date shown on the battery's label.

Production Date



Manufactured in January 2012.

**Replacement Procedure**

Use the following procedure to replace the battery when the previous battery has become completely discharged. You must complete this procedure within five minutes after turning OFF the power to the CPU Unit to ensure memory backup.

**Note**

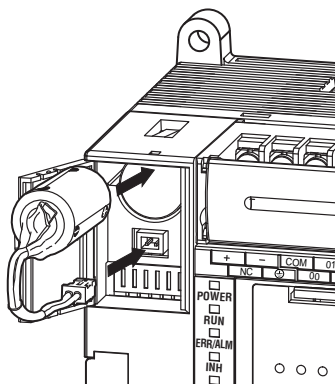
1. We recommend replacing the battery with the power OFF to prevent the CPU Unit's sensitive internal components from being damaged by static electricity. The battery can be replaced without turning OFF the power supply. To do so, always touch a grounded piece of metal to discharge static electricity from your body before starting the procedure.
2. After replacing the battery, connect the CX-Programmer and clear the battery error.

**Procedure****1,2,3...**

1. Turn OFF the power to the CPU Unit.
- or If the CPU Unit has not been ON, turn it ON for at least five minutes and then turn it OFF.

**Note** If power is not turned ON for at least five minutes before replacing the battery, the capacitor that backs up memory when the battery is removed will not be fully charged and memory may be lost before the new battery is inserted.

2. Open the compartment on the CPU Unit and carefully draw out the battery.
3. Remove the battery connector.
4. Connect the new battery, place it into the compartment, and close the cover.



**! WARNING** Never short-circuit the battery terminals; never charge the battery; never disassemble the battery; and never heat or incinerate the battery. Doing any of these may cause the battery to leak, burn, or rupturing resulting in injury, fire, and possible loss of life or property. Also, never use a battery that has been dropped on the floor or otherwise subject to shock. It may leak.

**! Caution** You must complete this procedure within five minutes after turning OFF the power to the CPU Unit to ensure memory backup. If the procedure is not completed within 5 minutes, data may be lost.

**! Caution** UL standards require that batteries be replaced by experienced technicians. Always place an experienced technician in charge of battery replacement.

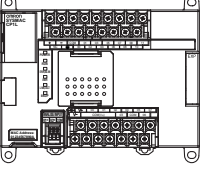
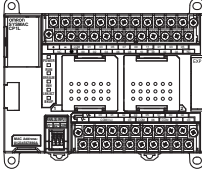
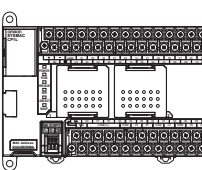
**! Caution** Turn ON the power after replacing the battery for a CPU Unit that has been unused for a long time. Leaving the CPU Unit unused again without turning ON the power even once after the battery is replaced may result in a shorter battery life.

**Note** The battery error will automatically be cleared when a new battery is inserted.


# Appendix A

## Standard Models

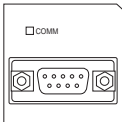
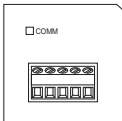
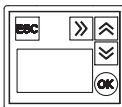

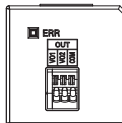
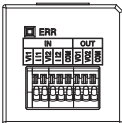

### CPU Units

| Name and appearance   | Model          | Specifications |                                 |                     | Remarks  |
|---|----------------|----------------|---------------------------------|---------------------|--|
|   |                | Power supply   | Outputs                         | Inputs              |  |
| CPU Units with 20 I/O Points<br>   | CP1L-EL20DR-D  | 24 VDC         | 8 relay outputs                 | 24 VDC<br>12 inputs | Memory capacity: 5 Ksteps<br>High-speed counters:<br>100 kHz, 4 counters<br>Pulse outputs:<br>2 axes at 100 kHz  |
|   | CP1L-EL20DT-D  |                | 8 transistor outputs, sinking   |                     |  |
|   | CP1L-EL20DT1-D |                | 8 transistor outputs, sourcing  |                     |  |
| CPU Units with 30 I/O Points<br>   | CP1L-EM30DR-D  | 24 VDC         | 12 relay outputs                | 24 VDC<br>18 inputs | Memory capacity: 10 Ksteps<br>High-speed counters:<br>100 kHz, 4 counters<br>Pulse outputs:<br>2 axes at 100 kHz |
|   | CP1L-EM30DT-D  |                | 12 transistor outputs, sinking  |                     |  |
|   | CP1L-EM30DT1-D |                | 12 transistor outputs, sourcing |                     |  |
| CPU Units with 40 I/O Points<br> | CP1L-EM40DR-D  | 24 VDC         | 16 relay outputs                | 24 VDC<br>24 inputs |  |
|   | CP1L-EM40DT-D  |                | 16 transistor outputs, sinking  |                     |  |
|   | CP1L-EM40DT1-D |                | 16 transistor outputs, sourcing |                     |  |

### Programming Devices

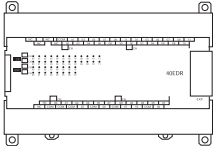
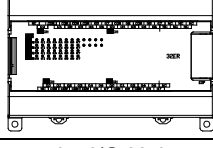
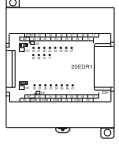
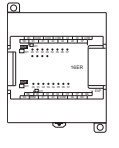
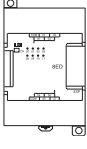
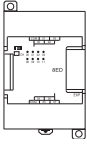
| Name and appearance   | Model                            | Application   | Remarks  |
|---|----------------------------------|---|--|
| CX-Programmer Ver. 9.4<br> | CXONE-AL□□C-V4<br>CXONE-AL□□D-V4 | Programming and monitoring from a Windows environment | <ul style="list-style-type: none"> <li>The CP1L-EL/EM with 20, 30 or 40 points is supported by CX-Programmer version 9.4 or higher.</li> <li>Use a twisted-pair Ethernet cable to connect the computer running the CX-Programmer to the Ethernet port on the CP1L-EL/EM CPU Unit.</li> </ul> |

## Optional Products

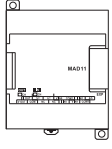
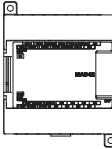
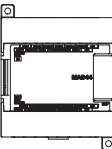
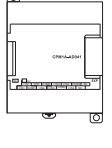
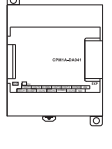
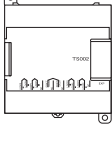
| Name and appearance   | Model                | Application   | Remarks |
|---|----------------------|---|---------|
| RS-232C Option Board<br>               | CP1W-CIF01           | Mounted in option slot 1 or 2 on the CPU Unit to function as an RS-232C port.   | ---     |
| RS-422A/485 Option Board<br>           | CP1W-CIF11/<br>CIF12 | Mounted in option slot 1 or 2 on the CPU Unit to function as an RS-422A/485 port.   |         |
| LCD Option Board<br>                   | CP1W-DAM01           | Used to monitor and change user-specified messages, time or other data of the CPU Unit.   | ---     |
| Analog Input Option Board<br>          | CP1W-ADB21           | Mounted in option slot 1 or 2 on the CPU Unit to function as an analog input module.<br>• 2 analog inputs<br>0 to 10 V (Resolution: 1/4000)<br>0 to 20 mA (Resolution: 1/2000)  | ---     |
| Analog Output Option Board<br>       | CP1W-DAB21V          | Mounted in option slot 1 or 2 on the CPU Unit to function as an analog output module.<br>• 2 analog outputs<br>0 to 10 V (Resolution: 1/4000)   | ---     |
| Analog Input/Output Option Board<br> | CP1W-MAB221          | Mounted in option slot 1 or 2 on the CPU Unit to function as an analog input/output module.<br>• 2 analog inputs<br>0 to 10 V (Resolution: 1/4000)<br>0 to 20 mA (Resolution: 1/2000)<br>• 2 analog outputs<br>0 to 10 V (Resolution: 1/4000) | ---     |
| Memory Cassette<br>                  | CP1W-ME05M           | Used to save CPU Unit user programming, parameters, and data or to copy these to another CPU Unit.  | ---     |

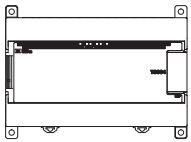



## Expansion I/O Units

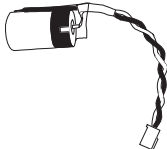
| Name and appearance  | Model       | Specifications      |                                 | Remarks |
|--|-------------|---------------------|---------------------------------|---------|
|  |             | Inputs              | Outputs                         |         |
| <b>40-point I/O Units</b><br>     | CP1W-40EDR  | 24 VDC<br>24 inputs | 16 relay outputs                | ---     |
|  | CP1W-40EDT  |                     | 16 transistor outputs, sinking  |         |
|  | CP1W-40EDT1 |                     | 16 transistor outputs, sourcing |         |
| <b>32-point Output Units</b><br>  | CP1W-32ER   | None                | 32 relay outputs                | ---     |
|  | CP1W-32ET   |                     | 32 transistor outputs, sinking  |         |
|  | CP1W-32ET1  |                     | 32 transistor outputs, sourcing |         |
| <b>20-point I/O Units</b><br>     | CP1W-20EDR1 | 24 VDC<br>12 inputs | 8 relay outputs                 | ---     |
|  | CP1W-20EDT  |                     | 8 transistor outputs, sinking   |         |
|  | CP1W-20EDT1 |                     | 8 transistor outputs, sourcing  |         |
| <b>16-point Output Units</b><br> | CP1W-16ER   | None                | 16 relay outputs                | ---     |
|  | CP1W-16ET   |                     | 16 transistor outputs, sinking  |         |
|  | CP1W-16ET1  |                     | 16 transistor outputs, sourcing |         |
| <b>8-point Input Units</b><br>  | CP1W-8ED    | 24 VDC<br>8 inputs  | None                            | ---     |
| <b>8-point Output Units</b><br> | CP1W-8ER    | None                | 8 relay outputs                 | ---     |
|  | CP1W-8ET    |                     | 8 transistor outputs, sinking   |         |
|  | CP1W-8ET1   |                     | 8 transistor outputs, sourcing  |         |

## Expansion Units



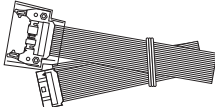
| Name and appearance   | Model      | Specifications  | Remarks |
|---|------------|---|---------|
| Analog I/O Unit<br>            | CP1W-MAD11 | 2 analog inputs<br>0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>1 analog output<br>1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/6,000   | ---     |
| Analog I/O Unit<br>            | CP1W-MAD42 | 4 analog inputs<br>0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>2 analog outputs<br>1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/12,000 | ---     |
| Analog I/O Unit<br>            | CP1W-MAD44 | 4 analog inputs<br>0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>4 analog outputs<br>1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/12,000 | ---     |
| Analog Input Unit<br>         | CP1W-AD041 | 4 analog inputs<br>0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/6,000   | ---     |
|   | CP1W-AD042 | 4 analog inputs<br>0 to 5 V, 1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/12,000  | ---     |
| Analog Output Unit<br>       | CP1W-DA021 | 2 analog outputs<br>1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/6,000  | ---     |
|   | CP1W-DA041 | 4 analog outputs<br>1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/6,000  | ---     |
|   | CP1W-DA042 | 4 analog outputs<br>1 to 5 V, 0 to 10 V, -10 to +10 V, 0 to 20 mA, 4 to 20 mA<br>Resolution: 1/12,000   | ---     |
| Temperature Sensor Units<br> | CP1W-TS001 | Thermocouple inputs K or J, 2 inputs  | ---     |
|   | CP1W-TS002 | Thermocouple inputs K or J, 4 inputs  | ---     |
|   | CP1W-TS003 | Thermocouple inputs K or J, 4 inputs<br>or 2 analog inputs 0 to 10V, 1 to 5V, 4 to 20mA<br>AD Resolution: 1/12,000<br>TS Resolution: 0.1°C or 0.1°F   | ---     |
|   | CP1W-TS101 | Platinum resistance thermometer inputs Pt100 or JPt100, 2 inputs  | ---     |
|   | CP1W-TS102 | Platinum resistance thermometer inputs Pt100 or JPt100, 4 inputs  | ---     |

| Name and appearance   | Model      | Specifications   | Remarks |
|---|------------|--|---------|
| Temperature Sensor Units<br> | CP1W-TS004 | Thermocouple inputs K or J, 12 inputs                        | ---     |
| CompoBus/S I/O Link Unit<br> | CP1W-SRT21 | As a CompoBus/S slave, 8 inputs and 8 outputs are allocated. |         |

## Maintenance Products

| Name and appearance  | Model      | Specifications | Remarks                    |
|--|------------|----------------|----------------------------|
| Battery<br> | CJ1W-BAT01 | ---            | Installed in the CPU Unit. |

## Installation and Wiring Products

| Name and appearance   | Model      | Specifications   | Remarks |
|---|------------|--|---------|
| DIN Track<br>            | PFP-50N    | ---  | ---     |
|   | PFP-100N   | ---  |         |
|   | PFP-100N2  | ---  |         |
| End Plate<br>            | PFP-M      | ---  |         |
| I/O Connecting Cable<br> | CP1W-CN811 | Used to install CP-series Expansion Units and Expansion I/O Units in a second row.<br>Only one I/O Connecting Cable can be used in each PLC. | ---     |

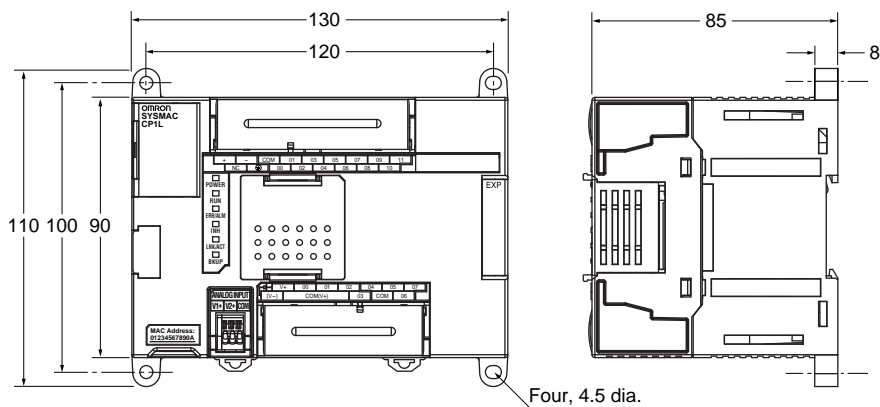


# Appendix B

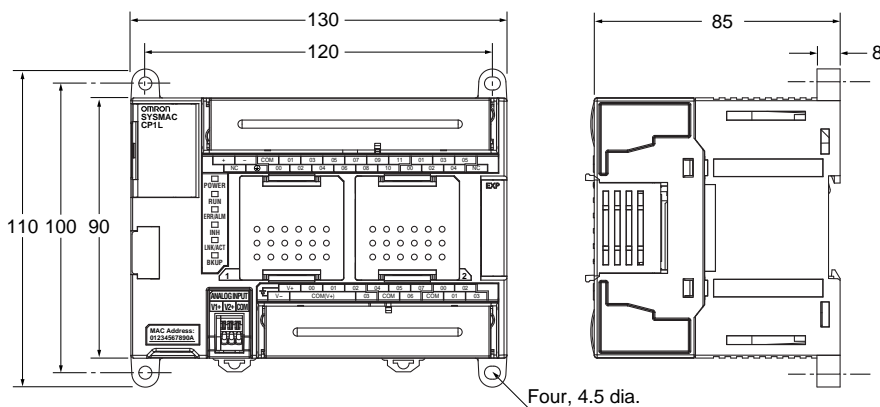
## Dimensions Diagrams

### CP1L-EL/EM CPU Units

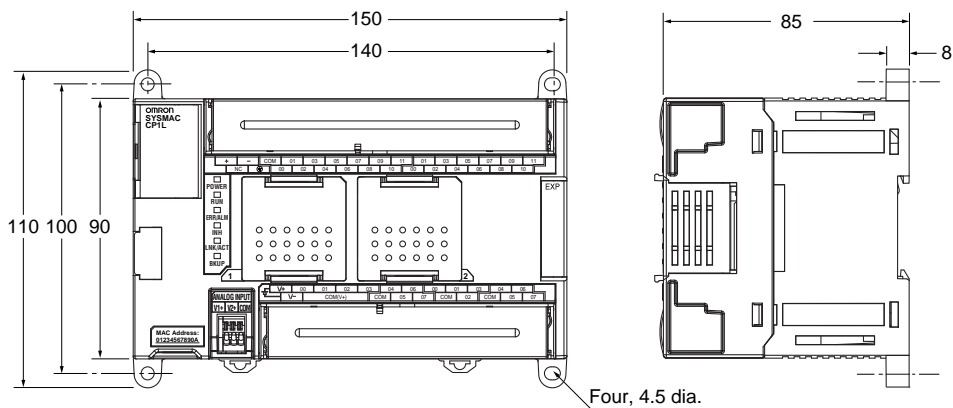
#### CPU Units with 20 I/O Points



#### CPU Units with 30 I/O Points

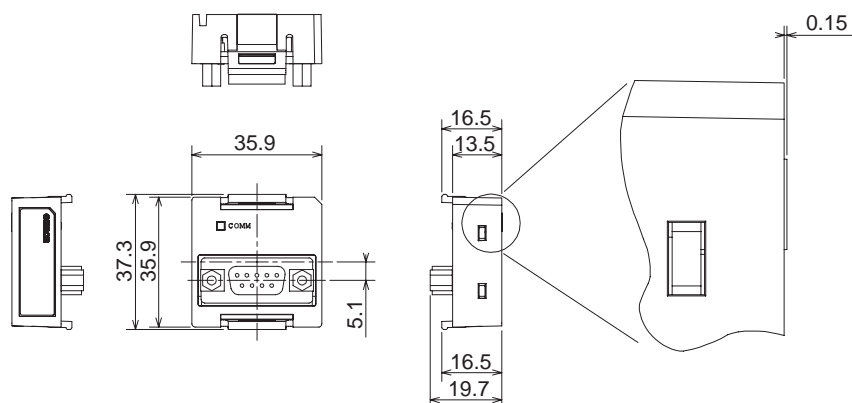


#### CPU Units with 40 I/O Points

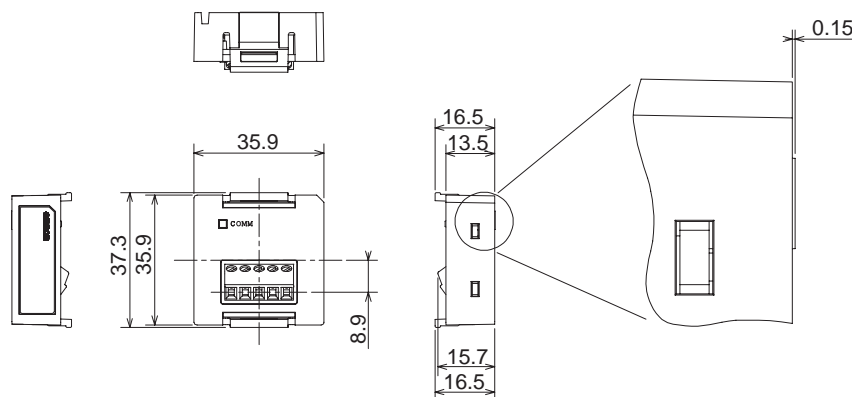


## Optional Products

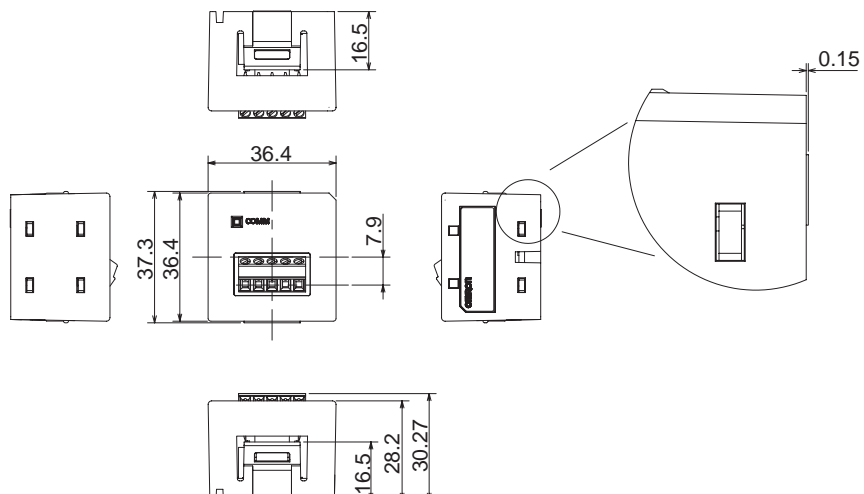
### CP1W-CIF01 Option Board



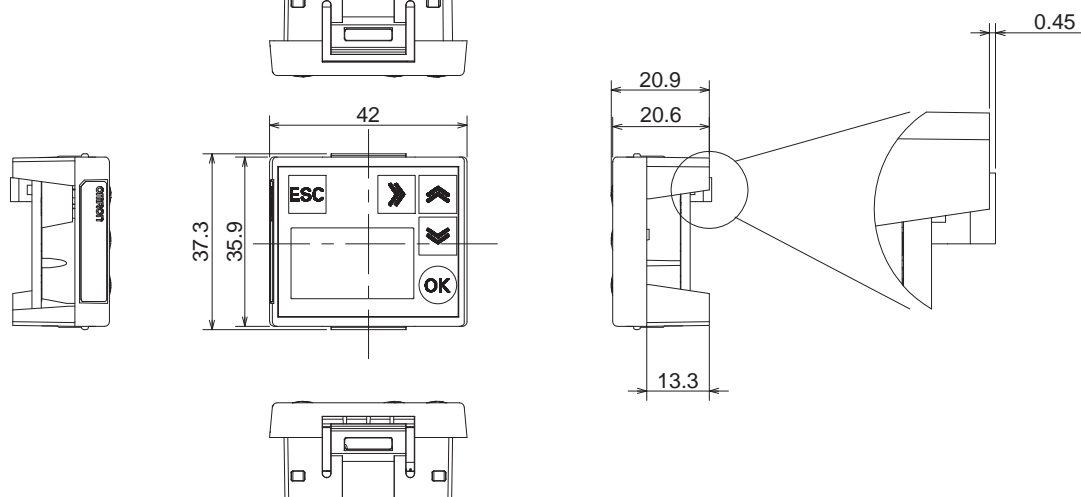
### CP1W-CIF11/CP1W-CIF12-V1 Option Board



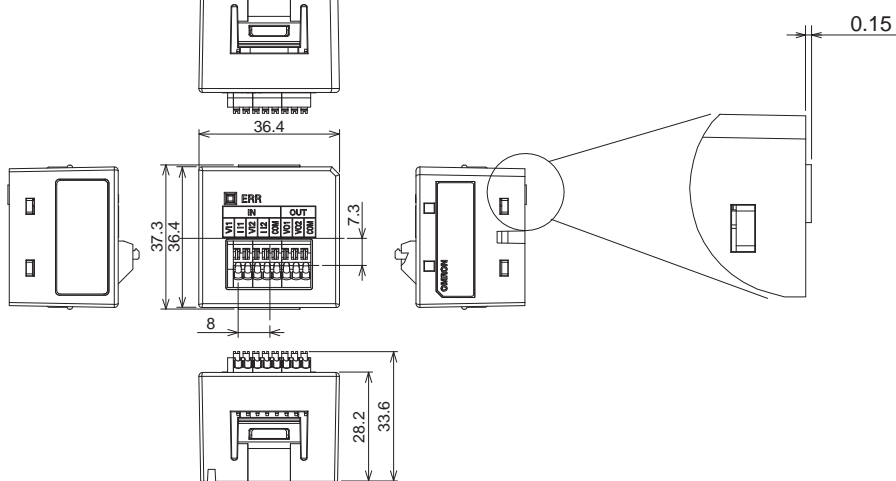
### CP1W-CIF12 Option Board (Not include CP1W-CIF12-V1)



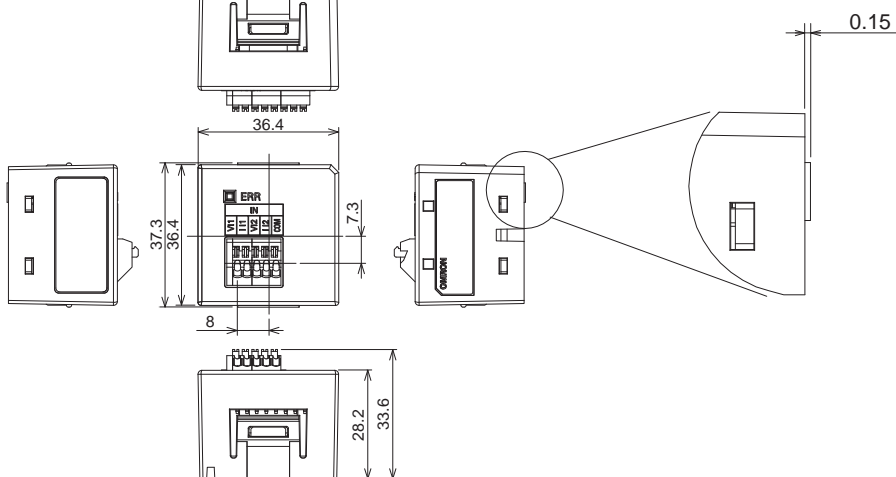
## CP1W-DAM01 LCD Option Board

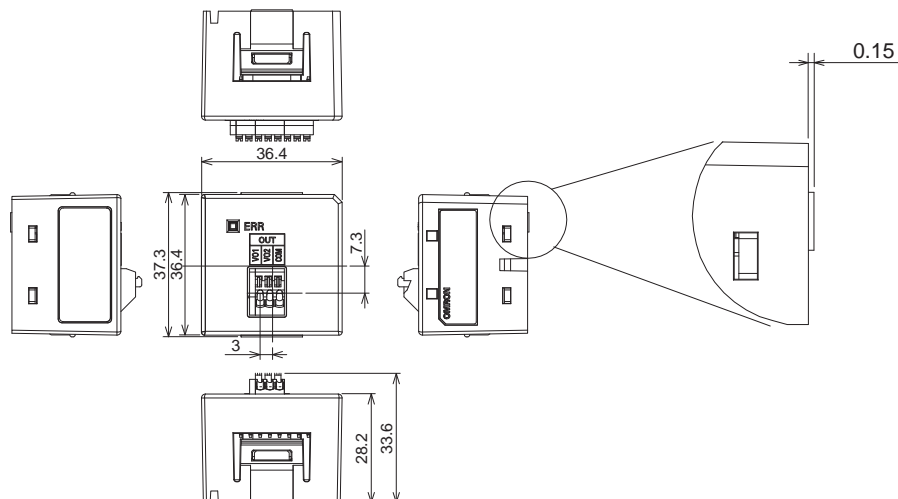
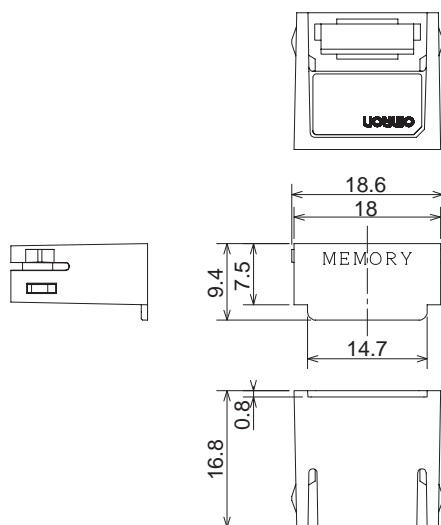


## CP1W-MAB221 Analog Input/Output Option Board



## CP1W-ADB21 Analog Input Option Board

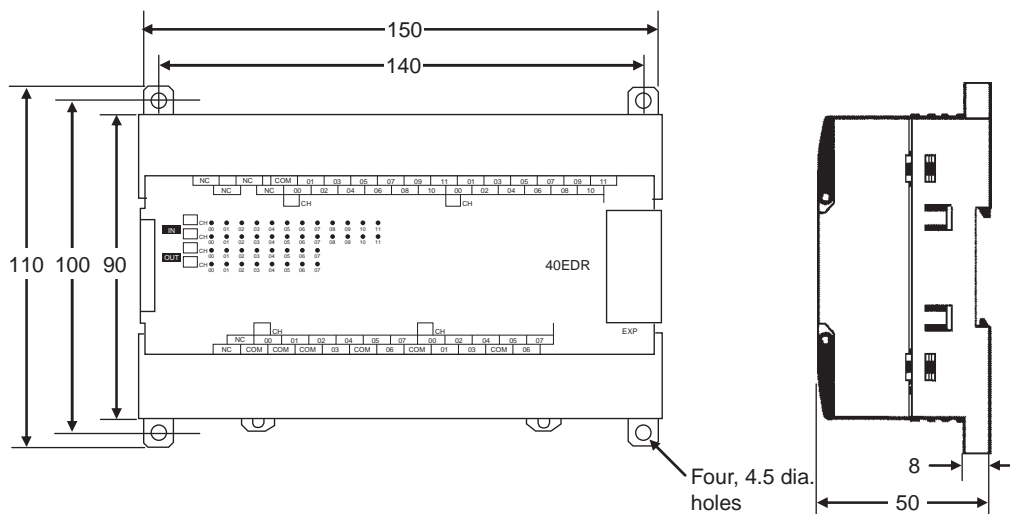


**CP1W-DAB21V Analog Output Option Board****CP1W-ME05M Memory Cassette**

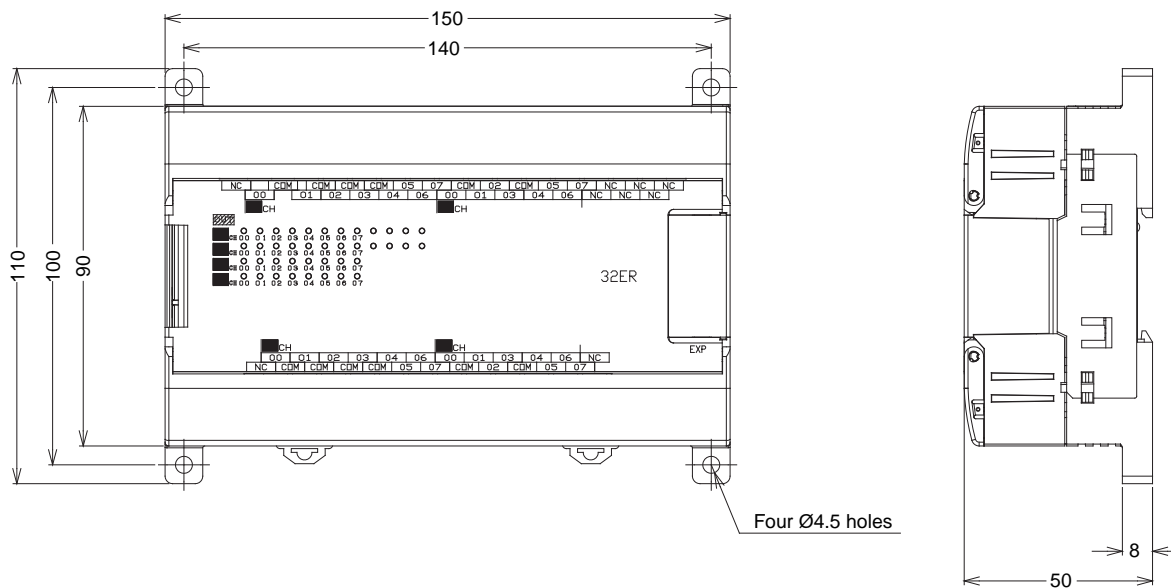


## Expansion I/O Units

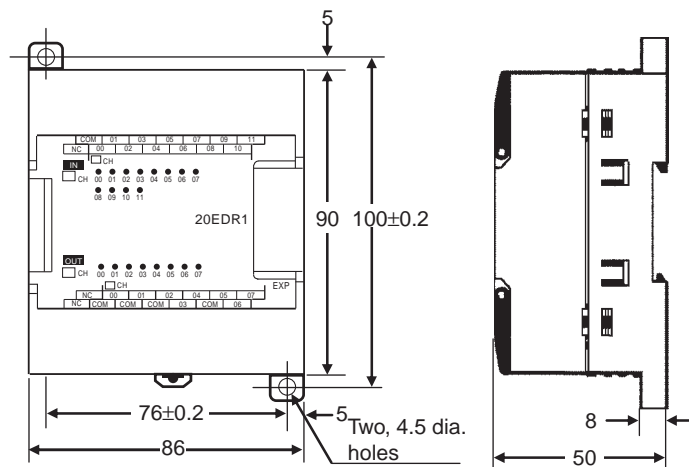
### 40-point I/O Units (CP1W-40EDR/40EDT/40EDT1)



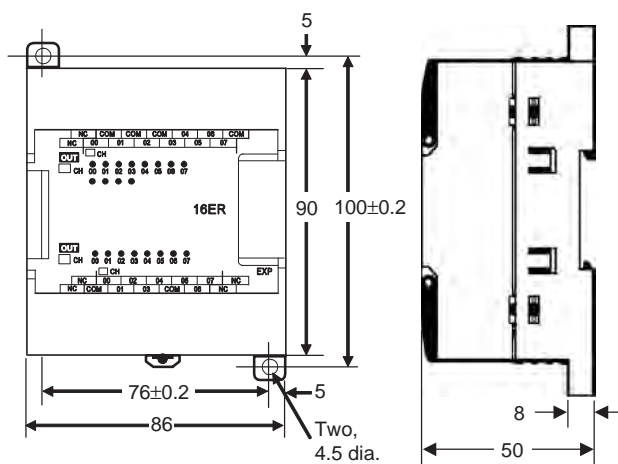
### 32-point Output Units (CP1W-32ER/32ET/32ET1)



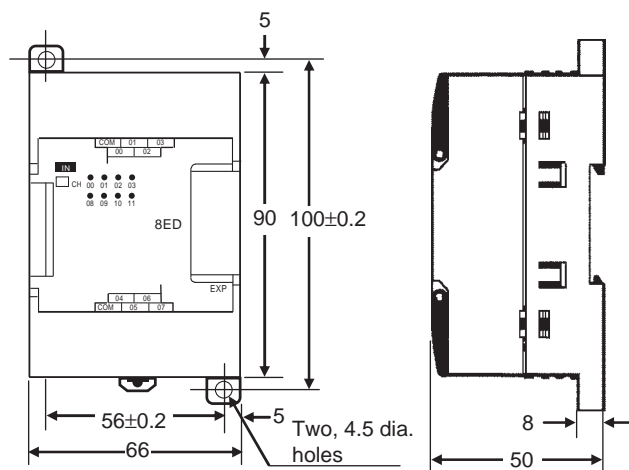
## 20-point I/O Units (CP1W-20EDR1/20EDT/20EDT1)



## 16-point Output Unit (CP1W-16ER/16ET/16ET1)



## 8-point I/O Units (CP1W-8ER/8ET/8ET1)

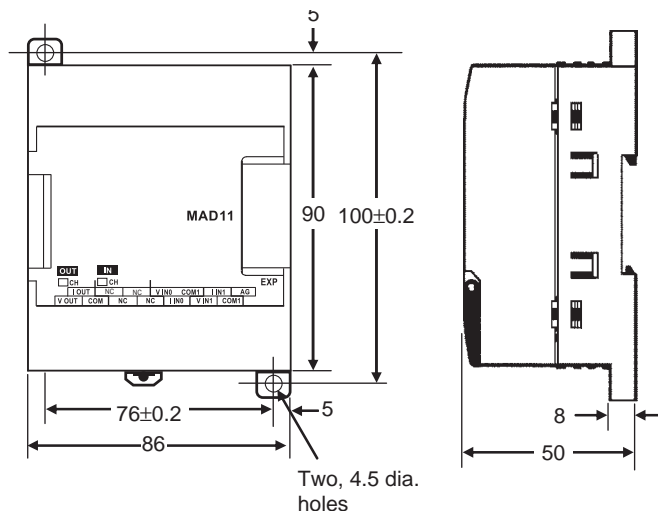


## Expansion Units

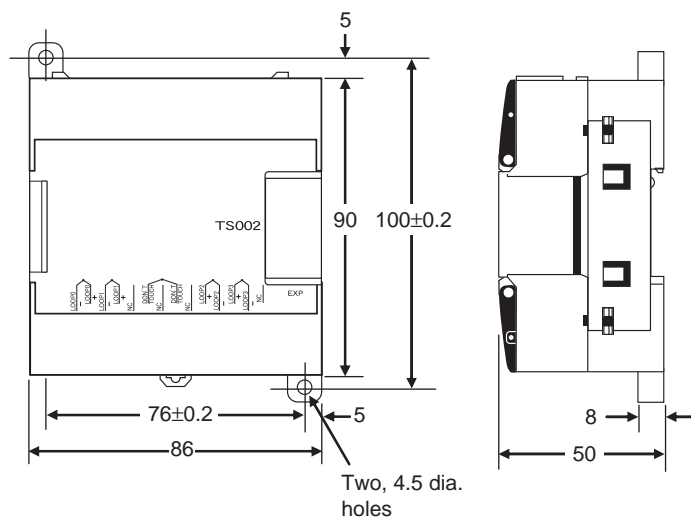
## CP1W-AD041/CP1W-AD042 Analog Input Units

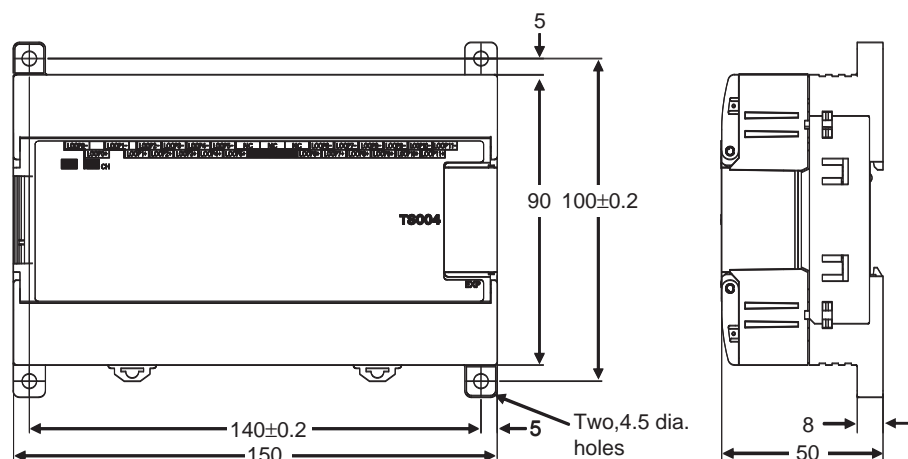
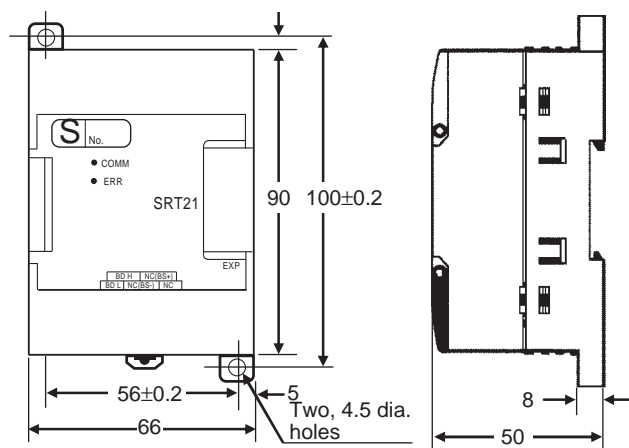
## CP1W-DA041/CP1W-DA042 Analog Output Units

## CP1W-MAD11/CP1W-MAD42/CP1W-MAD44 Analog I/O Units



## CP1W-TS001/101/002/102/003 Temperature Sensor Units



**CP1W-TS004 Temperature Sensor Units****CP1W-SRT21 CompoBus/S I/O Link Unit**

# Appendix C

## Auxiliary Area Allocations by Function

### Initial Settings

| Name                   | Address | Description   | Access     | Updated |
|------------------------|---------|---|------------|---------|
| IOM Hold Bit           | A500.12 | Turn this bit ON to retain the status of the I/O Memory when shifting from PROGRAM to RUN or MONITOR mode or vice versa or when turning ON the power supply.<br>ON: I/O memory retained<br>OFF: I/O memory not retained | Read/write |         |
| Forced Status Hold Bit | A500.13 | Turn this bit ON to preserve the status of bits that have been force-set or force-reset when shifting from PROGRAM to MONITOR mode or vice versa or when turning ON the power supply.                                   | Read/write |         |

### CPU Unit Settings

| Name                       | Address       | Description   | Access    | Updated |
|----------------------------|---------------|---|-----------|---------|
| Status of DIP Switch Pin 3 | A395.12       | The status of pin 3 on the DIP switch on the front of the CPU Unit is written to this flag every cycle.   | Read-only |         |
| Manufacturing Lot Number   | A310 and A311 | The manufacturing lot number is stored in 5 digits hexadecimal. X, Y, and Z in the lot number are converted to 10, 11, and 12, respectively.<br>Examples:<br>Lot number 23805<br>A310 = 0823, A311 = 0005<br>Lot number 15X05<br>A310 = 1015, A311 = 0005 | Read-only |         |

### DM Initial Value Settings

| Name  | Address | Description  | Access     | Updated |
|---|---------|--|------------|---------|
| DM Initial Values Flag                      | A345.04 | ON when DM initial values are stored in the flash memory.  | Read-only  |         |
| DM Initial Values Read Error Flag           | A751.11 | ON when an error occurred in transferring DM initial values from the DM initial value area in flash memory to the DM Area.   | Read-only  |         |
| DM Initial Values Save Execution Error Flag | A751.12 | ON when the DM Initial Values Transfer Password (A752) is incorrect or when the DM Initial values area was not specified when starting to transfer DM initial values from the DM Area to the DM initial value area in flash memory.  | Read-only  |         |
| DM Initial Values Save Error Flag           | A751.13 | ON when an error occurred in transferring DM initial values from the DM Area to the DM initial value area in flash memory.   | Read-only  |         |
| DM Initial Values Save Flag                 | A751.14 | ON while DM initial values are being transferred from the DM Area to the DM initial value area in flash memory.<br>OFF when the transfer has been completed.   | Read-only  |         |
| DM Initial Values Save Start Bit            | A751.15 | Turn ON this bit to start transferring DM initial values. This bit is valid only when a correct password is stored in A752 and the DM Area Initial Value Area is specified (i.e., when A753.00 is ON).<br>The system will turn this bit OFF automatically when the transfer has been completed.  | Read/Write |         |
| DM Initial Values Transfer Password         | A752    | Set the passwords here to transfer DM initial values between the DM area and the DM initial value area in flash memory. The transfer will not be started unless the correct password is set.<br>The transfer is started when A751.15 is turned ON.<br>The password will be cleared by the system when the transfer has been completed.<br>A5A5 hex: Save initial values from DM to flash | Read/Write |         |
| DM Initial Values Save Area Specifications  | A753.00 | Specifies the area to be transferred to flash memory.  | Read/Write |         |

## Built-in Inputs

### Built-in Analog Input

| Name              | Address | Description   | Access    | Updated |
|-------------------|---------|---|-----------|---------|
| Analog Input 1 PV | A642    | Stores the value set from the analog input 1 as a hexadecimal value (resolution: 1/1000).<br>0000 to 03E8 hex | Read-only |         |
| Analog Input 2 PV | A643    | Stores the value set from the analog input 2 as a hexadecimal value (resolution: 1/1000).<br>0000 to 03E8 hex | Read-only |         |

### Input Interrupts, Interrupt Counters 0 to 5

| Interrupt counter   | Counter SV | Counter PV |
|---------------------|------------|------------|
| Interrupt counter 0 | A532       | A536       |
| Interrupt counter 1 | A533       | A537       |
| Interrupt counter 2 | A534       | A538       |
| Interrupt counter 3 | A535       | A539       |
| Interrupt counter 4 | A544       | A548       |
| Interrupt counter 5 | A545       | A549       |

| Name                         | Description  | Access     | Updated   |
|------------------------------|--|------------|---|
| Interrupt Counter Counter SV | Used for an interrupt input in counter mode.<br>Sets the count value at which the interrupt task will start. The corresponding interrupt task will start when the interrupt counter has counted this number of pulses.   | Read/Write | <ul style="list-style-type: none"> <li>Retained when power is turned ON.</li> <li>Retained when operation starts.</li> </ul>  |
| Interrupt Counter Counter PV | These words contain the interrupt counter PVs for interrupt inputs operating in counter mode.<br>In increment mode, the counter PV starts incrementing from 0. When the counter PV reaches the counter SV, the PV is automatically reset to 0.<br>In decrement mode, the counter PV starts decrementing from the counter SV. When the counter PV reaches the 0, the PV is automatically reset to the SV. | Read/Write | <ul style="list-style-type: none"> <li>Retained when power is turned ON.</li> <li>Cleared when operation starts.</li> <li>Updated when interrupt is generated.</li> </ul> |

### High-speed Counters 0 to 3

| Item   |                    | High-speed counter 0 | High-speed counter 1 | High-speed counter 2 | High-speed counter 3 |
|--|--------------------|----------------------|----------------------|----------------------|----------------------|
| High-speed Counter PV                                  | Leftmost 4 digits  | A271                 | A273                 | A317                 | A319                 |
|  | Rightmost 4 digits | A270                 | A272                 | A316                 | A318                 |
| High-speed Counter Range Comparison Condition Met Flag | Range 1            | A274.00              | A275.00              | A320.00              | A321.00              |
|  | Range 2            | A274.01              | A275.01              | A320.01              | A321.01              |
|  | Range 3            | A274.02              | A275.02              | A320.02              | A321.02              |
|  | Range 4            | A274.03              | A275.03              | A320.03              | A321.03              |
|  | Range 5            | A274.04              | A275.04              | A320.04              | A321.04              |
|  | Range 6            | A274.05              | A275.05              | A320.05              | A321.05              |
|  | Range 7            | A274.06              | A275.06              | A320.06              | A321.06              |
|  | Range 8            | A274.07              | A275.07              | A320.07              | A321.07              |
| High-speed Counter Comparison In-progress Flag         |                    | A274.08              | A275.08              | A320.08              | A321.08              |
| High-speed Counter Overflow/Underflow Flag             |                    | A274.09              | A275.09              | A320.09              | A321.09              |
| High-speed Counter Count Direction                     |                    | A274.10              | A275.10              | A320.10              | A321.10              |
| High-speed Counter Count Reset Bit                     |                    | A531.00              | A531.01              | A531.02              | A531.03              |
| High-speed Counter Gate Flag                           |                    | A531.08              | A531.09              | A531.10              | A531.11              |

| Name  |         | Description   | Read/Write | Updated  |
|---|---------|---|------------|--|
| High-speed Counter PV                                   |         | Contains the PV of the high-speed counter.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Updated each cycle during overseeing process.</li> <li>• Updated when PRV(881) instruction is executed for the corresponding counter.</li> </ul>  |
| High-speed Counter Range Comparison Condition Met Flags | Range 1 | These flags indicate whether the PV is within the specified ranges when the high-speed counter is being operated in range-comparison mode.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when range comparison table is registered.</li> <li>• Updated each cycle during overseeing process.</li> <li>• Updated when PRV(881) instruction is executed to read range comparison results.</li> </ul> |
|   | Range 2 |   |            |  |
|   | Range 3 | OFF: PV not in range  |            |  |
|   | Range 4 | ON: PV in range   |            |  |
|   | Range 5 |   |            |  |
|   | Range 6 |   |            |  |
|   | Range 7 |   |            |  |
|   | Range 8 |   |            |  |
| High-speed Counter Comparison In-progress Flag          |         | <p>This flag indicates whether a comparison operation is being executed for the high-speed counter.</p> <p>OFF: Stopped.</p> <p>ON: Being executed.</p>   | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Updated when comparison operation starts or stops.</li> </ul>   |
| High-speed Counter Overflow/Underflow Flag              |         | <p>This flag indicates when an overflow or underflow has occurred in the high-speed counter PV. (Used with the linear mode counting range only.)</p> <p>OFF: Normal</p> <p>ON: Overflow or underflow</p>  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when the PV is changed.</li> <li>• Updated when an overflow or underflow occurs.</li> </ul>   |
| High-speed Counter Count Direction                      |         | <p>This flag indicates whether the high-speed counter is currently being incremented or decremented. The counter PV for the current cycle is compared with the PLC in last cycle to determine the direction.</p> <p>OFF: Decrementing</p> <p>ON: Incrementing</p>   | Read-only  | <ul style="list-style-type: none"> <li>• Setting used for high-speed counter, valid during counter operation.</li> </ul>   |
| High-speed Counter Reset Bit                            |         | <p>When the reset method is set to Phase-Z signal + Software reset, the corresponding high-speed counter's PV will be reset if the phase-Z signal is received while this bit is ON.</p> <p>When the reset method is set to a software reset, the corresponding high-speed counter's PV will be reset in the cycle when this bit goes ON.</p>  | Read/Write | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> </ul>   |
| High-speed Counter Gate Bit                             |         | <p>When a counter's Gate Bit is ON, the counter's PV will not be changed even if pulse inputs are received for the counter.</p> <p>When the bit is turned OFF again, counting will restart and the high-speed counter's PV will be updated.</p> <p>When the reset method is set to Phase-Z signal + Software reset, the Gate Bit is disabled while the corresponding Reset Bit is ON.</p> | Read/Write | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> </ul>   |

## Built-in Outputs

### Pulse Outputs 0, 1

| Item                                    |                    | Pulse output 0 | Pulse output 1 |
|---|--------------------|----------------|----------------|
| Pulse Output PV                         | Leftmost 4 digits  | A277           | A279           |
|   | Rightmost 4 digits | A276           | A278           |
| Pulse Output Accel/Decel Flag           |                    | A280.00        | A281.00        |
| Pulse Output Overflow/Underflow Flag    |                    | A280.01        | A281.01        |
| Pulse Output, Output Amount Set Flag    |                    | A280.02        | A281.02        |
| Pulse Output, Output Completed Flag     |                    | A280.03        | A281.03        |
| Pulse Output, Output In-progress Flag   |                    | A280.04        | A281.04        |
| Pulse Output No-origin Flag             |                    | A280.05        | A281.05        |
| Pulse Output At-origin Flag             |                    | A280.06        | A281.06        |
| Pulse Output, Output Stopped Error Flag |                    | A280.07        | A281.07        |
| PWM Output, Output In-progress Flag     |                    | A283.00        | A283.08        |

| Item                                      | Pulse output<br>0 | Pulse output<br>1 |
|---|-------------------|-------------------|
| Pulse Output Stop Error Code              | A444              | A445              |
| Pulse Output Reset Bit                    | A540.00           | A541.00           |
| Pulse Output CW Limit Input Signal Flag   | A540.08           | A541.08           |
| Pulse Output CCW Limit Input Signal Flag  | A540.09           | A541.09           |
| Pulse Output Positioning Completed Signal | A540.10           | A541.10           |

| Name                                  | Description  | Read/Write | Updated  |
|---------------------------------------|--|------------|--|
| Pulse Output PV                       | Contain the number of pulses output from the corresponding pulse output port. PV range: 8000 0000 to 7FFF FFFF hex (-2,147,483,648 to 2,147,483,647)<br>When pulses are being output in the CW direction, the PV is incremented by 1 for each pulse.<br>When pulses are being output in the CCW direction, the PV is decremented by 1 for each pulse.<br>PV after overflow: 7FFF FFFF hex<br>PV after underflow: 8000 0000 hex<br><b>Note</b> If the coordinate system uses relative coordinates (undefined origin), the PV will be cleared to 0 when a pulse output starts, i.e. when a pulse output instruction (SPED(885), ACC(888), or PLS2(887)) is executed. | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Updated each cycle during over-see process.</li> <li>• Updated when the PV is changed by the INI(880) instruction.</li> </ul>   |
| Pulse Output Accel/Decel Flag         | This flag will be ON when pulses are being output according to an ACC(888) or PLS2(887) instruction and the output frequency is being changed in steps (accelerating or decelerating).<br>OFF: Constant speed<br>ON: Accelerating or decelerating  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts or stops.</li> <li>• Updated each cycle during over-see process.</li> </ul>   |
| Pulse Output Overflow/Underflow Flag  | This flag indicates when an overflow or underflow has occurred in the pulse output PV.<br>OFF: Normal<br>ON: Overflow or underflow   | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when the PV is changed by the INI(880) instruction.</li> <li>• Updated when an overflow or underflow occurs.</li> </ul> |
| Pulse Output, Output Amount Set Flag  | ON when the number of output pulses has been set with the PULS(886) instruction.<br>OFF: No setting<br>ON: Setting made  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts or stops.</li> <li>• Updated when the PULS(886) instruction is executed.</li> <li>• Updated when pulse output stops.</li> </ul>             |
| Pulse Output, Output Completed Flag   | ON when the number of output pulses set with the PULS(886) or PLS2(887) instruction has been output.<br>OFF: Output not completed.<br>ON: Output completed.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts or stops.</li> <li>• Updated at the start or completion of pulse output in independent mode.</li> </ul>                                     |
| Pulse Output, Output In-progress Flag | ON when pulses are being output.<br>OFF: Stopped<br>ON: Outputting pulses.   | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts or stops.</li> <li>• Updated when pulse output starts or stops.</li> </ul>  |
| Pulse Output No-origin Flag           | ON when the origin has not been determined and goes OFF when the origin has been determined.<br>OFF: Origin established.<br>ON: Origin not established.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Updated when pulse output starts or stops.</li> <li>• Updated each cycle during the overseeing processes.</li> </ul>            |
| Pulse Output At-origin Flag           | ON when the pulse output PV matches the origin (0).<br>OFF: Not stopped at origin.<br>ON: Stopped at origin.   | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Updated each cycle during the overseeing processes.</li> </ul>  |



| Name                                      | Description   | Read/Write | Updated   |
|---|---|------------|---|
| Pulse Output, Output Stopped Error Flag   | ON when an error occurred while outputting pulses in the pulse output 0 origin search function.<br>OFF: No error<br>ON: Stop error occurred.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Updated when origin search starts.</li> <li>• Updated when a pulse output stop error occurs.</li> </ul>  |
| PWM Output, Output In-progress Flag       | ON when pulses are being output from the PWM output.<br>OFF: Stopped<br>ON: Outputting pulses.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts or stops.</li> <li>• Updated when pulse output starts or stops.</li> </ul> |
| Pulse Output Stop Error Code              | If a Pulse Output Stop Error occurs, the error code is written to this word.  | Read-only  | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Updated when origin search starts.</li> <li>• Updated when a pulse output stop error occurs.</li> </ul>  |
| Pulse Output Reset Bit                    | The pulse output PV will be cleared when this bit is turned ON.   | Read/Write | Cleared when power is turned ON.  |
| Pulse Output CW Limit Input Signal Flag   | This is the CW limit input signal for the pulse output, which is used in the origin search. To use this signal, write the input from the actual sensor as an input condition in the ladder program and output the result to this flag.  | Read/Write | Cleared when power is turned ON.  |
| Pulse Output CCW Limit Input Signal Flag  | This is the CCW limit input signal for the pulse output, which is used in the origin search. To use this signal, write the input from the actual sensor as an input condition in the ladder program and output the result to this flag. | Read/Write | Cleared when power is turned ON.  |
| Pulse Output Positioning Completed Signal | This is the positioning completed input signal used in the origin search for the pulse output. The input signal from the servo driver is output to this bit from the ladder program to enable using the signal.                         | Read/Write | Cleared when power is turned ON.  |

## Inverter Positioning

### Inverter Positioning 0 and 1

| Item  |                    | Inverter positioning 0 | Inverter positioning 1 |
|---|--------------------|------------------------|------------------------|
| Inverter Frequency Command Value                          |                    | A23                    | A33                    |
| Present Value of Unsigned Output Value                    | Leftmost 4 digits  | A21                    | A31                    |
|   | Rightmost 4 digits | A20                    | A30                    |
| Present Value of Signed Output Value                      | Leftmost 4 digits  | A25                    | A35                    |
|   | Rightmost 4 digits | A24                    | A34                    |
| Operation Command Flag                                    |                    | A26.00                 | A36.00                 |
| Forward Operation Command Flag                            |                    | A26.01                 | A36.01                 |
| Reverse Operation Command Flag                            |                    | A26.02                 | A36.02                 |
| In-position Flag  |                    | A26.03                 | A36.03                 |
| Error Counter Error Flag                                  |                    | A26.04                 | A36.04                 |
| Error Counter Pulse Output Flag                           |                    | A26.05                 | A36.05                 |
| Error Counter Pulse Output Acceleration/Deceleration Flag |                    | A26.06                 | A36.06                 |
| Error Counter Alarm Flag                                  |                    | A26.07                 | A36.07                 |
| Inverter Positioning Output Value Sign Flag               |                    | A26.15                 | A36.15                 |
| Error Counter Present Value, Signed                       |                    | A22                    | A32                    |
| Present Value of Pulse Output to Inverter, Relative Value | Leftmost 4 digits  | A29                    | A39                    |
|   | Rightmost 4 digits | A28                    | A38                    |
| Error Counter Reset Bit                                   |                    | A562.00                | A563.00                |
| Error Counter Disable Bit                                 |                    | A562.01                | A563.01                |
| Present Value of High-speed Counter                       | Leftmost 4 digits  | A271                   | A273                   |
|   | Rightmost 4 digits | A270                   | A272                   |
| Present Value of Internal Pulse Output                    | Leftmost 4 digits  | A271                   | A279                   |
|   | Rightmost 4 digits | A270                   | A278                   |

| Name                                   | Description  | Read/Write | Updated  |
|--|--|------------|--|
| Inverter Frequency Command Value       | This word contains the automatically calculated frequency command value for the inverter.<br>Data range: 0000 to FFFF hex (0.00 to 655.35 Hz) (0.01-Hz increments, unsigned)<br>Set the Power Supply Frequency for One Motor Revolution per Second, Number of Encoder Pulses for One Motor Revolution, and Error Counter Cycle in the PLC Setup before using this value. | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when an error occurs in the error counter.</li> <li>• Updated each error counter cycle.</li> </ul>  |
| Present Value of Unsigned Output Value | These words contain the present value of the unsigned output value (output value = present value of error counter $\times$ error counter cycle (s) $\times$ gain).<br>Data range: 0000 0000 to 8000 0000 hex (0 to 2,147,483,648)<br>The maximum and minimum output values are applied.  | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when an error occurs in the error counter.</li> <li>• Updated each error counter cycle.</li> </ul>  |
| Present Value of Signed Output Value   | These words contain the present value of the signed output value (output value = present value of error counter $\times$ error counter cycle (s) $\times$ gain).<br>Data range: 8000 0000 to 7FFF FFFF hex (-214,748,348 to 214,748,347)<br>The maximum and minimum output values are applied.   | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when an error occurs in the error counter.</li> <li>• Updated each error counter cycle.</li> </ul>  |
| Operation Command Flag                 | This flag turns ON during an inverter positioning operation command.<br>ON: Operation command executed.<br>OFF: Stop command executed.   | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when inverter positioning is stopped (immediate stop) using INI instruction.</li> </ul>   |
| Forward Operation Command Flag         | This flag turns ON during an inverter positioning forward operation command.<br>ON: Forward command in progress<br>OFF: Reverse command in progress or stopped   | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when error counter present value is 0 or less than 0 (negative).</li> <li>• Turned ON when error counter present value is greater than 0 (positive).</li> </ul>  |
| Reverse Operation Command Flag         | This flag turns ON during an inverter positioning reverse operation command.<br>ON: Reverse command in progress<br>OFF: Forward command in progress or stopped   | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when error counter present value is 0 or greater than 0 (positive).</li> <li>• Turned ON when error counter present value is less than 0 (negative).</li> </ul>  |
| In-position Flag                       | This flag turns ON when inverter positioning is in position.<br>ON: In position<br>OFF: Not in position  | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when pulses are being output to error counter.</li> <li>• Turned OFF absolute value of error counter present value is greater than in-position range.</li> <li>• Turned OFF when pulse output to error counter is stopped and absolute value of error counter present value is less than in-position range.</li> </ul> |

| Name  | Description   | Read/Write | Updated   |
|---|---|------------|---|
| Error Counter Error Flag                                  | This flag turns ON when an error occurs in the error counter for inverter positioning.<br>ON: Error counter error<br>OFF: No error  | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when error counter error is reset.</li> <li>• Turned ON when pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter error detection value.</li> </ul>   |
| Error Counter Pulse Output Flag                           | This flag is ON while pulses are being output to the output counter for inverter positioning.<br>ON: Pulses being output<br>OFF: Pulse output stopped   | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when error counter error is reset.</li> <li>• Turned ON when pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter error detection value.</li> </ul>   |
| Error Counter Pulse Output Acceleration/Deceleration Flag | This flag is ON while pulse output to the output counter for inverter positioning is accelerating or decelerating.<br>ON: Pulse output to the error counter is accelerating or decelerating (i.e., the frequency is changing)<br>OFF: Pulse output to the error counter is constant | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF during output of a constant pulse frequency to error counter.</li> <li>• Turned OFF when pulse output to error counter is stopped (including immediate stops and deceleration stops).</li> <li>• Turned ON when pulse output frequency to error counter is changed by ACC or PLS2 instruction.</li> </ul> |
| Error Counter Alarm Flag                                  | This flag turns ON when an alarm occurs in the error counter for inverter positioning.<br>ON: Error counter alarm<br>OFF: No alarm  | Read       | <ul style="list-style-type: none"> <li>• Turned OFF when power is turned ON.</li> <li>• Turned OFF when CPU Unit operation starts.</li> <li>• Turned OFF when CPU Unit operation stops.</li> <li>• Turned OFF when error counter alarm is reset.</li> <li>• Turned ON when pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter alarm detection value.</li> </ul>   |
| Inverter Positioning Output Value Sign Flag               | This flag is ON when the inverter positioning output value is positive and is OFF when it is negative.<br>ON: Positive value<br>OFF: Negative value   | Read       | <ul style="list-style-type: none"> <li>• Turned ON when signed output value is between 0000 0000 and 7FFF FFFF hex.</li> <li>• Turned OFF when signed output value is between FFFF FFFF and 8000 0000 hex.</li> </ul>   |
| Error Counter Present Value, Signed                       | This word contains the present value of the error counter.<br>Data range: 8000 to 7FFF hex (–32,768 to 32,767)  | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when error counter is reset.</li> <li>• Held when Error Counter Disable Bit (A562.01) is turned ON.</li> <li>• Updated each error counter cycle.</li> </ul>  |
| Present Value of Pulse Output to Inverter, Relative Value | These words contain the relative value of the internal pulse output value when pulses are being output to the error counter.<br>Data range: 8000 0000 to 7FFF FFFF hex (–2,147,483,648 to 2,147,483,647)  | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Cleared when pulse output to error counter is started.</li> <li>• Updated each error counter cycle.</li> </ul>   |

| Name  | Description  | Read/Write | Updated  |
|---|--|------------|--|
| Error Counter Reset Bit   | Turn ON this bit to reset the Error Counter Present Value and turn OFF the Error Counter Error Flag.   | Read/write | ---  |
| Error Counter Disable Bit   | Turn ON this bit to hold the error counter value.<br>ON: Error counter value held.<br>OFF: Error counter value not held.   | Read/write | ---  |
| Present Value of High-speed Counter   | These words contain the present value of the high-speed counter.   | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Updated each cycle during over-see process.</li> <li>• Updated when present value is read using PRV instruction.</li> </ul> |
| Present Value of Internal Pulse Output, Absolute Value for Absolute Coordinates | These words contain the absolute value of the actual movement in relation to the internal pulse origin when pulses are being output to the error counter.<br>Data range: 8000 0000 to 7FFF FFFF hex<br>(-2,147,483,648 to 2,147,483,647) | Read       | <ul style="list-style-type: none"> <li>• Cleared when power is turned ON.</li> <li>• Cleared when operation starts.</li> <li>• Updated each error counter cycle.</li> </ul>  |

## System Flags

| Name                                   | Address      | Description   | Access    | Updated |
|--|--------------|---|-----------|---------|
| First Cycle Flag                       | A200.11      | ON for one cycle after PLC operation begins (after the mode is switched from PROGRAM to RUN or MONITOR, for example).   | Read-only |         |
| Initial Task Execution Flag            | A200.15      | ON when a task is executed for the first time, i.e., when it changes from INI to RUN status.  | Read-only |         |
| Task Started Flag                      | A200.14      | When a task switches from WAIT or INI to RUN status, this flag will be turned ON within the task for one cycle only.<br><b>Note</b> The only difference between this flag and A200.15 is that this flag also turns ON when the task switches from WAIT to RUN status.   | Read-only |         |
| Maximum Cycle Time                     | A262 to A263 | These words contain the maximum cycle time since the start of PLC operation. The cycle time is recorded in 8-digit hexadecimal with the leftmost 4 digits in A263 and the rightmost 4 digits in A262.<br>0 to FFFFFFFF: 0 to 429,496,729.5 ms (0.1-ms units)  | Read-only |         |
| Present Cycle Time                     | A264 to A265 | These words contain the present cycle time in 8-digit hexadecimal with the leftmost 4 digits in A265 and the rightmost 4 digits in A264.  | Read-only |         |
| 10-ms Incrementing Free Running Timer  | A0           | This word contains the system timer used after the power is turned ON.<br>A value of 0000 hex is set when the power is turned ON and this value is automatically incremented by 1 every 10 ms. The value returns to 0000 hex after reaching FFFF hex (655,350 ms), and then continues to be automatically incremented by 1 every 10 ms.<br><b>Note:</b> The timer will continue to be incremented when the operating mode is switched to RUN mode.<br>Example: The interval can be counted between processing A and processing B without requiring timer instructions. This is achieved by calculating the difference between the value in A0 for processing A and the value in A0 for processing B. The interval is counted in 10 ms units.      | Read-only |         |
| 100-ms Incrementing Free Running Timer | A1           | This word contains the system timer used after the power is turned ON.<br>A value of 0000 hex is set when the power is turned ON and this value is automatically incremented by 1 every 100 ms. The value returns to 0000 hex after reaching FFFF hex (6,553,500 ms), and then continues to be automatically incremented by 1 every 100 ms.<br><b>Note:</b> The timer will continue to be incremented when the operating mode is switched to RUN mode.<br>Example: The interval can be counted between processing A and processing B without requiring timer instructions. This is achieved by calculating the difference between the value in A0 for processing A and the value in A0 for processing B. The interval is counted in 100 ms units. | Read-only |         |

## Task Information

| Name                                     | Address | Description   | Access    | Updated |
|--|---------|---|-----------|---------|
| Task Number when Program Stopped         | A294    | This word contains the task number of the task that was being executed when program execution was stopped because of a program error.   | Read-only |         |
| Maximum Interrupt Task Processing Time   | A440    | Contains the Maximum Interrupt Task Processing Time in units of 0.1 ms as hexadecimal data.   | Read-only |         |
| Interrupt Task with Max. Processing Time | A441    | Contains the task number of the interrupt task with the maximum processing time. Hexadecimal values 8000 to 80FF correspond to task numbers 00 to FF. Bit 15 is turned ON when an interrupt has occurred. | Read-only |         |
| IR/DR Operation between Tasks            | A99.14  | ON when index and data registers are shared between all tasks.<br>OFF: Independent<br>ON: Shared (default)  | Read-only |         |

## Debugging Information

### Online Editing

| Name                                 | Address            | Description  | Access     | Updated |
|--------------------------------------|--------------------|--|------------|---------|
| Online Editing Wait Flag             | A201.10            | ON when an online editing process is waiting.  | Read-only  |         |
| Online Editing Processing Flag       | A201.11            | ON when an online editing process is being executed.   | Read-only  |         |
| Online Editing Disable Bit Validator | A527.00 to A527.07 | The Online Editing Disable Bit (A527.09) is valid only when this byte contains 5A.   | Read/write |         |
| Online Editing Disable Bit           | A527.09            | Turn this bit ON to disable online editing. The setting of this bit is valid only when A527.00 to A527.07 have been set to 5A. | Read/write |         |

### Output Control

| Name           | Address | Description   | Access     | Updated |
|----------------|---------|---|------------|---------|
| Output OFF Bit | A500.15 | Turn this bit ON to turn OFF all outputs from the CPU Unit and Special I/O Units. | Read/write |         |

### Differentiate Monitor

| Name                                 | Address | Description  | Access     | Updated |
|--------------------------------------|---------|--|------------|---------|
| Differentiate Monitor Completed Flag | A508.09 | ON when the differentiate monitor condition has been established during execution of differentiation monitoring. | Read/write |         |

### Data Tracing

| Name                       | Address | Description  | Access     | Updated |
|----------------------------|---------|--|------------|---------|
| Sampling Start Bit         | A508.15 | When a data trace is started by turning this bit ON from the CX-Programmer, the PLC will begin storing data in Trace Memory by one of the three following methods:<br>Data is sampled at regular intervals (10 to 2,550 ms).<br>Data is sampled when TRSM(045) is executed in the program.<br>Data is sampled at the end of every cycle. | Read/write |         |
| Trace Start Bit            | A508.14 | Turn this bit ON to establish the trigger condition. The offset indicated by the delay value (positive or negative) determines which data samples are valid.   | Read/write |         |
| Trace Busy Flag            | A508.13 | ON when the Sampling Start Bit (A508.15) is turned ON. OFF when the trace is completed.  | Read/write |         |
| Trace Completed Flag       | A508.12 | ON when sampling of a region of trace memory has been completed during execution of a trace.   | Read/write |         |
| Trace Trigger Monitor Flag | A508.11 | ON when a trigger condition is established by the Trace Start Bit (A508.14). OFF when the next data trace is started by the Sampling Start Bit (A508.15).  | Read/write |         |

## Comment Memory

| Name                    | Address | Description   | Access    | Updated |
|-------------------------|---------|---|-----------|---------|
| Program Index File Flag | A345.01 | Turns ON when the comment memory contains a program index file.<br>OFF: No file<br>ON: File present | Read-only |         |
| Comment File Flag       | A345.02 | Turns ON when the comment memory contains a comment file.<br>OFF: No file<br>ON: File present       | Read-only |         |
| Symbol Table File Flag  | A345.03 | Turns ON when the comment memory contains a symbol table file.<br>OFF: No file<br>ON: File present  | Read-only |         |

## Error Information

### Error Log, Error Code

| Name                        | Address      | Description  | Access     | Updated |
|-----------------------------|--------------|--|------------|---------|
| Error Log Area              | A100 to A199 | When an error has occurred, the error code, error contents, and error's time and date are stored in the Error Log Area.  | Read-only  |         |
| Error Log Pointer           | A300         | When an error occurs, the Error Log Pointer is incremented by 1 to indicate the location where the next error record will be recorded as a hexadecimal offset from the beginning of the Error Log Area (A100 to A199). | Read-only  |         |
| Error Log Pointer Reset Bit | A500.14      | Turn this bit ON to reset the Error Log Pointer (A300) to 00.  | Read/write |         |
| Error Code                  | A400         | When a non-fatal error (user-defined FAL(006) or system error) or a fatal error (user-defined FALS(007) or system error) occurs, the 4-digit hexadecimal error code is written to this word.                           | Read-only  |         |

### Memory Error Information

| Name                                    | Address            | Description  | Access    | Updated |
|---|--------------------|--|-----------|---------|
| Memory Error Flag (fatal error)         | A401.15            | ON when an error occurred in memory or there was an error in automatic transfer from the Memory Cassette when the power was turned ON.<br>CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light.<br><b>Note</b> A403.09 will be turned ON if there was an error during automatic transfer at startup.<br>The automatic transfer at startup error cannot be cleared without turning OFF the PLC. | Read-only |         |
| Memory Error Location                   | A403.00 to A403.08 | When a memory error occurs, the Memory Error Flag (A401.15) is turned ON and one of the following flags is turned ON to indicate the memory area where the error occurred<br>A403.00: User program<br>A403.04: PLC Setup<br>A403.07: Routing Table   | Read-only |         |
| Startup Memory Card Transfer Error Flag | A403.09            | ON when automatic transfer at startup has been selected and an error occurs during automatic transfer. An error will occur if there is a transfer error, the specified file does not exist, or the Memory Cassette is not installed.<br>(This flag will be turned OFF when the error is cleared by turning the power OFF. The error cannot be cleared without turning the power OFF.)  | Read-only |         |
| Flash Memory Error                      | A403.10            | ON when the flash memory fails.  | Read-only |         |
| IP Address Table Checksum Error         | A403.11            | ON when there is a checksum error in IP address table.   | Read-only |         |
| IP Router Table Checksum Error          | A403.12            | ON when there is a checksum error in IP router table.  | Read-only |         |

## Program Error Information

| Name                                  | Address       | Description   | Access    | Updated           |
|---------------------------------------|---------------|---|-----------|-------------------|
| Other Fatal Error Flag                | A401.00       | ON when a fatal error that is not defined for A401.01 to A401.15 occurs. Detailed information is output to the bits of A314.<br>OFF: No other fatal error<br>ON: Other fatal error  |           |                   |
| Program Error Flag (fatal error)      | A401.09       | ON when program contents are incorrect.<br>CPU Unit operation will stop.  | Read-only | When error occurs |
| Program Error Task                    | A294          | This word contains the task number of the task that was being executed when program execution was stopped because of a program error.   | Read-only |                   |
| Instruction Processing Error Flag     | A295.08       | This flag and the Error Flag (ER) will be turned ON when an instruction processing error has occurred and the PLC Setup has been set to stop operation for an instruction error.  | Read-only |                   |
| Indirect DM/EM BCD Error Flag         | A295.09       | This flag and the Access Error Flag (AER) will be turned ON when an indirect DM BCD error has occurred and the PLC Setup has been set to stop operation an indirect DM BCD error. (This error occurs when the content of an indirectly addressed DM word is not BCD although BCD mode has been selected.) | Read-only |                   |
| Illegal Access Error Flag             | A295.10       | This flag and the Access Error Flag (AER) will be turned ON when an illegal access error has occurred and the PLC Setup has been set to stop operation an illegal access error. (This error occurs when a region of memory is accessed illegally.)  | Read-only |                   |
| No END Error Flag                     | A295.11       | ON when there isn't an END(001) instruction in each program within a task   | Read-only |                   |
| Task Error Flag                       | A295.12       | ON when a task error has occurred. The following conditions generate a task error.<br>There isn't even one regular task that is executable (started).<br>There isn't a program allocated to the task.   | Read-only |                   |
| Differentiation Overflow Error Flag   | A295.13       | ON when the allowed value for Differentiation Flags which correspond to differentiation instructions has been exceeded.   | Read-only |                   |
| Illegal Instruction Error Flag        | A295.14       | ON when a program that cannot be executed has been stored.  | Read-only |                   |
| UM Overflow Error Flag                | A295.15       | ON when the last address in UM (User Memory) has been exceeded  | Read-only |                   |
| Program Address Where Program Stopped | A298 and A299 | These words contain the 8-digit binary program address of the instruction where program execution was stopped due to a program error.<br>A298: Rightmost 4 digits, A299: Leftmost 4 digits  | Read-only |                   |

## FAL/FALS Error Information

| Name  | Address      | Description  | Access     | Updated |
|---|--------------|--|------------|---------|
| FAL Error Flag (non-fatal error)            | A402.15      | ON when a non-fatal error is generated by executing FAL(006). The CPU Unit will continue operating.  | Read-only  |         |
| Executed FAL Number Flags                   | A360 to A391 | The flag corresponding to the specified FAL number will be turned ON when FAL(006) is executed. Bits A360.01 to A391.15 correspond to FAL numbers 001 to 511.  | Read-only  |         |
| FALS Error Flag (fatal error)               | A401.06      | ON when a fatal error is generated by the FALS(007) instruction. The CPU Unit will stop operating.   | Read-only  |         |
| FAL/FALS Number for System Error Simulation | A529         | Set a dummy FAL/FALS number to use to simulate the system error using FAL(006) or FALS(007).<br>Set the FAL/FALS number.<br>0001 to 01FF hex: FAL/FALS numbers 1 to 511<br>0000 or 0200 to FFFF hex: No FAL/FALS number for system error simulation. (No error will be generated.) | Read/write |         |

## PLC Setup Error Information

| Name                                   | Address | Description   | Access    | Updated |
|--|---------|---|-----------|---------|
| PLC Setup Error Flag (non-fatal error) | A402.10 | ON when there is a setting error in the PLC Setup.  | Read-only |         |
| PLC Setup Error Location               | A406    | When there is a setting error in the PLC Setup, the location of that error is written to A406 in 4-digit hexadecimal. | Read-only |         |

## I/O Information

| Name                                   | Address            | Description  | Access    | Updated |
|--|--------------------|--|-----------|---------|
| Too Many I/O Points Flag (fatal error) | A401.11            | ON when the number of Expansion Units and Expansion I/O Units exceeds the limit, when the number of words allocated to these Units exceeds the limit, are mounted.   | Read-only |         |
| Too Many I/O Points, Details           | A407.00 to A407.12 | Always 0000 hex.   | Read-only |         |
| Too Many I/O Points, Cause             | A407.13 to A407.15 | The 3-digit binary value of these bits indicates the cause of the Too Many I/O Points Error.<br>010: Too many words<br>011: Too many Units   | Read-only |         |
| I/O Bus Error Flag (fatal error)       | A401.14            | ON in the following cases:<br><ul style="list-style-type: none"> <li>When an error occurs in a data transfer between the CPU Unit and a Expansion Unit or Expansion I/O Unit. If this happens, 0A0A hex will be output to A404.</li> <li>When an error occurs in a data transfer between the CPU Unit. If this happens, 0000 hex will be output to A404 to indicate the first Unit, 0001 hex to indicate the second Unit, and 0F0F hex to indicate an undetermined Unit.</li> </ul> CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light.<br>(This flag will be turned OFF when the error is cleared.) | Read-only |         |
| I/O Bus Error Slot Number              | A404               | Contains information on I/O bus errors.<br>The CPU Unit will stop operating and the ERR/ALM indicator on the front of the CPU Unit will light.<br>(A401.14 (I/O Bus Error Flag) will turn ON.)<br>(This information will be cleared when the error is cleared.)<br>0A0A hex: Expansion Unit or Expansion I/O Unit error  | Read-only |         |
| Duplication Error Flag (fatal error)   | A401.13            | ON in the following cases:<br><ul style="list-style-type: none"> <li>Two CPU Bus Units have been assigned the same unit number.</li> </ul>   | Read-only |         |
| Unit Error Flags                       | A436.00 to A436.05 | ON when an error occurs in an Expansion Unit or Expansion I/O Unit.<br>A436.00: 1st Unit<br>A436.01: 2nd Unit<br>A436.02: 3rd Unit<br>A436.03: 4th Unit<br>A436.04: 5th Unit<br>A436.05: 6th Unit<br>CP1W-AD041/DA041, CP1W-32ER/32ET/32ET1, CP1W-TS002 and CP1W-TS102 are each counted as two Units.  | Read-only |         |
| Number of Connected Units              | A437               | Stores the number of Expansion Units and Expansion I/O Units connected as a hexadecimal number.<br><br><b>Note</b> This information is valid only when a Too Many I/O Points error has occurred. CP1W-AD041/DA041, CP1W-32ER/32ET/32ET1, CP1W-TS002 and CP1W-TS102 are each counted as two Units.  | Read-only |         |

## Ethernet Controller Stop Error

| Name                           | Address | Description  | Access    | Updated |
|--------------------------------|---------|--|-----------|---------|
| Ethernet Controller Stop Error | A401.04 | ON when the Ethernet controller stops because of sum value of MAC address error or controller error. | Read-only |         |



## Other PLC Operating Information

| Name                                   | Address | Description  | Access     | Updated              |
|--|---------|--|------------|----------------------|
| Battery Error Flag (non-fatal error)   | A402.04 | ON if the CPU Unit's battery is disconnected or its voltage is low and the Detect Battery Error setting has been set in the PLC Setup.   | Read-only  |                      |
| Cycle Time Too Long Flag (fatal error) | A401.08 | ON if the cycle time exceeds the maximum cycle time set in the PLC Setup (the cycle time monitoring time).   | Read-only  |                      |
| FPD Teaching Bit                       | A598.00 | Turn this bit ON to set the monitoring time automatically with the teaching function.  | Read/write |                      |
| Option Board Error Flag                | A315.13 | ON when the Option Board is removed while the power is being supplied.<br>CPU Unit operation will continue and the ERR/ALM indicator will flash.<br>OFF when the error has been cleared. | Read-only  | When an error occurs |
| Flash Memory Error Flag                | A315.15 | ON when writing to the internal flash memory fails.<br>CPU Unit operation will continue and the ERR/ALM indicator will flash.<br>OFF when the error has been cleared.                    | Read-only  | When an error occurs |
| Other Fatal Error Flag                 | A402.00 | ON when a non-fatal error that is not defined for A402.01 to A402.15 occurs. Detailed information is output to the bits of A315.<br>OFF: No other fatal error<br>ON: Other fatal error   | Read-only  | When an error occurs |

## Clock

## Clock Information

| Name       | Address  | Description   | Access    | Updated |
|------------|--|---|-----------|---------|
| Clock Data | The clock data from the clock built into the CPU Unit is stored here in BCD. |   | Read-only |         |
|            | A351.00 to A351.07   | Seconds: 00 to 59 (BCD)   |           |         |
|            | A351.08 to A351.15   | Minutes: 00 to 59 (BCD)   |           |         |
|            | A352.00 to A352.07   | Hour: 00 to 23 (BCD)  |           |         |
|            | A352.08 to A352.15   | Day of the month: 01 to 31 (BCD)  |           |         |
|            | A353.00 to A353.07   | Month: 01 to 12 (BCD)   |           |         |
|            | A353.08 to A353.15   | Year: 00 to 99 (BCD)  |           |         |
|            | A354.00 to A354.07   | Day of the week: 00: Sunday, 01: Monday, 02: Tuesday, 03: Wednesday, 04: Thursday, 05: Friday, 06: Saturday |           |         |

**Note** The clock data is stored in the CPU Unit as BCD.

## Operation Start and End Times

| Name                 | Address      | Description  | Access     | Updated |
|----------------------|--------------|--|------------|---------|
| Operation Start Time | A515 to A517 | The time that operation started as a result of changing the operating mode to RUN or MONITOR mode is stored here in BCD.<br>A515.00 to A515.07: Seconds (00 to 59)<br>A515.08 to A515.15: Minutes (00 to 59)<br>A516.00 to A516.07: Hour (00 to 23)<br>A516.08 to A516.15: Day of month (01 to 31)<br>A517.00 to A517.07: Month (01 to 12)<br>A517.08 to A517.15: Year (00 to 99)<br><b>Note</b> The previous start time is stored after turning ON the power supply until operation is started.   | Read/write |         |
| Operation End Time   | A518 to A520 | The time that operation stopped as a result of changing the operating mode to PROGRAM mode is stored here in BCD.<br>A518.00 to A518.07: Seconds (00 to 59)<br>A518.08 to A518.15: Minutes (01 to 59)<br>A519.00 to A519.07: Hour (00 to 23)<br>A519.08 to A519.15: Day of month (01 to 31)<br>A520.00 to A520.07: Month (01 to 12)<br>A520.08 to A520.15: Year (00 to 99)<br><b>Note</b> If an error occurs in operation, the time of the error will be stored. If the operating mode is then changed to PROGRAM mode, the time that PROGRAM mode was entered will be stored. | Read/write |         |

## Power Supply Information

| Name                          | Address       | Description   | Access     | Updated |
|-------------------------------|---------------|---|------------|---------|
| Startup Time                  | A510 and A511 | These words contain the time at which the power was turned ON. The contents are updated every time that the power is turned ON. The data is stored in BCD.<br>A510.00 to A510.07: Second (00 to 59)<br>A510.08 to A510.15: Minute (00 to 59)<br>A511.00 to A511.07: Hour (00 to 23)<br>A511.08 to A511.15: Day of month (01 to 31)  | Read/write |         |
| Power Interruption Time       | A512 and A513 | These words contain the time at which the power was interrupted. The contents are updated every time that the power is interrupted. The data is stored in BCD.<br>A512.00 to A512.07: Second (00 to 59)<br>A512.08 to A512.15: Minute (00 to 59)<br>A513.00 to A513.07: Hour (00 to 23)<br>A513.08 to A513.15: Day of month (01 to 31)<br>(These words are not cleared at startup.) | Read/write |         |
| Number of Power Interruptions | A514          | Contains the number of times that power has been interrupted since the power was first turned ON. The data is stored in binary. To reset this value, overwrite the current value with 0000.   | Read/write |         |
| Total Power ON Time           | A523          | Contains the total time that the PLC has been ON in 10-hour units. The data is stored in binary and it is updated every 10 hours. To reset this value, overwrite the current value with 0000.   | Read/write |         |

## Flash Memory Backup Information

| Name              | Address    | Description   | Access    | Updated |
|-------------------|------------|---|-----------|---------|
| User Program Date | A90 to A93 | These words contain in BCD the date and time that the user program was last overwritten.<br>A90.00 to A90.07: Seconds (00 to 59)<br>A90.08 to A90.15: Minutes (00 to 59)<br>A91.00 to A91.07: Hour (00 to 23)<br>A91.08 to A91.15: Day of month (01 to 31)<br>A92.00 to A92.07: Month (01 to 12)<br>A92.08 to A92.15: Year (00 to 99)<br>A93.00 to A93.07: Day of the week (00 to 06)<br>(00: Sunday, 01: Monday, 02: Tuesday, 03: Wednesday, 04: Thursday, 05: Friday, 06: Saturday) | Read-only |         |
| Parameter Date    | A94 to A97 | These words contain in BCD the date and time that the parameters were last overwritten.<br>A94.00 to A94.07: Seconds (00 to 59)<br>A94.08 to A94.15: Minutes (00 to 59)<br>A95.00 to A95.07: Hour (00 to 23)<br>A95.08 to A95.15: Day of month (01 to 31)<br>A96.00 to A96.07: Month (01 to 12)<br>A96.08 to A96.15: Year (00 to 99)<br>A97.00 to A97.07: Day of the week (00 to 06)<br>(00: Sunday, 01: Monday, 02: Tuesday, 03: Wednesday, 04: Thursday, 05: Friday, 06: Saturday)  | Read-only |         |

## Memory Cassette Information

| Name                                 | Address | Description   | Access    | Updated |
|--------------------------------------|---------|---|-----------|---------|
| Memory Cassette Access Status        | A342    | <p>A342.03: ON when data is being written to the Memory Cassette or the Memory Cassette is being initialized. OFF when processing has been completed.</p> <p>A342.04: ON when data is being read from the Memory Cassette. OFF when processing has been completed.</p> <p>A342.05: ON when data is being compared with data on the Memory Cassette. OFF when processing has been completed.</p> <p>A342.07: ON when an error occurs in initializing the Memory Cassette.<br/>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).</p> <p>A342.08: ON when an error occurs in writing the Memory Cassette.<br/>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).</p> <p>A342.10: ON when an error occurs in reading or comparing the Memory Cassette.<br/>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).</p> <p>A342.12: ON when the data in the CPU Unit is not the same as the data in the Memory Cassette when a verification operation is performed.<br/>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).</p> <p>A342.13: ON when the Memory Cassette is being accessed. OFF when processing has been completed.</p> <p>A342.15: ON when a Memory Cassette is mounted.<br/>OFF when a Memory Cassette is not mounted.</p> | Read-only |         |
| Memory Cassette Verification Results | A494    | <p>Stores the results of comparing data in the Memory Cassette and CPU Unit. Each bit turns ON to indicate status.</p> <p>A494.00: User program is different.</p> <p>A494.01: Function block sources are different.</p> <p>A494.02: Parameter area is different.</p> <p>A494.03: Symbol table is different.</p> <p>A494.04: Comments are different.</p> <p>A494.05: Program indices are different.</p> <p>A494.06: Data memory is different.</p> <p>A494.07: DM initial values are different.</p>   | Read-only |         |

## Information on Read Protection Using a Password

| Name   | Address | Description  | Access    | Updated |
|--|---------|--|-----------|---------|
| UM Read Protection Flag                      | A99.00  | Indicates whether the entire user program in the PLC is read-protected.<br>OFF: UM not read-protected.<br>ON: UM read-protected. | Read-only |         |
| Task Read Protection Flag                    | A99.01  | Indicates whether read protection is set for individual tasks.<br>OFF: Tasks not read-protected.<br>ON: Tasks read-protected.    | Read-only |         |
| Program Write Protection for Read Protection | A99.02  | Indicates whether the program is write-protected.<br>OFF: Write-enabled.<br>ON: Write-protected.                                 | Read-only |         |
| Enable/Disable Bit for Program Backup        | A99.03  | Indicates whether creating a backup program file (.OBJ) is enabled or disabled.<br>OFF: Enabled.<br>ON: Disabled.                | Read-only |         |

## Communications

### Ethernet Status

| Name                          | Address | Description  | Access    | Updated |
|-------------------------------|---------|--|-----------|---------|
| Link Status Flag              | A45.14  | ON while a link is established between hubs.<br>OFF while a link is terminated.  | Read-only |         |
| IP Address Setting Error Flag | A46.02  | ON if any of the following conditions apply to the IP address.<br>• All bits in the host ID are 0 or 1.<br>• All bits in the network ID are 0 or 1.<br>• All bits in the subnet ID are 1.<br>• The IP address begins with 127 (0x7F)<br>OFF when the IP address is normal. | Read-only |         |
| IP Address Table Error Flag   | A46.03  | ON if the IP address table information is incorrect.<br>OFF when the IP address table is normal.   | Read-only |         |
| IP Router Table Error Flag    | A46.04  | ON if the IP router table information is incorrect.<br>OFF when the IP router table is normal.   | Read-only |         |
| DNS Server Error Flag         | A46.05  | ON when the following errors occur during DNS server operation:<br>• An illegal server IP address is set.<br>• A timeout occurs during communications with the server.<br>OFF when DNS server operation is normal.   | Read-only |         |
| Routing Table Error Flag      | A46.06  | ON if the routing table information is incorrect.<br>OFF when the routing table is normal.   | Read-only |         |
| SNTP Server Error Flag        | A46.11  | ON when the following errors occur during SNTP server operation:<br>• An illegal server IP address or host name is set.<br>• A timeout occurs during communications with the server.<br>OFF when SNTP server operation is normal.  | Read-only |         |
| Address Disagreement Flag     | A46.14  | ON if the remote IP address is set to automatic generation but the local IP address host number and FINS node address do not agree.<br>OFF under all other circumstances.  | Read-only |         |
| FINS/TCP Connection Flag 1    | A47.00  | Turned ON by the Unit when a connection is established.<br>Turned OFF by the Unit when the connection is terminated.   | Read-only |         |
| FINS/TCP Connection Flag 2    | A47.01  | Turned ON by the Unit when a connection is established.<br>Turned OFF by the Unit when the connection is terminated.   | Read-only |         |
| FINS/TCP Connection Flag 3    | A47.02  | Turned ON by the Unit when a connection is established.<br>Turned OFF by the Unit when the connection is terminated.   | Read-only |         |

**Ethernet Communication Error**

| Name                                     | Address    | Description   | Access     | Updated |
|--|------------|---|------------|---------|
| Ethernet Communication Error Information | A40 to A44 | When an error has occurred, the error code, error contents, and error's time and date are stored in these AR channels. The most recent error can be stored. | Read-only  |         |
| Ethernet Communication Error Flag        | A46.15     | ON if an Ethernet communication error has occurred. The detail information is stored in A40 to A44.   | Read-only  |         |
| Ethernet Communication Error Clear Flag  | A500.11    | Turn this bit ON to clear Ethernet communication error (Ethernet communication error flag turns OFF).   | Read/write |         |

**Ethernet Service Request**

| Name                              | Address | Description  | Access     | Updated |
|-----------------------------------|---------|--|------------|---------|
| Socket Force-close Switch         | A566.02 | All sockets are forcibly closed when this bit turns ON. Turned OFF by Unit after sockets are closed.                                       | Read/Write |         |
| Automatic Clock Adjustment Switch | A566.04 | The automatic clock adjustment is executed when this bit turns ON. Turned OFF by Unit after automatic clock adjustment has been completed. | Read/Write |         |

**Socket Service****Status of TCP/UDP Sockets 1 to 3**

| Item                       | TCP/UDP Socket No.1 | TCP/UDP Socket No.2 | TCP/UDP Socket No.3 |
|----------------------------|---------------------|---------------------|---------------------|
| Openning Flag              | A567.00             | A568.00             | A569.00             |
| Receiving Flag             | A567.01             | A568.01             | A569.01             |
| Sending Flag               | A567.02             | A568.02             | A569.02             |
| Closing Flag               | A567.03             | A568.03             | A569.03             |
| Data Received Flag         | A567.13             | A568.13             | A569.13             |
| Results Storage Error Flag | A567.14             | A568.14             | A569.14             |
| TCP/UDP Open Flag          | A567.15             | A568.15             | A569.15             |

| Name                       | Description   | Access    | Updated |
|----------------------------|---|-----------|---------|
| Openning Flag              | ON during open processing. (Turns ON when open request is received.)<br>OFF when open processing has been completed.  | Read-only |         |
| Receiving Flag             | ON during receive processing. (Turns ON when receive request is received.)<br>OFF when receive processing has been completed.   | Read-only |         |
| Sending Flag               | ON during send processing. (Turns ON when send request is received.)<br>OFF when send processing has been completed.  | Read-only |         |
| Closing Flag               | ON during close processing. (Turns ON when close request is received.)<br>OFF when close processing has been completed.   | Read-only |         |
| Data Received Flag         | ON when data from a remote node has been received at an open TCP socket.<br>OFF when receive processing has been requested for an open TCP socket.                                | Read-only |         |
| Results Storage Error Flag | ON if there is an error in storing the results when socket services are used by means of the CMND(490) instruction.<br>OFF when the next request is received. (Connected by TCP.) | Read-only |         |
| TCP/UDP Open Flag          | ON when open processing has been completed.<br>OFF when close processing has been completed. (Stays OFF for abnormal open processing completion.)                                 | Read-only |         |

**Socket Service Request Switches**

| Item                            | Socket Service Request Switch 1 | Socket Service Request Switch 2 | Socket Service Request Switch 3 |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| UDP Open Request Switch         | A571.00                         | A571.08                         | A572.00                         |
| TCP Passive Open Request Switch | A571.01                         | A571.09                         | A572.01                         |
| TCP Active Open Request Switch  | A571.02                         | A571.10                         | A572.02                         |
| Send Request Switch             | A571.03                         | A571.11                         | A572.03                         |
| Receive Request Switch          | A571.04                         | A571.12                         | A572.04                         |
| Close Request Switch            | A571.05                         | A571.13                         | A572.05                         |

| Name                            | Description   | Access     | Updated |
|---------------------------------|---|------------|---------|
| UDP Open Request Switch         | UDP socket opened when switch is turned ON. Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).  | Read/Write |         |
| TCP Passive Open Request Switch | Passive TCP socket opened when switch is turned ON. Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).                                | Read/Write |         |
| TCP Active Open Request Switch  | Active TCP socket opened when switch is turned ON. Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).                                 | Read/Write |         |
| Send Request Switch             | Send processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch when send processing has been completed.       | Read/Write |         |
| Receive Request Switch          | Receive processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch when receive processing has been completed. | Read/Write |         |
| Close Request Switch            | Close processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch when close processing has been completed.     | Read/Write |         |

**Networks****Network Communications Information**

| Name                                 | Address            | Description  | Access    | Updated |
|--------------------------------------|--------------------|--|-----------|---------|
| Communications Port Enabled Flags    | A202.00 to A202.07 | ON when a network instruction or background execution can be executed with the corresponding port number. Bits 00 to 07 correspond to communications ports 0 to 7.                         | Read-only |         |
| Communications Port Completion Codes | A203 to A210       | These words contain the completion codes for the corresponding port numbers when network instructions have been executed.<br>Words A203 to A210 correspond to communications ports 0 to 7. | Read-only |         |
| Communications Port Error Flags      | A219.00 to A219.07 | ON when an error occurred during execution of a network instruction.<br>OFF when a normal response is returned.<br>Bits 00 to 07 correspond to communications ports 0 to 7.                | Read-only |         |

**Information When Automatically Allocating Communications Ports**

| Name  | Address            | Description  | Access    | Updated |
|---|--------------------|--|-----------|---------|
| Network Communications Port Allocation Enabled Flag     | A202.15            | ON when there is a communications port available for automatic allocation.<br><b>Note</b> Use this flag to confirm whether a communications port is available for automatic allocation before executing communications instructions when using 9 or more communications instructions simultaneously.   | Read-only |         |
| First Cycle Flags after Network Communications Finished | A214.00 to A214.07 | Each flag will turn ON for just one cycle after communications have been completed. Bits 00 to 07 correspond to ports 0 to 7. Use the Used Communications Port Number stored in A218 to determine which flag to access.<br><b>Note</b> These flags are not effective until the next cycle after the communications instruction is executed. Delay accessing them for at least one cycle.   | Read-only |         |
| First Cycle Flags after Network Communications Error    | A215.00 to A215.07 | Each flag will turn ON for just one cycle after a communications error occurs. Bits 00 to 07 correspond to ports 0 to 7. Use the Used Communications Port Number stored in A218 to determine which flag to access. Determine the cause of the error according to the Communications Port Completion Codes stored in A203 to A210.<br><b>Note</b> These flags are not effective until the next cycle after the communications instruction is executed. Delay accessing them for at least one cycle. | Read-only |         |
| Network Communications Completion Code Storage Address  | A216 to A217       | The completion code for a communications instruction is automatically stored at the address with the I/O memory address given in these words.<br>Place this address into an index register and use indirect addressing through the index register to read the communications completion code.  | Read-only |         |
| Used Communications Port Numbers                        | A218               | Stores the communications port numbers used when a communications instruction is executed using automatic communication port allocations.<br>0000 to 0007 hex: Communications port 0 to 7  | Read-only |         |

**Serial Port 1 Information (CP1L CPU Units with EM CPU Type)**

| Name   | Address            | Description  | Access     | Updated |
|--|--------------------|--|------------|---------|
| Peripheral Port Communications Error Flag                    | A392.12            | ON when a communications error has occurred at the serial port 1.  | Read-only  |         |
| Peripheral Port Restart Bit                                  | A526.01            | Turn this bit ON to restart the serial port 1.   | Read/write |         |
| Peripheral Port Settings Change Bit                          | A619.01            | ON while the serial port 1's communications settings are being changed.  | Read/write |         |
| Peripheral Port Error Flags                                  | A528.08 to A528.15 | These flags indicate what kind of error has occurred at the serial port 1.   | Read/write |         |
| Serial Port 1 Send Ready Flag<br>(No-protocol Mode)          | A392.13            | ON when the serial port 1 is able to send data in no-protocol mode.  | Read-only  |         |
| Serial Port 1 Reception Completed Flag<br>(No-protocol Mode) | A392.14            | ON when the serial port 1 has completed the reception in no-protocol mode.   | Read-only  |         |
| Serial Port 1 Reception Overflow Flag<br>(No-protocol Mode)  | A392.15            | ON when a data overflow occurred during reception through the serial port 1 in no-protocol mode.   | Read-only  |         |
| Peripheral Port PT Communications Flags                      | A394.00 to A394.07 | The corresponding bit will be ON when the serial port 1 is communicating with a PT in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7. | Read-only  |         |
| Peripheral Port PT Priority Registered Flags                 | A394.08 to A394.15 | The corresponding bit will be ON for the PT that has priority when the serial port 1 is communicating in NT link mode.                         | Read-only  |         |
| Serial Port 1 Reception Counter<br>(No-protocol Mode)        | A394.00 to A394.15 | Indicates (in binary) the number of bytes of data received when serial port 1 is in no-protocol mode.  | Read-only  |         |

## Serial Port 1 Information (CP1L CPU Units with EL CPU Type)

| Name  | Address            | Description   | Access     | Updated |
|---|--------------------|---|------------|---------|
| Serial Port 1 Communications Error Flag                   | A392.04            | ON when a communications error has occurred at the serial port 1.<br><b>Note</b> Not supported for 1:N NT Link Mode.  | Read-only  |         |
| Serial Port 1 Restart Bit                                 | A526.00            | Turn this bit ON to restart the serial port 1.  | Read/write |         |
| Serial Port 1 Settings Change Bit                         | A619.02            | ON while the serial port 1's communications settings are being changed.   | Read/write |         |
| Serial Port 1 Error Flags                                 | A528.00 to A528.07 | These flags indicate what kind of error has occurred at the serial port 1.  | Read/write |         |
| Serial Port 1 Send Ready Flag (No-protocol mode)          | A392.05            | ON when the serial port 1 is able to send data in no-protocol mode.   | Read-only  |         |
| Serial Port 1 Reception Completed Flag (No-protocol Mode) | A392.06            | ON when the serial port 1 has completed the reception in no-protocol mode.  | Read-only  |         |
| Serial Port 1 Reception Overflow Flag (No-protocol mode)  | A392.07            | ON when a data overflow occurred during reception through the serial port 1 in no-protocol mode.  | Read-only  |         |
| Serial Port 1 PT Communications Flags                     | A393.00 to A393.07 | The corresponding bit will be ON when the serial port 1 is communicating with a PT in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7.                    | Read-only  |         |
| Serial Port 1 PT Priority Registered Flags                | A393.08 to A393.15 | The corresponding bit will be ON for the PT that has priority when the serial port 1 is communicating in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7. | Read-only  |         |
| Serial Port 1 Reception Counter (No-protocol Mode)        | A393.00 to A393.15 | Indicates (in binary) the number of bytes of data received when serial port 1 is in no-protocol mode.   | Read-only  |         |

## Serial Port 2 Information (CP1L CPU Units with EM CPU Type)

| Name  | Address            | Description  | Access     | Updated |
|---|--------------------|--|------------|---------|
| Serial Port 2 Communications Error Flag                   | A392.04            | ON when a communications error has occurred at the serial port 2.  | Read-only  |         |
| Serial Port 2 Restart Bit                                 | A526.00            | Turn this bit ON to restart the serial port 2.   | Read/write |         |
| Serial Port 2 Settings Change Bit                         | A619.02            | ON while the serial port 2's communications settings are being changed.  | Read/write |         |
| Serial Port 2 Error Flags                                 | A528.00 to A528.07 | These flags indicate what kind of error has occurred at the serial port 2.   | Read/write |         |
| Serial Port 2 Send Ready Flag (No-protocol mode)          | A392.05            | ON when the serial port 2 is able to send data in no-protocol mode.  | Read-only  |         |
| Serial Port 2 Reception Completed Flag (No-protocol Mode) | A392.06            | ON when the serial port 2 has completed the reception in no-protocol mode.   | Read-only  |         |
| Serial Port 2 Reception Overflow Flag (No-protocol mode)  | A392.07            | ON when a data overflow occurred during reception through the serial port 2 in no-protocol mode.   | Read-only  |         |
| Serial Port 2 PT Communications Flags                     | A393.00 to A393.07 | The corresponding bit will be ON when the serial port 2 is communicating with a PT in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7. | Read-only  |         |
| RS-232C Port PT Priority Registered Flags                 | A393.08 to A393.15 | The corresponding bit will be ON for the PT that has priority when the serial port 2 is communicating in NT link mode.                         | Read-only  |         |
| RS-232C Port Reception Counter (No-protocol Mode)         | A393.00 to A393.15 | Indicates (in binary) the number of bytes of data received when serial port 2 is in no-protocol mode.  | Read-only  |         |



**Modbus-RTU Easy Master Information (CP1L CPU Units with EM CPU Type)**

| Name  | Address | Description   | Access    | Updated |
|---|---------|---|-----------|---------|
| Serial Port 1 Modbus-RTU Master Execution Bit         | A641.00 | Turn ON this bit to send a command and receive a response for serial port 1 using the Modbus-RTU easy master function.<br>This bit will be turned OFF automatically by the system when communications have been completed.<br>Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. | Read-only |         |
| Serial Port 1 Modbus-RTU Master Execution Normal Flag | A641.01 | ON when one command has been sent and the response received for serial port 1 using the Modbus-RTU easy master function.<br>ON: Execution normal.<br>OFF: Execution error or still in progress.   | Read-only |         |
| Serial Port 1 Modbus-RTU Master Execution Error Flag  | A641.02 | ON when an error has occurred in communications for serial port 1 using the Modbus-RTU easy master function. The error code is output to D32352 in the DM fixed allocation words for Modbus-RTU Easy Master.<br>ON: Execution error.<br>OFF: Execution normal or still in progress.   | Read-only |         |
| Serial Port 2 Modbus-RTU Master Execution Bit         | A640.00 | Turn ON this bit to send a command and receive a response for serial port 2 using the Modbus-RTU easy master function.<br>This bit will be turned OFF automatically by the system when communications have been completed.<br>Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. | Read-only |         |
| Serial Port 2 Modbus-RTU Master Execution Normal Flag | A640.01 | ON when one command has been sent and the response received for serial port 2 using the Modbus-RTU easy master function.<br>ON: Execution normal.<br>OFF: Execution error or still in progress.   | Read-only |         |
| Serial Port 2 Modbus-RTU Master Execution Error Flag  | A640.02 | ON when an error has occurred in communications for serial port 2 using the Modbus-RTU easy master function. The error code is output to D32252 in the DM fixed allocation words for Modbus-RTU Easy Master.<br>ON: Execution error.<br>OFF: Execution normal or still in progress.   | Read-only |         |

**Note** DM fixed allocation words for Modbus-RTU Easy Master for serial port 1: D32200 to D32299  
DM fixed allocation words for Modbus-RTU Easy Master for serial port 2: D32300 to D32399

**Modbus-RTU Easy Master Information (CP1L CPU Units with EL CPU Type)**

| Name  | Address | Description   | Access    | Updated |
|---|---------|---|-----------|---------|
| Serial Port 1 Modbus-RTU Master Execution Bit         | A640.00 | Turn ON this bit to send a command and receive a response for serial port 2 using the Modbus-RTU easy master function.<br>This bit will be turned OFF automatically by the system when communications have been completed.<br>Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. | Read-only |         |
| Serial Port 1 Modbus-RTU Master Execution Normal Flag | A640.01 | ON when one command has been sent and the response received for serial port 2 using the Modbus-RTU easy master function.<br>ON: Execution normal.<br>OFF: Execution error or still in progress.   | Read-only |         |
| Serial Port 1 Modbus-RTU Master Execution Error Flag  | A640.02 | ON when an error has occurred in communications for serial port 2 using the Modbus-RTU easy master function. The error code is output to D32252 in the DM fixed allocation words for Modbus-RTU Easy Master.<br>ON: Execution error.<br>OFF: Execution normal or still in progress.   | Read-only |         |

**Note** DM fixed allocation words for Modbus-RTU Easy Master for serial port 2: D32300 to D32399

## Instruction-related Information

| Name                    | Address      | Description  | Access     | Updated |
|-------------------------|--------------|--|------------|---------|
| Step Flag               | A200.12      | ON for one cycle when step execution is started with STEP(008).  | Read-only  |         |
| Macro Area Input Words  | A600 to A603 | Before the subroutine specified in MCRO(099) is executed, the source words for the subroutine are transferred to A600 through A603 (input parameter words).                                      | Read/write |         |
| Macro Area Output Words | A604 to A607 | After the subroutine specified in MCRO(099) has been executed, the results of the subroutine are transferred from A604 through A607 to the specified destination words (output parameter words). | Read/write |         |

## Function Block Information

### Function Block Memory Information

| Name                 | Address | Description   | Access    | Updated |
|----------------------|---------|---|-----------|---------|
| FB Program Data Flag | A345.00 | Turns ON if the FB program memory contains FB program data.<br>OFF: No data<br>ON: Data present | Read-only |         |

### OMRON FB Library Information

| Name   | Address            | Description  | Access    | Updated |
|--|--------------------|--|-----------|---------|
| FB Communications Instruction Response Required                  | A580.15            | 0: Not required<br>1: Required   | Read-only |         |
| FB Communications Instruction Port No.                           | A580.08 to A580.11 | 0 to 7 hex: Communications port No. 0 to 7<br>F hex: Automatic allocation  | Read-only |         |
| FB Communications Instruction Retries                            | A580.00 to A580.03 | Automatically stores the number of retries in the FB communications instruction settings specified in the PLC Setup.   | Read-only |         |
| FB Communications Instruction Response Monitoring Time           | A581               | Automatically stores the FB communications instruction response monitoring time set in the PLC Setup.<br>0001 to FFFF hex (Unit: 0.1 s; Range: 0.1 to 6553.5)<br>0000 hex: 2 s           | Read-only |         |
| FB DeviceNet Communications Instruction Response Monitoring Time | A582               | Automatically stores the FB DeviceNet communications instruction response monitoring time set in the PLC Setup.<br>0001 to FFFF hex (Unit: 0.1 s; Range: 0.1 to 6553.5)<br>0000 hex: 2 s | Read-only |         |

**Note** These Auxiliary Area bits/words are not to be written by the user. The number of resends and response monitoring time must be set by the user in the FB communications instructions settings in the PLC Setup, particularly when using function blocks from the OMRON FB Library to execute FINS messages or DeviceNet explicit messages communications. The values set in the Settings for OMRON FB Library in the PLC Setup will be automatically stored in the related Auxiliary Area words A580 to A582 and used by the function blocks from the OMRON FB Library.

## Option Board Status Area

### CP1L CPU Units with EM CPU Type

| Name   | Address | Description   | Access    | Updated |
|--|---------|---|-----------|---------|
| I/O Option Board Run State Flag (Option 1/left)  | A435.14 | Turn ON when the I/O Option Board works normally.<br>Turn OFF when the I/O Option Board is in initial state or abnormality state. | Read-only |         |
| I/O Option Board Run State Flag (Option 2/right) | A435.15 | Turn ON when the I/O Option Board works normally.<br>Turn OFF when the I/O Option Board is in initial state or abnormality state. | Read-only |         |

### CP1L CPU Units with EL CPU Type

| Name                                       | Address | Description   | Access    | Updated |
|--|---------|---|-----------|---------|
| I/O Option Board Run State Flag (Option 1) | A435.15 | Turn ON when the I/O Option Board works normally.<br>Turn OFF when the I/O Option Board is in initial state or abnormality state. | Read-only |         |

# Appendix D

## Auxiliary Area Allocations by Address

### Read-only Area (Set by System)

| Address     |      | Name                                     | Function   | Settings | Status after mode change | Status at start-up | Write timing                          | Related flags, settings |
|-------------|------|--|--|----------|--------------------------|--------------------|---------------------------------------|-------------------------|
| Words       | Bits |  |  |          |                          |                    |                                       |                         |
| A0          | ---  | 10-ms Incrementing Free Running Timer    | <p>This word contains the system timer used after the power is turned ON.</p> <p>A value of 0000 hex is set when the power is turned ON and this value is automatically incremented by 1 every 10 ms. The value returns to 0000 hex after reaching FFFF hex (655,350 ms), and then continues to be automatically incremented by 1 every 10 ms.</p> <p><b>Note:</b> The timer will continue to be incremented when the operating mode is switched to RUN mode.</p> <p>Example: The interval can be counted between processing A and processing B without requiring timer instructions. This is achieved by calculating the difference between the value in A0 for processing A and the value in A0 for processing B. The interval is counted in 10 ms units.</p>      | ---      | Retained                 | Cleared            | Every 10 ms after power is turned ON  | ---                     |
| A1          | ---  | 100-ms Incrementing Free Running Timer   | <p>This word contains the system timer used after the power is turned ON.</p> <p>A value of 0000 hex is set when the power is turned ON and this value is automatically incremented by 1 every 100 ms. The value returns to 0000 hex after reaching FFFF hex (6,553,500 ms), and then continues to be automatically incremented by 1 every 100 ms.</p> <p><b>Note:</b> The timer will continue to be incremented when the operating mode is switched to RUN mode.</p> <p>Example: The interval can be counted between processing A and processing B without requiring timer instructions. This is achieved by calculating the difference between the value in A0 for processing A and the value in A0 for processing B. The interval is counted in 100 ms units.</p> | ---      | Retained                 | Cleared            | Every 100 ms after power is turned ON | ---                     |
| A20 and A21 | ---  | Present Value of Unsigned Output Value 0 | <p>These words contain the present value of the unsigned output value (output value = present value of error counter <math>\times</math> error counter cycle (s) <math>\times</math> gain) for inverter positioning 0.</p> <p>Data range: 0000 0000 to 8000 0000 hex (0 to 2,147,483,648)</p> <p>The maximum and minimum output values set for inverter positioning 0 in the PLC Setup are applied.</p> <p>A21 contains the leftmost 4 digits and A20 contains the rightmost 4 digits.</p>   | ---      | ---                      | Cleared            | Every error counter 0 cycle           | ---                     |

| Address     |      | Name                                   | Function  | Settings   | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|-------------|------|--|---|--|--------------------------|--------------------|--|-------------------------|
| Words       | Bits |  |   |  |                          |                    |  |                         |
| A22         | ---  | Error Counter 0 Present Value, Signed  | This word contains the present value of the error counter for inverter positioning 0.<br>Data range: 8000 to 7FFF hex (–32,768 to 32,767) (signed)  | ---  | ---                      | Cleared            | Every error counter 0 cycle  | ---                     |
| A23         | ---  | Inverter Frequency 0 Command Value     | This word contains the automatically calculated frequency command value for the inverter for inverter positioning 0.<br>Data range: 0000 to FFFF hex (0.00 to 655.35 Hz) (0.01-Hz increments, unsigned)<br>Set the Power Supply Frequency for One Motor Revolution per Second, Number of Encoder Pulses for One Motor Revolution, and Error Counter Cycle for inverter positioning 0 in the PLC Setup before using this value.                      | ---  | ---                      | Cleared            | Every error counter 0 cycle  | ---                     |
| A24 and A25 | ---  | Present Value of Signed Output Value 0 | These words contain the present value of the signed output value (output value = present value of error counter × error counter cycle (s) × gain) for inverter positioning 0.<br>Data range: 8000 0000 to 7FFF FFFF hex (–214,748,348 to 214,748,347) (signed)<br>The maximum and minimum output values set for inverter positioning 0 in the PLC Setup are applied.<br>A25 contains the leftmost 4 digits and A24 contains the rightmost 4 digits. | ---  | ---                      | Cleared            | Every error counter 0 cycle  | ---                     |
| A26         | 00   | Operation Command Flag 0               | This flag turns ON during an operation command for inverter positioning 0.  | ON: Operation command executed.<br>OFF: Stop command executed.                 | ---                      | Cleared            | When inverter positioning 0 is started   | ---                     |
|             | 01   | Forward Operation Command Flag 0       | This flag turns ON during a forward operation command for inverter positioning 0.   | ON: Forward command in progress<br>OFF: Reverse command in progress or stopped | ---                      | Cleared            | When present value of error counter 0 is positive  | ---                     |
|             | 02   | Reverse Operation Command Flag 0       | This flag turns ON during a reverse operation command for inverter positioning 0.   | ON: Reverse command in progress<br>OFF: Forward command in progress or stopped | ---                      | Cleared            | When present value of error counter 0 is negative  | ---                     |
|             | 03   | In-position Flag 0                     | This flag turns ON when inverter positioning 0 is in position.  | ON: In position<br>OFF: Not in position  | ---                      | Cleared            | When pulse output to error counter 0 is stopped and the present value of error counter 0 is within the in-position range | ---                     |

| Address     |      | Name  | Function  | Settings  | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|-------------|------|---|---|---|--------------------------|--------------------|---|-------------------------|
| Words       | Bits |   |   |   |                          |                    |   |                         |
| A26         | 04   | Error Counter Error Flag 0                                  | This flag turns ON when an error occurs in the error counter for inverter positioning 0.  | ON: Error counter error<br>OFF: No error  | ---                      | Cleared            | When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter error detection value | ---                     |
|             | 05   | Error Counter Pulse Output Flag 0                           | This flag is ON while pulses are being output to the output counter for inverter positioning 0.   | ON: Pulses being output<br>OFF: Pulse output stopped  | ---                      | Cleared            | When pulse output to error counter 0 is started   | ---                     |
|             | 06   | Error Counter Pulse Output Acceleration/Deceleration Flag 0 | This flag is ON while pulse output to the output counter for inverter positioning 0 is accelerating or decelerating.  | ON: Pulse output to the error counter is accelerating or decelerating (i.e., the frequency is changing)<br>OFF: Pulse output to the error counter is constant | ---                      | Cleared            | When pulse output frequency to error counter is changed by ACC or PLS2 instruction  | ---                     |
|             | 07   | Error Counter Alarm Flag 0                                  | This flag turns ON when an alarm occurs in the error counter for inverter positioning 0.  | ON: Error counter alarm<br>OFF: No error counter alarm  | ---                      | Cleared            | When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter alarm detection value | ---                     |
|             | 15   | Inverter Positioning Output Value Sign Flag 0               | This flag is ON when the inverter positioning 0 output value is positive and is OFF when it is negative.  | ON: Positive value<br>OFF: Negative value   | ---                      | Cleared            | When signed output value is between 0000 0000 and 7FFF FFFF hex   | ---                     |
| A28 and A29 | ---  | Present Value of Pulse Output to Inverter 0, Relative Value | These words contain the relative value of the internal pulse output when pulses are being output to the error counter for inverter positioning 0.<br><br>Data range: 8000 0000 to 7FFF FFFF hex (–2,147,483,648 to 2,147,483,647) | ---   | ---                      | Cleared            | Every error counter 0 cycle   | ---                     |

| Address     |      | Name                                     | Function  | Settings   | Status after mode change | Status at start-up | Write timing                                      | Related flags, settings |
|-------------|------|--|---|--|--------------------------|--------------------|---|-------------------------|
| Words       | Bits |  |   |  |                          |                    |   |                         |
| A30 and A31 | ---  | Present Value of Unsigned Output Value 1 | These words contain the present value of the unsigned output value (output value = present value of error counter × error counter cycle (s) × gain) for inverter positioning 1.<br>Data range: 0000 0000 to 8000 0000 hex (0 to 2,147,483,648)<br>The maximum and minimum output values set for inverter positioning 1 in the PLC Setup are applied.<br>A30 contains the leftmost 4 digits and A31 contains the rightmost 4 digits.                 | ---  | ---                      | Cleared            | Every error counter 1 cycle                       | ---                     |
| A32         | ---  | Error Counter 1 Present Value, Signed    | This word contains the present value of the error counter for inverter positioning 1.<br>Data range: 8000 to 7FFF hex (–32,768 to 32,767) (signed)  | ---  | ---                      | Cleared            | Every error counter 1 cycle                       | ---                     |
| A33         | ---  | Inverter Frequency Command Value 1       | This word contains the automatically calculated frequency command value for the inverter for inverter positioning 1.<br>Data range: 0000 to FFFF hex (0.00 to 655.35 Hz) (0.01-Hz increments, unsigned)<br>Set the Power Supply Frequency for One Motor Revolution per Second, Number of Encoder Pulses for One Motor Revolution, and Error Counter Cycle in the PLC Setup before using this value.   | ---  | ---                      | Cleared            | Every error counter 1 cycle                       | ---                     |
| A34 and A35 | ---  | Present Value of Signed Output Value 1   | These words contain the present value of the signed output value (output value = present value of error counter × error counter cycle (s) × gain) for inverter positioning 1.<br>Data range: 8000 0000 to 7FFF FFFF hex (–214,748,348 to 214,748,347) (signed)<br>The maximum and minimum output values set for inverter positioning 1 in the PLC Setup are applied.<br>A34 contains the leftmost 4 digits and A35 contains the rightmost 4 digits. | ---  | ---                      | Cleared            | Every error counter 1 cycle                       | ---                     |
| A36         | 00   | Operation Command Flag 1                 | This flag turns ON during an operation command for inverter positioning 1.  | ON: Operation command executed.<br>OFF: Stop command executed.                 | ---                      | Cleared            | When inverter positioning 1 is started            | ---                     |
|             | 01   | Forward Operation Command Flag 1         | This flag turns ON during a forward operation command for inverter positioning 1.   | ON: Forward command in progress<br>OFF: Reverse command in progress or stopped | ---                      | Cleared            | When present value of error counter 1 is positive | ---                     |
|             | 02   | Reverse Operation Command Flag 1         | This flag turns ON during a reverse operation command for inverter positioning 1.   | ON: Reverse command in progress<br>OFF: Forward command in progress or stopped | ---                      | Cleared            | When present value of error counter 1 is negative | ---                     |

| Address |      | Name  | Function   | Settings  | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|---------|------|---|--|---|--------------------------|--------------------|---|-------------------------|
| Words   | Bits |   |  |   |                          |                    |   |                         |
| A36     | 03   | In-position Flag 1  | This flag turns ON when inverter positioning 1 is in position.   | ON: In position<br>OFF: Not in position   | ---                      | Cleared            | When pulse output to error counter 1 is stopped and the present value of error counter 1 is within the in-position range  | ---                     |
|         | 04   | Error Counter Error Flag 1                                  | This flag turns ON when an error occurs in the error counter for inverter positioning 1.                             | ON: Error counter error<br>OFF: No error  | ---                      | Cleared            | When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter error detection value | ---                     |
|         | 05   | Error Counter Pulse Output Flag 1                           | This flag is ON while pulses are being output to the output counter for inverter positioning 1.                      | ON: Pulses being output<br>OFF: Pulse output stopped  | ---                      | Cleared            | When pulse output to error counter 1 is started   | ---                     |
|         | 06   | Error Counter Pulse Output Acceleration/Deceleration Flag 1 | This flag is ON while pulse output to the output counter for inverter positioning 1 is accelerating or decelerating. | ON: Pulse output to the error counter is accelerating or decelerating (i.e., the frequency is changing)<br>OFF: Pulse output to the error counter is constant | ---                      | Cleared            | When pulse output frequency to error counter is changed by ACC or PLS2 instruction  | ---                     |
|         | 07   | Error Counter Alarm Flag 1                                  | This flag turns ON when an alarm occurs in the error counter for inverter positioning 1.                             | ON: Error counter alarm<br>OFF: No error counter alarm  | ---                      | Cleared            | When pulse output to error counter is stopped and absolute value of error counter present value is greater than or equal to error counter alarm detection value | ---                     |
|         | 15   | Inverter Positioning Output Value Sign Flag 1               | This flag is ON when the inverter positioning 1 output value is positive and is OFF when it is negative.             | ON: Positive value<br>OFF: Negative value   | ---                      | Cleared            | When signed output value is between FFFF FFFF and 8000 0000   | ---                     |

| Address     |      | Name  | Function   | Settings   | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|-------------|------|---|--|--|--------------------------|--------------------|---|-------------------------|
| Words       | Bits |   |  |  |                          |                    |   |                         |
| A38 and A39 | All  | Present Value of Pulse Output to Inverter 1, Relative Value | These words contain the relative value of the internal pulse output when pulses are being output to the error counter for inverter positioning 1.<br>Data range: 8000 0000 to 7FFF FFFF hex (–2,147,483,648 to 2,147,483,647)<br>A38 contains the leftmost 4 digits and A39 contains the rightmost 4 digits.   | ---  | ---                      | Cleared            | Every error counter 1 cycle                         | ---                     |
| A40 to A44  | All  | Ethernet Communication Error Information                    | When an error has occurred, the error code, error contents, and error's time and date are stored in these AR channels. The most recent error can be stored. The function of these 5 words is as follows:<br>1) Error code (bits 0 to 15)<br>2) Error contents (bits 0 to 15)<br>3) Minutes (bits 8 to 15), Seconds (bits 0 to 7)<br>4) Day of month (bits 8 to 15), Hours (bits 0 to 7)<br>5) Year (bits 8 to 15), Month (bits 0 to 7) | The detail of error code and contents, please refer to 12-2-6.<br>Seconds: 00 to 59, BCD<br>Minutes: 00 to 59, BCD<br>Hours: 00 to 23, BCD<br>Day of month: 01 to 31, BCD<br>Month: 01 to 12, BCD<br>Year: 00 to 99, BCD | Retained                 | Retained           | Refreshed when error occurs.                        | A46.15<br>A500.11       |
| A45         | 14   | Link Status Flag  | ON while a link is established between hubs.   | ON: Established<br>OFF: Terminated   | ---                      | Cleared            | Refreshed when link state changes.                  | ---                     |
| A46         | 02   | IP Address Setting Error Flag                               | ON if any of the following conditions apply to the IP address.<br>• All bits in the host ID are 0 or 1.<br>• All bits in the network ID are 0 or 1.<br>• All bits in the subnet ID are 1.<br>• The IP address begins with 127 (0x7F)   | ON: Error<br>OFF: No error   | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 03   | IP Address Table Error Flag                                 | ON if the IP address table information is incorrect.   | ON: Incorrect<br>OFF: Correct  | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 04   | IP Router Table Error Flag                                  | ON if the IP router table information is incorrect.  | ON: Incorrect<br>OFF: Correct  | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 05   | DNS Server Error Flag                                       | ON when the following errors occur during DNS server operation:<br>• An illegal server IP address is set.<br>• A timeout occurs during communications with the server.   | ON: Error<br>OFF: No error   | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 06   | Routing Table Error Flag                                    | ON if the routing table information is incorrect.  | ON: Incorrect<br>OFF: Correct  | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 11   | SNTP Server Error Flag                                      | ON when the following errors occur during SNTP server operation:<br>• An illegal server IP address or host name is set.<br>• A timeout occurs during communications with the server.   | ON: Error<br>OFF: No error   | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 14   | Address Disagreement Flag                                   | ON if the remote IP address is set to automatic generation but the local IP address host number and FINS node address do not agree.  | ON: Disagreement<br>OFF: Agreement   | ---                      | Cleared            | Refreshed when error occurs.                        | ---                     |
|             | 15   | Ethernet Communication Error Flag                           | ON while an Ethernet communication error occurs.   | ON: Error<br>OFF: No error   | ---                      | Cleared            | Refreshed when Ethernet communication error occurs. | A40 to A44<br>A500.11   |



| Address    |      | Name  | Function  | Settings  | Status after mode change | Status at start-up | Write timing                             | Related flags, settings |
|------------|------|---|---|---|--------------------------|--------------------|--|-------------------------|
| Words      | Bits |   |   |   |                          |                    |  |                         |
| A47        | 00   | FINS/TCP Connection Flag 1  | Turned ON by the Unit when a connection is established.   | ON: Established<br>OFF: Terminated                          | ---                      | Cleared            | Refreshed when connection state changes. | ---                     |
|            | 01   | FINS/TCP Connection Flag 2  | Turned ON by the Unit when a connection is established.   | ON: Established<br>OFF: Terminated                          | ---                      | Cleared            | Refreshed when connection state changes. | ---                     |
|            | 02   | FINS/TCP Connection Flag 3  | Turned ON by the Unit when a connection is established.   | ON: Established<br>OFF: Terminated                          | ---                      | Cleared            | Refreshed when connection state changes. | ---                     |
| A90 to A93 | All  | User Program Date   | These words contain in BCD the date and time that the user program was last overwritten.<br>A90.00 to A90.07: Seconds (00 to 59)<br>A90.08 to A90.15: Minutes (00 to 59)<br>A91.00 to A91.07: Hour (00 to 23)<br>A91.08 to A91.15: Day of month (01 to 31)<br>A92.00 to A92.07: Month (01 to 12)<br>A92.08 to A92.15: Year (00 to 99)<br>A93.00 to A93.07: Day of the week (00: Sunday, 01: Monday, 02: Tuesday, 03: Wednesday, 04: Thursday, 05: Friday, 06: Saturday) | ---   | Retained                 | Retained           | ---                                      | ---                     |
| A94 to A97 | All  | Parameter Date  | These words contain in BCD the date and time that the parameters were last overwritten.<br>The format is the same as above.   | ---   | Retained                 | Retained           | ---                                      | ---                     |
| A99        | 00   | UM Read Protection Status   | Indicates whether the entire user program in the PLC is read-protected.   | OFF: UM not read-protected.<br>ON: UM read-protected.       | Retained                 | Retained           | When protection is set or cleared        | ---                     |
|            | 01   | Task Read Protection Status   | Indicates whether read protection is set for individual tasks.  | OFF: Tasks not read-protected.<br>ON: Tasks read-protected. | Retained                 | Retained           | When protection is set or cleared        | ---                     |
|            | 02   | Program Write Protection Status when Read Protection Is Set           | Indicates whether the program is write-protected.   | OFF: Write-enabled.<br>ON: Write-protected.                 | Retained                 | Retained           | When protection is set or cleared        | ---                     |
|            | 03   | Enable/Disable Status for Backing Up the Program to a Memory Cassette | Indicates whether creating a backup program file (.OBJ) is enabled or disabled.   | OFF: Enabled.<br>ON: Disabled.                              | Retained                 | Retained           | When protection is set or cleared        | ---                     |

| Address      |      | Name                                      | Function  | Settings  | Status after mode change | Status at start-up | Write timing                 | Related flags, settings |
|--------------|------|---|---|---|--------------------------|--------------------|------------------------------|-------------------------|
| Words        | Bits |   |   |   |                          |                    |                              |                         |
| A99          | 14   | IR/DR Operation between Tasks<br>Retained | ON when index and data registers are shared between all tasks.<br>OFF when separate index and data registers are being used in each task.   | OFF: Independent<br>ON: Shared (default)  | Retained                 | Retained           |                              | ---                     |
|              | 15   | Timer/Counter PV Refresh Mode Flag        | Indicates whether the CPU Unit is operating in BCD mode or binary mode.   | OFF: BCD mode<br>ON: Binary mode  | Retained                 | Retained           |                              | ---                     |
| A100 to A199 | All  | Error Log Area                            | <p>When an error has occurred, the error code, error contents, and error's time and date are stored in the Error Log Area. Information on the 20 most recent errors can be stored.</p> <p>Each error record occupies 5 words; the function of these 5 words is as follows:</p> <ol style="list-style-type: none"> <li>1) Error code (bits 0 to 15)</li> <li>2) Error contents (bits 0 to 15)</li> <li>3) Minutes (bits 8 to 15), Seconds (bits 0 to 7)</li> <li>4) Day of month (bits 8 to 15), Hours (bits 0 to 7)</li> <li>5) Year (bits 8 to 15), Month (bits 0 to 7)</li> </ol> <p>Errors generated by FAL(006) and FALS(007) will also be stored in this Error Log.</p> <p>The Error Log Area can be reset from the CX-Programmer.</p> <p>If the Error Log Area is full (20 records) and another error occurs, the oldest record in A100 to A104 will be cleared, the other 19 records are shifted down, and the new record is stored in A195 to A199.</p> | <p>Error code</p> <p>Error contents:</p> <p>Address of Aux. Area word with details or 0000.</p> <p>Seconds: 00 to 59, BCD</p> <p>Minutes: 00 to 59, BCD</p> <p>Hours: 00 to 23, BCD</p> <p>Day of month: 01 to 31, BCD</p> <p>Month: 01 to 12, BCD</p> <p>Year: 00 to 99, BCD</p> | Retained                 | Retained           | Refreshed when error occurs. | A500.14<br>A300<br>A400 |
| A200         | 11   | First Cycle Flag                          | ON for one cycle after PLC operation begins (after the mode is switched from PROGRAM to RUN or MONITOR, for example).   | ON for the first cycle  | ---                      | ---                | ---                          | ---                     |
|              | 12   | Step Flag                                 | ON for one cycle when step execution is started with STEP(008). This flag can be used for initialization processing at the beginning of a step.   | ON for the first cycle after execution of STEP(008).  | Cleared                  | ---                | ---                          | ---                     |
|              | 14   | Task Started Flag                         | <p>When a task switches from WAIT or INI to RUN status, this flag will be turned ON within the task for one cycle only.</p> <p>The only difference between this flag and A200.15 is that this flag also turns ON when the task switches from WAIT to RUN status.</p>  | ON: ON for first cycle (including transitions from WAIT and IN)<br>OFF: Other   | Cleared                  | Cleared            | ---                          | ---                     |
|              | 15   | First Task Startup Flag                   | ON when a task is executed for the first time. This flag can be used to check whether the current task is being executed for the first time so that initialization processing can be performed if necessary.  | ON: First execution<br>OFF: Not executable for the first time or not being executed.  | Cleared                  | ---                | ---                          | ---                     |

| Address      |          | Name  | Function   | Settings  | Status after mode change | Status at start-up | Write timing | Related flags, settings |
|--------------|----------|---|--|---|--------------------------|--------------------|--------------|-------------------------|
| Words        | Bits     |   |  |   |                          |                    |              |                         |
| A201         | 10       | Online Editing Wait Flag                                | ON when an online editing process is waiting.<br>(If another online editing command is received while waiting, the other command won't be recorded and an error will occur.)   | ON: Waiting for online editing<br>OFF: Not waiting for online editing                                   | Cleared                  | Cleared            | ---          | A527                    |
|              | 11       | Online Editing Flag                                     | ON when an online editing process is being executed.   | ON: Online editing in progress<br>OFF: Online editing not in progress                                   | Cleared                  | Cleared            | ---          | A527                    |
| A202         | 00 to 07 | Communications Port Enabled Flags                       | ON when a network instruction (SEND, RECV, CMND, or PMCR) can be executed with the corresponding port number. Bits 00 to 07 correspond to communications ports 0 to 7.<br><br>When two or more network instructions are programmed with the same port number, use the corresponding flag as an execution condition to prevent the instructions from being executed simultaneously.<br>(The flag for a given port is turned OFF while a network instruction with that port number is being executed.) | ON: Network instruction is not being executed<br>OFF: Network instruction is being executed (port busy) | Cleared                  | ---                | ---          | ---                     |
|              | 15       | Network Communications Port Allocation Enabled Flag     | ON when there is a communications port available for automatic allocation.<br><br><b>Note</b> Use this flag to confirm whether a communications port is available for automatic allocation before executing communications instructions when using 9 or more communications instructions simultaneously.   | ON: Port available<br>OFF: Port not available   | Cleared                  | ---                | ---          | ---                     |
| A203 to A210 | All      | Communications Port Completion Codes                    | These words contain the completion codes for the corresponding port numbers when network instructions (SEND, RECV, CMND, or PMCR) have been executed.<br>(The corresponding word will be cleared when background execution has been completed.)<br><br>Words A203 to A210 correspond to communications ports 0 to 7.   | Non-zero: Error code<br>0000: Normal condition  | Retained                 | ---                | ---          | ---                     |
| A214         | 00 to 07 | First Cycle Flags after Network Communications Finished | Each flag will turn ON for just one cycle after communications have been completed. Bits 00 to 07 correspond to ports 0 to 7. Use the Used Communications Port Number stored in A218 to determine which flag to access.<br><br><b>Note</b> These flags are not effective until the next cycle after the communications instruction is executed. Delay accessing them for at least one cycle.   | ON: First cycle after communications finish only<br>OFF: Other status                                   | ---                      | ---                | ---          | ---                     |

| Address       |          | Name   | Function   | Settings  | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|---------------|----------|--|--|---|--------------------------|--------------------|--|-------------------------|
| Words         | Bits     |  |  |   |                          |                    |  |                         |
| A215          | 00 to 07 | First Cycle Flags after Network Communications Error   | Each flag will turn ON for just one cycle after a communications error occurs. Bits 00 to 07 correspond to ports 0 to 7. Use the Used Communications Port Number stored in A218 to determine which flag to access. Determine the cause of the error according to the Communications Port Completion Codes stored in A203 to A210.<br><b>Note</b> These flags are not effective until the next cycle after the communications instruction is executed. Delay accessing them for at least one cycle. | ON: First cycle after communications error only<br>OFF: Other status      | ---                      | ---                | ---  | ---                     |
| A216 to A217  | All      | Network Communications Completion Code Storage Address | The completion code for a communications instruction is automatically stored at the address with the I/O memory address given in these words.<br>Place this address into an index register and use indirect addressing through the index register to read the communications completion code.  | I/O memory address for the network communications completion code storage | ---                      | ---                | ---  | ---                     |
| A218          | All      | Used Communications Port Numbers                       | Stores the communications port numbers used when a communications instruction is executed using automatic communication port allocations.  | 0000 to 0007 hex: Communications port 0 to 7                              | ---                      | ---                | ---  | ---                     |
| A219          | 00 to 07 | Communications Port Error Flags                        | ON when an error occurred during execution of a network instruction (SEND, RECV, CMND, or PMCR). Bits 00 to 07 correspond to communications ports 0 to 7.  | ON: Error occurred<br>OFF: Normal condition                               | Retained                 | ---                | ---  | ---                     |
| A262 and A263 | All      | Maximum Cycle Time                                     | These words contain the maximum cycle time since the start of PLC operation. The cycle time is recorded in 8-digit hexadecimal with the leftmost 4 digits in A263 and the rightmost 4 digits in A262.  | 0 to FFFFFFFF:<br>0 to 429,496,729.5 ms<br>(0.1-ms units)                 | ---                      | ---                | ---  | ---                     |
| A264 and A265 | All      | Present Cycle Time                                     | These words contain the present cycle time in 8-digit hexadecimal with the leftmost 4 digits in A265 and the rightmost 4 digits in A264.   | 0 to FFFFFFFF:<br>0 to 429,496,729.5 ms                                   | ---                      | ---                | ---  | ---                     |
| A270 to A271  | All      | High-speed Counter 0 PV                                | Contains the PV of high-speed counter 0. A271 contains the leftmost 4 digits and A270 contains the rightmost 4 digits.<br>The PV is cleared when operation starts.   | ---   | ---                      | Cleared            | Refreshed each cycle during oversee process.<br>Refreshed when PRV(881) instruction is executed. | ---                     |
| A272 to A273  | All      | High-speed Counter 1 PV                                | Contains the PV of high-speed counter 1. A273 contains the leftmost 4 digits and A272 contains the rightmost 4 digits.<br>The PV is cleared when operation starts.   | ---   | ---                      | Cleared            | Refreshed each cycle during oversee process.<br>Refreshed when PRV(881) instruction is executed. | ---                     |

| Address |      | Name  | Function  | Settings | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|---------|------|---|---|----------|--------------------------|--------------------|--|-------------------------|
| Words   | Bits |   |   |          |                          |                    |  |                         |
| A274    | 00   | High-speed Counter 0<br>Range 1 Comparison Condition Met Flag | These flags indicate whether the PV is within the specified ranges when high-speed counter 0 is being operated in range-comparison mode.<br>Cleared at beginning of operation.<br>Cleared when range comparison table is registered.<br>OFF: PV not in range<br>ON: PV in range | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.<br>Refreshed when PRV(881) instruction is executed. | ---                     |
|         | 01   | High-speed Counter 0<br>Range 2 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 02   | High-speed Counter 0<br>Range 3 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 03   | High-speed Counter 0<br>Range 4 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 04   | High-speed Counter 0<br>Range 5 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 05   | High-speed Counter 0<br>Range 6 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 06   | High-speed Counter 0<br>Range 7 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 07   | High-speed Counter 0<br>Range 8 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 08   | High-speed Counter 0<br>Comparison In-progress Flag           | This flag indicates whether a comparison operation is being executed for high-speed counter 0.<br>Cleared at beginning of operation.<br>OFF: Stopped.<br>ON: Being executed.  | ---      | ---                      | Cleared            | Refreshed when comparison operation starts or stops.   | ---                     |
|         | 09   | High-speed Counter 0<br>Overflow/Underflow Flag               | This flag indicates when an overflow or underflow has occurred in the high-speed counter 0 PV. (Used with the linear mode counting range only.)<br>Cleared when operation starts.<br>Cleared when PV is changed.<br>OFF: Normal<br>ON: Overflow or underflow                    | ---      | ---                      | Cleared            | Refreshed when an overflow or underflow occurs.  | ---                     |
|         | 10   | High-speed Counter 0<br>Count Direction                       | This flag indicates whether the high-speed counter is currently being incremented or decremented. The counter PV for the current cycle is compared with the PLC in last cycle to determine the direction.<br>OFF: Decrementing<br>ON: Incrementing                              | ---      | ---                      | Cleared            | Setting used for high-speed counter, valid during counter operation.                             | Read only               |

| Address |      | Name  | Function  | Settings | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|---------|------|---|---|----------|--------------------------|--------------------|---|-------------------------|
| Words   | Bits |   |   |          |                          |                    |   |                         |
| A275    | 00   | High-speed Counter 1<br>Range 1 Comparison Condition Met Flag | These flags indicate whether the PV is within the specified ranges when high-speed counter 1 is being operated in range-comparison mode.<br>Cleared when operation starts.<br>Cleared when range comparison table is registered.<br>OFF: PV not in range<br>ON: PV in range | ---      | ---                      | Cleared            | Refreshed each cycle during overseeing process.<br>Refreshed when PRV(881) instruction is executed for the corresponding counter. | ---                     |
|         | 01   | High-speed Counter 1<br>Range 2 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 02   | High-speed Counter 1<br>Range 3 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 03   | High-speed Counter 1<br>Range 4 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 04   | High-speed Counter 1<br>Range 5 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 05   | High-speed Counter 1<br>Range 6 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 06   | High-speed Counter 1<br>Range 7 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 07   | High-speed Counter 1<br>Range 8 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|         | 08   | High-speed Counter 1<br>Comparison In-progress Flag           | This flag indicates whether a comparison operation is being executed for high-speed counter 1.<br>Cleared when operation starts.<br>OFF: Stopped.<br>ON: Being executed   | ---      | ---                      | Cleared            | Refreshed when comparison operation starts or stops.  | ---                     |
|         | 09   | High-speed Counter 1<br>Overflow/Underflow Flag               | This flag indicates when an overflow or underflow has occurred in the high-speed counter 1 PV. (Used with the linear mode counting range only.)<br>Cleared when operation starts.<br>Cleared when the PV is changed.<br>OFF: Normal<br>ON: Overflow or underflow            | ---      | ---                      | Cleared            | Refreshed when an overflow or underflow occurs.   | ---                     |
|         | 10   | High-speed Counter 1<br>Count Direction                       | This flag indicates whether the high-speed counter is currently being incremented or decremented. The counter PV for the current cycle is compared with the PC in last cycle to determine the direction.<br>OFF: Decrementing<br>ON: Incrementing                           | ---      | ---                      | Cleared            | Setting used for high-speed counter, valid during counter operation.  | ---                     |

| Address       |      | Name                                   | Function   | Settings | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|---------------|------|--|--|----------|--------------------------|--------------------|---|-------------------------|
| Words         | Bits |  |  |          |                          |                    |   |                         |
| A276 and A277 | All  | Pulse Output 0 PV                      | Contain the number of pulses output from the corresponding pulse output port.  | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.  | ---                     |
| A278 and A279 | All  | Pulse Output 1 PV                      | <p>PV range: 8000 0000 to 7FFF FFFF hex<br/>(-2,147,483,648 to 2,147,483,647)</p> <p>When pulses are being output in the CW direction, the PV is incremented by 1 for each pulse.</p> <p>When pulses are being output in the CCW direction, the PV is decremented by 1 for each pulse.</p> <p>PV after overflow: 7FFF FFFF hex<br/>PV after underflow: 8000 0000 hex</p> <p>A277 contains the leftmost 4 digits and A276 contains the rightmost 4 digits of the pulse output 0 PV.</p> <p>A279 contains the leftmost 4 digits and A278 contains the rightmost 4 digits of the pulse output 1 PV.</p> <p>Cleared when operation starts.</p> <p><b>Note</b> If the coordinate system is relative coordinates (undefined origin), the PV will be cleared to 0 when a pulse output starts, i.e. when a pulse output instruction (SPED(885), ACC(888), or PLS2(887)) is executed.</p> | ---      | ---                      | Cleared            | Refreshed when the INI(880) instruction is executed (PV change).  | ---                     |
| A280          | 00   | Pulse Output 0 Accel/Decel Flag        | <p>This flag will be ON when pulses are being output from pulse output 0 according to an ACC(888) or PLS2(887) instruction and the output frequency is being changed in steps (accelerating or decelerating).</p> <p>Cleared when operation starts or stops.</p> <p>OFF: Constant speed<br/>ON: Accelerating or decelerating</p>   | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.  | ---                     |
|               | 01   | Pulse Output 0 Overflow/Underflow Flag | <p>This flag indicates when an overflow or underflow has occurred in the pulse output 0 PV.</p> <p>Cleared when operation starts.</p> <p>OFF: Normal<br/>ON: Overflow or underflow</p>   | ---      | ---                      | Cleared            | <p>Cleared when the PV is changed by the INI(880) instruction.</p> <p>Refreshed when an overflow or underflow occurs.</p> | ---                     |

| Address |      | Name                                     | Function  | Settings | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|---------|------|--|---|----------|--------------------------|--------------------|---|-------------------------|
| Words   | Bits |  |   |          |                          |                    |   |                         |
| A280    | 02   | Pulse Output 0 Output Amount Set Flag    | ON when the number of output pulses for pulse output 0 has been set with the PULS(886) instruction. Cleared when operation starts or stops.<br>OFF: No setting<br>ON: Setting made  | ---      | ---                      | Cleared            | Refreshed when the PULS(886) instruction is executed.<br>Refreshed when pulse output stops. | ---                     |
|         | 03   | Pulse Output 0 Output Completed Flag     | ON when the number of output pulses set with the PULS(886) or PLS2(887) instruction has been output through pulse output 0. Cleared when operation starts or stops.<br>OFF: Output not completed.<br>ON: Output completed.  | ---      | ---                      | Cleared            | Refreshed at the start or completion of pulse output in independent mode.                   | ---                     |
|         | 04   | Pulse Output 0 Output In-progress Flag   | ON when pulses are being output from pulse output 0. Cleared when operation starts or stops.<br>OFF: Stopped<br>ON: Outputting pulses.  | ---      | ---                      | Cleared            | Refreshed when pulse output starts or stops.  | ---                     |
|         | 05   | Pulse Output 0 No-origin Flag            | ON when the origin has not been determined for pulse output 0 and goes OFF when the origin has been determined.<br>Turned ON when power is turned ON.<br>Turned ON when operation starts.<br>OFF: Origin established.<br>ON: Origin not established.  | ---      | ---                      | Cleared            | Refreshed each cycle during the overseeing processes.                                       | ---                     |
|         | 06   | Pulse Output 0 At-origin Flag            | ON when the pulse output PV matches the origin (0).<br>OFF: Not stopped at origin.<br>ON: Stopped at origin.  | ---      | ---                      | Cleared            | Refreshed each cycle during the overseeing processes.                                       | ---                     |
|         | 07   | Pulse Output 0 Output Stopped Error Flag | ON when an error occurred while outputting pulses in the pulse output 0 origin search function.<br>The Pulse Output 0 Output Stop Error code will be written to A444.<br>OFF: No error<br>ON: Stop error occurred.  | ---      | ---                      | Cleared            | Refreshed when origin search starts.<br>Refreshed when a pulse output stop error occurs.    | ---                     |
| A281    | 00   | Pulse Output 1 Accel/Decel Flag          | This flag will be ON when pulses are being output from pulse output 1 according to an ACC(888) or PLS2(887) instruction and the output frequency is being changed in steps (accelerating or decelerating). Cleared when operation starts or stops.<br>OFF: Constant speed<br>ON: Accelerating or decelerating | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.  | ---                     |



| Address |      | Name                                     | Function   | Settings | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|---------|------|--|--|----------|--------------------------|--------------------|--|-------------------------|
| Words   | Bits |  |  |          |                          |                    |  |                         |
| A281    | 01   | Pulse Output 1 Overflow/Underflow Flag   | This flag indicates when an overflow or underflow has occurred in the pulse output 1 PV.<br>Cleared when operation starts.<br>OFF: Normal<br>ON: Overflow or underflow   | ---      | ---                      | Cleared            | Refreshed when the PV is changed by the INI(880) instruction.<br>Refreshed when an overflow or underflow occurs. | ---                     |
|         | 02   | Pulse Output 1 Output Amount Set Flag    | ON when the number of output pulses for pulse output 1 has been set with the PULS(886) instruction.<br>Cleared when operation starts or stops.<br>OFF: No setting<br>ON: Setting made  | ---      | ---                      | Cleared            | Refreshed when the PULS(886) instruction is executed.  | ---                     |
|         | 03   | Pulse Output 1 Output Completed Flag     | ON when the number of output pulses set with the PULS(886) or PLS2(887) instruction has been output through pulse output 1.<br>Cleared when operation starts or stops.<br>OFF: Output not completed.<br>ON: Output completed.                        | ---      | ---                      | Cleared            | Refreshed when PULS(886) (886) instruction is executed.<br>Refreshed at the start or completion of pulse output. | ---                     |
|         | 04   | Pulse Output 1 Output In-progress Flag   | ON when pulses are being output from pulse output 1.<br>Cleared when operation starts or stops.<br>OFF: Stopped<br>ON: Outputting pulses.  | ---      | ---                      | Cleared            | Refreshed when pulse output starts or stops.   | ---                     |
|         | 05   | Pulse Output 1 No-origin Flag            | ON when the origin has not been determined for pulse output 1 and goes OFF when the origin has been determined.<br>Turned ON when power is turned ON.<br>Turned ON when operation starts.<br>OFF: Origin established.<br>ON: Origin not established. | ---      | ---                      | Cleared            | Refreshed each cycle during overseeing processes.  | ---                     |
|         | 06   | Pulse Output 1 At-origin Flag            | ON when the pulse output PV matches the origin (0).<br>OFF: Not stopped at origin.<br>ON: Stopped at origin.   | ---      | ---                      | Cleared            | Refreshed each cycle during overseeing processes.  | ---                     |
|         | 07   | Pulse Output 1 Output Stopped Error Flag | ON when an error occurred while outputting pulses in the pulse output 1 origin search function.<br>The Pulse Output 1 Output Stop Error code will be written to A445.<br>OFF: No error<br>ON: Stop error occurred.                                   | ---      | ---                      | Cleared            | Refreshed when origin search starts.<br>Refreshed when pulse output stop error occurs.                           | ---                     |

| Address |      | Name                                 | Function  | Settings   | Status after mode change | Status at start-up | Write timing                                 | Related flags, settings  |
|---------|------|--------------------------------------|---|--|--------------------------|--------------------|--|--|
| Words   | Bits |                                      |   |  |                          |                    |  |  |
| A283    | 00   | PWM Output 0 Output In-progress Flag | ON when pulses are being output from PWM output 0.<br>Cleared when operation starts or stops.<br>OFF: Stopped<br>ON: Outputting pulses.   | ---  | ---                      | Cleared            | Refreshed when pulse output starts or stops. | ---  |
|         | 08   | PWM Output 1 Output In-progress Flag | ON when pulses are being output from PWM output 1.<br>OFF: Stopped<br>ON: Outputting pulses.  | ---  | ---                      | Cleared            |  | ---  |
| A294    | All  | Task Number when Program Stopped     | This word contains the task number of the task that was being executed when program execution was stopped because of a program error. (A298 and A299 contain the program address where program execution was stopped.)  | Normal tasks: 0000 to 001F (task 0 to 31)<br>Interrupt tasks: 8000 to 80FF (task 0 to 255) | Cleared                  | Cleared            | When program error occurs.                   | A298/A299  |
| A295    | 08   | Instruction Processing Error Flag    | This flag and the Error Flag (ER) will be turned ON when an instruction processing error has occurred and the PLC Setup has been set to stop operation for an instruction error. CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.<br>(The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.)  | ON: Error Flag ON<br>OFF: Error Flag OFF   | Cleared                  | Cleared            | When program error occurs.                   | A294, A298/A299<br>PLC Setup (Operation when instruction error has occurred) |
|         | 09   | Indirect DM BCD Error Flag           | This flag and the Access Error Flag (AER) will be turned ON when an indirect DM BCD error has occurred and the PLC Setup has been set to stop operation an indirect DM BCD error. (This error occurs when the content of an indirectly addressed DM word is not BCD although BCD mode has been selected.) CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.<br>(The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.)   | ON: Not BCD<br>OFF: Normal   | Cleared                  | Cleared            | When program error occurs.                   | A294, A298/A299<br>PLC Setup (Operation when instruction error has occurred) |
|         | 10   | Illegal Access Error Flag            | This flag and the Access Error Flag (AER) will be turned ON when an illegal access error has occurred and the PLC Setup has been set to stop operation an illegal access error. (This error occurs when a region of memory is accessed illegally.) CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.<br>The following operations are considered illegal access:<br>1) Reading/writing the system area<br>2) Indirect DM BCD error (in BCD mode)<br>(The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.) | ON: Illegal access occurred<br>OFF: Normal condition                                       | Cleared                  | Cleared            | When program error occurs.                   | A294, A298/A299<br>PLC Setup (Operation when instruction error has occurred) |

| Address |      | Name   | Function  | Settings                              | Status after mode change | Status at start-up | Write timing                 | Related flags, settings |
|---------|------|--|---|---------------------------------------|--------------------------|--------------------|------------------------------|-------------------------|
| Words   | Bits |  |   |                                       |                          |                    |                              |                         |
| A295    | 11   | No END Error Flag  | ON when there is not an END(001) instruction in each program within a task.<br>CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.<br>(The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.)  | ON: No END<br>OFF: Normal condition   | Cleared                  | Cleared            | ---                          | A294, A298/A299         |
|         | 12   | Task Error Flag  | ON when a task error has occurred. The following conditions generate a task error.<br>There isn't even one regular task that is executable (started).<br>There isn't a program allocated to the task.<br>(The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.)   | ON: Error<br>OFF: Normal              | Cleared                  | Cleared            | ---                          | A294, A298/A299         |
|         | 13   | Differentiation Overflow Error Flag                        | The allowed value for Differentiation Flags which correspond to differentiation instructions has been exceeded. CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.<br>(The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.)   | ON: Error<br>OFF: Normal              | Cleared                  | Cleared            | ---                          | A294, A298/A299         |
|         | 14   | Illegal Instruction Error Flag                             | ON when a program that cannot be executed has been stored. CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.  | ON: Error<br>OFF: Normal              | Cleared                  | Cleared            | ---                          | A294, A298/A299         |
|         | 15   | UM Overflow Error Flag                                     | ON when the last address in UM (User Memory) has been exceeded. CPU Unit operation will stop and the ERR/ALM indicator will light when this flag goes ON.   | ON: Error<br>OFF: Normal              | Cleared                  | Cleared            | ---                          | A294, A298/A299         |
| A298    | All  | Program Address Where Program Stopped (Rightmost 4 digits) | These words contain the 8-digit binary program address of the instruction where program execution was stopped due to a program error. (A294 contains the task number of the task where program execution was stopped.)  | Right 4 digits of the program address | Cleared                  | Cleared            | ---                          | A294                    |
| A299    | All  | Program Address Where Program Stopped (Leftmost 4 digits)  |   | Left 4 digits of the program address  | Cleared                  | Cleared            | ---                          |                         |
| A300    | All  | Error Log Pointer  | When an error occurs, the Error Log Pointer is incremented by 1 to indicate the location where the next error record will be recorded as an offset from the beginning of the Error Log Area (A100 to A199).<br>The Error Log Pointer can be cleared to 00 by turning A500.14 (the Error Log Reset Bit) ON.<br>When the Error Log Pointer has reached 14 hex (20 decimal), the next record is stored in A195 to A199 when the next error occurs. | 00 to 14 hexadecimal                  | Retained                 | Retained           | Refreshed when error occurs. | A500.14                 |

| Address      |      | Name   | Function  | Settings | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|--------------|------|--|---|----------|--------------------------|--------------------|--|-------------------------|
| Words        | Bits |  |   |          |                          |                    |  |                         |
| A310         | All  | Manufacturing Lot Number, Lower Digits                     | The manufacturing lot number is stored in 6 digits hexadecimal. X, Y, and Z in the lot number are converted to 10, 11, and 12, respectively.<br>Examples:<br>Lot number 01805<br>A310 = 0801, A311 = 0005<br>Lot number 30Y05<br>A310 = 1130, A311 = 0005                       | ---      | Retained                 | Retained           | When the power supply is turned ON   | ---                     |
| A311         | All  | Manufacturing Lot Number, Upper Digits                     |   |          |                          |                    |  |                         |
| A313         | All  | Error Information  | When a non-fatal error (Built-in Ethernet error) occurs, the 4-digit hexadecimal error information is written to this word. When two or more errors occur simultaneously, the information of the highest error code will be recorded.   | ---      | Cleared                  | Cleared            | Refreshed when error occurs.   | A315.10<br>A315.11      |
| A315         | 10   | Built-in Ethernet Error Flag                               | ON when a Built-in Ethernet error has occurred in memory.   | ---      | Cleared                  | Cleared            | Refreshed when error occurs.   | A402.00, A313           |
|              | 11   | Logic Errors in Setting Table Flag                         | ON when an error occurs in routing table, IP address table, or IP router table.   | ---      | Cleared                  | Cleared            | Refreshed when error occurs.   | A402.00, A313           |
|              | 13   | Option Board Error Flag                                    | ON when the Option Board is removed while the power is being supplied. CPU Unit operation will continue and the ERR/ALM indicator will flash.<br>OFF when the error has been cleared.   | ---      | Cleared                  | Cleared            | Refreshed when error occurs.   | A402.00, A424           |
|              | 15   | Flash Memory Error Flag                                    | ON when writing to the internal flash memory fails. CPU Unit operation will continue and the ERR/ALM indicator will flash.<br>OFF when the error has been cleared.  | ---      | Cleared                  | Cleared            | Refreshed when error occurs.   | A402.00                 |
| A316 to A317 | All  | High-speed Counter 2 PV                                    | Contains the PV of high-speed counter 2. A317 contains the leftmost 4 digits and A316 contains the rightmost 4 digits.<br>The PV is cleared when operation starts.  | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.<br>Refreshed when PRV(881) instruction is executed. | ---                     |
| A318 to A319 | All  | High-speed Counter 3 PV                                    | Contains the PV of high-speed counter 3. A319 contains the leftmost 4 digits and A318 contains the rightmost 4 digits.<br>The PV is cleared when operation starts.  | ---      | ---                      | Cleared            | Refreshed when PRV(881) instruction is executed.   | ---                     |
| A320         | 00   | High-speed Counter 2 Range 1 Comparison Condition Met Flag | These flags indicate whether the PV is within the specified ranges when high-speed counter 2 is being operated in range-comparison mode.<br>Cleared at beginning of operation.<br>Cleared when range comparison table is registered.<br>OFF: PV not in range<br>ON: PV in range | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.<br>Refreshed when PRV(881) instruction is executed. | ---                     |

| Address |      | Name  | Function  | Settings | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|---------|------|---|---|----------|--------------------------|--------------------|--|-------------------------|
| Words   | Bits |   |   |          |                          |                    |  |                         |
| A320    | 01   | High-speed Counter 2<br>Range 2 Comparison Condition Met Flag | These flags indicate whether the PV is within the specified ranges when high-speed counter 2 is being operated in range-comparison mode.<br>Cleared at beginning of operation.<br>Cleared when range comparison table is registered.<br>OFF: PV not in range<br>ON: PV in range | ---      | ---                      | Cleared            | Refreshed each cycle during oversee process.<br>Refreshed when PRV(881) instruction is executed. | ---                     |
|         | 02   | High-speed Counter 2<br>Range 3 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 03   | High-speed Counter 2<br>Range 4 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 04   | High-speed Counter 2<br>Range 5 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 05   | High-speed Counter 2<br>Range 6 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 06   | High-speed Counter 2<br>Range 7 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 07   | High-speed Counter 2<br>Range 8 Comparison Condition Met Flag |   |          |                          |                    |  |                         |
|         | 08   | High-speed Counter 2<br>Comparison In-progress Flag           | This flag indicates whether a comparison operation is being executed for high-speed counter 2.<br>Cleared at beginning of operation.<br>OFF: Stopped.<br>ON: Being executed.  | ---      | ---                      | Cleared            | Refreshed when comparison operation starts or stops.   | ---                     |
|         | 09   | High-speed Counter 2<br>Overflow/Underflow Flag               | This flag indicates when an overflow or underflow has occurred in the high-speed counter 2 PV. (Used with the linear mode counting range only.)<br>Cleared when operation starts.<br>Cleared when PV is changed.<br>OFF: Normal<br>ON: Overflow or underflow                    | ---      | ---                      | Cleared            | Refreshed when an overflow or underflow occurs.  | ---                     |
|         | 10   | High-speed Counter 2<br>Count Direction                       | This flag indicates whether the high-speed counter is currently being incremented or decremented. The counter PV for the current cycle is compared with the PLC in last cycle to determine the direction.<br>OFF: Decrementing<br>ON: Incrementing                              | ---      | ---                      | Cleared            | Setting used for high-speed counter, valid during counter operation.                             | ---                     |

| Address       |      | Name  | Function  | Settings | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|---------------|------|---|---|----------|--------------------------|--------------------|---|-------------------------|
| Words         | Bits |   |   |          |                          |                    |   |                         |
| A321          | 00   | High-speed Counter 3<br>Range 1 Comparison Condition Met Flag | These flags indicate whether the PV is within the specified ranges when high-speed counter 3 is being operated in range-comparison mode.<br>Cleared when operation starts.<br>Cleared when range comparison table is registered.<br>OFF: PV not in range<br>ON: PV in range | ---      | ---                      | Cleared            | Refreshed each cycle during overseeing process.<br>Refreshed when PRV(881) instruction is executed for the corresponding counter. | ---                     |
|               | 01   | High-speed Counter 3<br>Range 2 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 02   | High-speed Counter 3<br>Range 3 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 03   | High-speed Counter 3<br>Range 4 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 04   | High-speed Counter 3<br>Range 5 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 05   | High-speed Counter 3<br>Range 6 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 06   | High-speed Counter 3<br>Range 7 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 07   | High-speed Counter 3<br>Range 8 Comparison Condition Met Flag |   |          |                          |                    |   |                         |
|               | 08   | High-speed Counter 3<br>Comparison In-progress Flag           | This flag indicates whether a comparison operation is being executed for high-speed counter 3.<br>Cleared when operation starts.<br>OFF: Stopped.<br>ON: Being executed   | ---      | ---                      | Cleared            | Refreshed when comparison operation starts or stops.  | ---                     |
|               | 09   | High-speed Counter 3<br>Overflow/Underflow Flag               | This flag indicates when an overflow or underflow has occurred in the high-speed counter 3 PV. (Used with the linear mode counting range only.)<br>Cleared when operation starts.<br>Cleared when the PV is changed.<br>OFF: Normal<br>ON: Overflow or underflow            | ---      | ---                      | Cleared            | Refreshed when an overflow or underflow occurs.   | ---                     |
|               | 10   | High-speed Counter 3<br>Count Direction                       | This flag indicates whether the high-speed counter is currently being incremented or decremented. The counter PV for the current cycle is compared with the PC in last cycle to determine the direction.<br>OFF: Decrementing<br>ON: Incrementing                           | ---      | ---                      | Cleared            | Setting used for high-speed counter, valid during counter operation.  | ---                     |
| A339 and A340 | All  | Maximum Differentiation Flag Number                           | These words contain the maximum value of the differentiation flag numbers being used by differentiation instructions.   | ---      | See Function column.     | Cleared            | Written at the start of operation   | A295.13                 |

| Address |      | Name                                      | Function  | Settings   | Status after mode change | Status at start-up | Write timing  | Related flags, settings |
|---------|------|---|---|--|--------------------------|--------------------|---|-------------------------|
| Words   | Bits |   |   |  |                          |                    |   |                         |
| A342    | 03   | Memory Cassette Write Flag                | ON when data is being written to the Memory Cassette.   | OFF: Not writing<br>ON: Writing                        | Retained                 | Cleared            | ---   | ---                     |
|         | 04   | Memory Cassette Read Flag                 | ON when data is being read from the Memory Cassette.  | OFF: Not reading<br>ON: Reading                        | Retained                 | Cleared            | ---   | ---                     |
|         | 05   | Memory Cassette Verify Flag               | ON when data is being compared with data on the Memory Cassette.  | OFF: Not verifying<br>ON: Verifying                    | Retained                 | Cleared            | ---   | ---                     |
|         | 07   | Memory Cassette Initialization Error Flag | ON when an error occurs in initializing the Memory Cassette.<br>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).   | OFF: No error<br>ON: Error                             | Retained                 | Cleared            | ---   | ---                     |
|         | 08   | Memory Cassette Write Error Flag          | ON when an error occurs in writing the Memory Cassette.<br>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).  | OFF: No error<br>ON: Error                             | Retained                 | Cleared            | ---   | ---                     |
|         | 10   | Memory Cassette Read Error Flag           | ON when an error occurs in reading the Memory Cassette.<br>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).  | OFF: No error<br>ON: Error                             | Retained                 | Cleared            | ---   | ---                     |
|         | 12   | Memory Cassette Mismatch Flag             | ON the data in the CPU Unit is not the same as the data in the Memory Cassette when a verification operation is performed.<br>OFF the next time the Memory Cassette is accessed normally (initialized, written, read, or compared). | OFF: Match<br>ON: Mismatch                             | Retained                 | Cleared            | ---   | ---                     |
|         | 13   | Memory Cassette Access Flag               | ON when the Memory Cassette is being accessed.<br>OFF when access is completed.   | OFF: Not being accessed<br>ON: Being accessed          |                          | Cleared            | ---   | ---                     |
|         | 15   | Memory Cassette Flag                      | ON when a Memory Cassette is mounted.<br>OFF when a Memory Cassette is not mounted.   | OFF: No Memory Cassette<br>ON: Memory Cassette mounted | Retained                 | Cleared            | ---   | ---                     |
| A345    | 00   | FB Program Data Flag                      | Turns ON if the FB program memory contains FB program data.   | OFF: No data<br>ON: Data present                       | Retained                 | Cleared            | Downloading programs from CX-Programmer or Memory Cassette or clearing VM | ---                     |
|         | 01   | Program Index File Flag                   | Turns ON when the comment memory contains a program index file.   | OFF: No file<br>ON: File present                       |                          |                    | Downloading programs from CX-Programmer or Memory Cassette                |                         |
|         | 02   | Comment File Flag                         | Turns ON when the comment memory contains a comment file.   | OFF: No file<br>ON: File present                       |                          |                    |   |                         |
|         | 03   | Symbol Table File Flag                    | Turns ON when the comment memory contains a symbol table file.  | OFF: No file<br>ON: File present                       |                          |                    |   |                         |
|         | 04   | DM Initial Values Flag                    | ON when DM initial values are stored in the flash memory.   | OFF: No values stored<br>ON: Values stored             | ---                      | ---                | ---   | ---                     |

| Address      |          | Name   | Function  | Settings  | Status after mode change | Status at start-up | Write timing                 | Related flags, settings |
|--------------|----------|--|---|---|--------------------------|--------------------|------------------------------|-------------------------|
| Words        | Bits     |  |   |   |                          |                    |                              |                         |
| A351 to A354 | All      | Calendar/Clock Area  | These words contain the CPU Unit's internal clock data in BCD. The clock can be set from the CX-Programmer such as a Programming Console, with the DATE(735) instruction, or with a FINS command (CLOCK WRITE, 0702).   | ---   | Retained                 | Retained           | Written every cycle          | ---                     |
|              | 00 to 07 |  | Seconds (00 to 59) (BCD)  |   |                          |                    |                              |                         |
|              | 08 to 15 |  | Minutes (00 to 59) (BCD)  |   |                          |                    |                              |                         |
|              | 00 to 07 |  | Hours (00 to 23) (BCD)  |   |                          |                    |                              |                         |
|              | 08 to 15 |  | Day of the month (01 to 31) (BCD)   |   |                          |                    |                              |                         |
|              | 00 to 07 |  | Month (01 to 12) (BCD)  |   |                          |                    |                              |                         |
|              | 08 to 15 |  | Year (00 to 99) (BCD)   |   |                          |                    |                              |                         |
|              | 00 to 07 |  | Day of the week (00 to 06) (BCD)<br>00: Sunday, 01: Monday, 02: Tuesday, 03: Wednesday, 04: Thursday, 05: Friday, 06: Saturday  |   |                          |                    |                              |                         |
| A360 to A391 | 01 to 15 | Executed FAL Number Flags  | The flag corresponding to the specified FAL number will be turned ON when FAL(006) is executed. Bits A360.01 to A391.15 correspond to FAL numbers 001 to 511.<br>The flag will be turned OFF when the error is cleared.   | ON: That FAL was executed<br>OFF: That FAL was not executed | Retained                 | Cleared            | Refreshed when error occurs. | A402.15                 |
| A392         | 04       | Serial Port 2 Error Flag (CP1L EM-type CPU Units)                                  | ON when an error has occurred at serial port 2 of a CP1L EM-type CPU Unit. (Not valid in Peripheral Bus Mode or NT Link mode.)  | ON: Error<br>OFF: No error                                  | Retained                 | Cleared            | Refreshed when error occurs. | ---                     |
|              |          | Serial Port 1 Error Flag (CP1L EL-type CPU Units)                                  | ON when an error has occurred at serial port 1 of a CP1L EL-type CPU Unit. (Not valid in Peripheral Bus Mode or NT Link mode.)  |   |                          |                    |                              |                         |
|              | 05       | Serial Port 2 Send Ready Flag (No-protocol mode) (CP1L EM-type CPU Units)          | ON when the serial port 2 of a CP1L EM-type CPU Unit is able to send data in no-protocol mode.  | ON: Able-to-send<br>OFF: Unable-to-send                     | Retained                 | Cleared            | Written after transmission   | ---                     |
|              |          | Serial Port 1 Send Ready Flag (No-protocol mode) (CP1L EL-type CPU Units)          | ON when the serial port 1 of a CP1L EL-type CPU Unit is able to send data in no-protocol mode.  |   |                          |                    |                              |                         |
|              | 06       | Serial Port 2 Reception Completed Flag (No-protocol mode) (CP1L EM-type CPU Units) | ON when the serial port 2 of a CP1L EM-type CPU Unit has completed the reception in no-protocol mode.<br>• When the number of bytes was specified: ON when the specified number of bytes is received.<br>• When the end code was specified: ON when the end code is received or 256 bytes are received. | ON: Reception completed<br>OFF: Reception not completed     | Retained                 | Cleared            | Written after reception      | ---                     |
|              |          | Serial Port 1 Reception Completed Flag (No-protocol mode) (CP1L EL-type CPU Units) | ON when the serial port 1 of a CP1L EL-type CPU Unit has completed the reception in no-protocol mode.<br>• When the number of bytes was specified: ON when the specified number of bytes is received.<br>• When the end code was specified: ON when the end code is received or 256 bytes are received. |   |                          |                    |                              |                         |



| Address |      | Name   | Function  | Settings  | Status after mode change | Status at start-up | Write timing               | Related flags, settings |
|---------|------|--|---|---|--------------------------|--------------------|----------------------------|-------------------------|
| Words   | Bits |  |   |   |                          |                    |                            |                         |
| A392    | 07   | Serial Port 2 Reception Overflow Flag (No-protocol mode) (CP1L EM-type CPU Units)  | ON when a data overflow occurred during reception through the serial port 2 of a CP1L EM-type CPU Unit in no-protocol mode. <ul style="list-style-type: none"> <li>When the number of bytes was specified: ON when more data is received after the reception was completed but before RXD(235) was executed.</li> <li>When the end code was specified: ON when more data is received after the end code was received but before RXD(235) was executed. ON when 257 bytes are received before the end code.</li> </ul> | ON: Overflow<br>OFF: No overflow                        | Retained                 | Cleared            | ---                        | ---                     |
|         |      | Serial Port 1 Reception Overflow Flag (No-protocol mode) (CP1L EL-type CPU Units)  | ON when a data overflow occurred during reception through the serial port 1 of a CP1L EL-type CPU Unit in no-protocol mode. <ul style="list-style-type: none"> <li>When the number of bytes was specified: ON when more data is received after the reception was completed but before RXD(235) was executed.</li> <li>When the end code was specified: ON when more data is received after the end code was received but before RXD(235) was executed. ON when 257 bytes are received before the end code.</li> </ul> |   |                          |                    |                            |                         |
|         | 12   | Serial Port 1 Communications Error Flag (CP1L EM-type CPU Units)                   | <ul style="list-style-type: none"> <li>ON when a communications error has occurred at the serial port 1 of a CP1L EM-type CPU Unit. (Not valid in Peripheral Bus Mode or NT Link mode.)</li> <li>ON when a timeout error, overrun error, framing error, parity error, or BCC error occurs in Serial Gateway mode.</li> </ul>  | ON: Error<br>OFF: No error                              | Retained                 | Cleared            | ---                        | ---                     |
|         | 13   | Serial Port 1 Send Ready Flag (No-protocol Mode) (CP1L EM-type CPU Units)          | ON when the serial port 1 of a CP1L EM-type CPU Unit is able to send data in no-protocol mode.  | ON: Able-to-send<br>OFF: Unable-to-send                 | Retained                 | Cleared            | Written after transmission | ---                     |
|         | 14   | Serial Port 1 Reception Completed Flag (No-protocol Mode) (CP1L EM-type CPU Units) | ON when the serial port 1 of a CP1L EM-type CPU Unit has completed the reception in no-protocol mode. <ul style="list-style-type: none"> <li>When the number of bytes was specified: ON when the specified number of bytes is received.</li> <li>When the end code was specified: ON when the end code is received or 256 bytes are received.</li> </ul>  | ON: Reception completed<br>OFF: Reception not completed | Retained                 | Cleared            | Written after reception    | ---                     |
|         | 15   | Serial Port 1 Reception Overflow Flag (No-protocol Mode) (CP1L EM-type CPU Units)  | ON when a data overflow occurred during reception through the serial port 1 of a CP1L EM-type CPU Unit in no-protocol mode. <ul style="list-style-type: none"> <li>When the number of bytes was specified: ON when more data is received after the reception was completed but before RXD(235) was executed.</li> <li>When the end code was specified: ON when more data is received after the end code was received but before RXD(235) was executed. ON when 257 bytes are received before the end code.</li> </ul> | ON: Overflow<br>OFF: No overflow                        | Retained                 | Cleared            | ---                        | ---                     |

| Address |          | Name  | Function  | Settings  | Status after mode change | Status at start-up   | Write timing  | Related flags, settings |
|---------|----------|---|---|---|--------------------------|----------------------|---|-------------------------|
| Words   | Bits     |   |   |   |                          |                      |   |                         |
| A393    | 00 to 07 | Serial Port 2 PT Communications Flags (CP1L EM-type CPU Units)              | The corresponding bit will be ON when the serial port 2 of a CP1L EM-type CPU Unit is communicating with a PT in NT Link or Serial PLC Link mode.<br>Bits 0 to 7 correspond to units 0 to 7.  | ON: Communicating<br>OFF: Not communicating             | Retained                 | Cleared              | Refreshed when there is a normal response to the token. | ---                     |
|         |          | Serial Port 1 PT Communications Flags (CP1L EL-type CPU Units)              | The corresponding bit will be ON when the serial port 1 of a CP1L EL-type CPU Unit is communicating with a PT in NT Link or Serial PLC Link mode.<br>Bits 0 to 7 correspond to units 0 to 7.  |   |                          |                      |   |                         |
|         | 08 to 15 | Serial Port 2 PT Priority Registered Flags (CP1L EM-type CPU Units)         | The corresponding bit will be ON for the PT that has priority when the serial port 2 of a CP1L EM-type CPU Unit is communicating in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7.<br>These flags are written when the priority registration command is received. | ON: Priority registered<br>OFF: Priority not registered | Retained                 | Cleared              | See Function column.                                    | ---                     |
|         |          | Serial Port 1 PT Priority Registered Flags (CP1L EL-type CPU Units)         | The corresponding bit will be ON for the PT that has priority when the serial port 1 of a CP1L EL-type CPU Unit is communicating in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7.<br>These flags are written when the priority registration command is received. |   |                          |                      |   |                         |
|         | 00 to 15 | Serial Port 2 Reception Counter (No-protocol Mode) (CP1L EM-type CPU Units) | Indicates (in binary) the number of bytes of data received when the serial port 2 of a CP1L EM-type CPU Unit is in no-protocol mode.  | ---   | Retained                 | Cleared              | Refreshed when data is received.                        | ---                     |
|         |          | Serial Port 1 Reception Counter (No-protocol Mode) (CP1L EL-type CPU Units) | Indicates (in binary) the number of bytes of data received when the serial port 1 of a CP1L EL-type CPU Unit is in no-protocol mode.  |   |                          |                      |   |                         |
| A394    | 00 to 07 | Serial Port 1 PT Communications Flags (CP1L EM-type CPU Units)              | The corresponding bit will be ON when the serial port 1 of a CP1L EM-type CPU Unit is communicating with a PT in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7.   | ON: Communicating<br>OFF: Not communicating             | Retained                 | Cleared              | Refreshed when there is a normal response to the token. | ---                     |
|         | 08 to 15 | Serial Port 1 PT Priority Registered Flags (CP1L EM-type CPU Units)         | The corresponding bit will be ON for the PT that has priority when the serial port 1 of a CP1L EM-type CPU Unit is communicating in NT link mode.<br>Bits 0 to 7 correspond to units 0 to 7.  | ON: Priority registered<br>OFF: Priority not registered | Retained                 | Cleared              | See Function column.                                    | ---                     |
|         | 00 to 15 | Serial Port 1 Reception Counter (No-protocol Mode) (CP1L EL-type CPU Units) | Indicates (in binary) the number of bytes of data received when serial port 1 of a CP1L EL-type CPU Unit is in no-protocol mode.  | ---   | Retained                 | Cleared              | Refreshed when data is received.                        | ---                     |
| A395    | 12       | DIP Switch Pin 3 Status Flag  | The status of pin 3 on the DIP switch on the front of the CPU Unit is written to this flag every cycle.   | ON: Pin 3 ON<br>OFF: Pin 3 OFF                          | Retained                 | See Function column. | Written every cycle.                                    | ---                     |

| Address |      | Name                                   | Function   | Settings   | Status after mode change | Status at start-up | Write timing                                   | Related flags, settings                |
|---------|------|--|--|--|--------------------------|--------------------|--|--|
| Words   | Bits |  |  |  |                          |                    |  |  |
| A400    | All  | Error code                             | When a non-fatal error (user-defined FAL(006) or system error) or a fatal error (user-defined FALS(007) or system error) occurs, the 4-digit hexadecimal error code is written to this word. When two or more errors occur simultaneously, the highest error code will be recorded.  | ---  | Cleared                  | Cleared            | Refreshed when error occurs.                   | ---                                    |
| A401    | 00   | Other Fatal Error Flag                 | ON when a fatal error that is not defined for A401.01 to A401.15 occurs. Detailed information is output to the bits of A314.<br>There are no errors that affect this flag at this time. This flag is reserved by the system.   | OFF: No other fatal error<br>ON: Other fatal error     | Cleared                  | Cleared            | Refreshed when error occurs.                   | A314                                   |
|         | 04   | Ethernet Controller Stop Flag          | ON when Ethernet controller stop because of sum value of MAC address error or controller error.  | ON: Error<br>OFF: No error                             | ---                      | Cleared            | Refreshed when error occurs.                   | ---                                    |
|         | 06   | FALS Error Flag (fatal error)          | ON when a fatal error is generated by the FALS(007) instruction. The CPU Unit will stop operating and the ERR/ALM indicator will light.<br>The corresponding error code will be written to A400. Error codes C101 to C2FF correspond to FALS numbers 001 to 511.<br>This flag will be turned OFF when the FALS errors are cleared.   | ON: FALS(007) executed<br>OFF: FALS(007) not executed  | Cleared                  | Cleared            | Refreshed when error occurs.                   | A400                                   |
|         | 08   | Cycle Time Too Long Flag (fatal error) | ON if the cycle time exceeds the maximum cycle time set in the PLC Setup (the cycle time monitoring time). CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light.<br>This flag will be turned OFF when the error is cleared.  | OFF: Cycle time under max.<br>ON: Cycle time over max. | Cleared                  | Cleared            | Refreshed when the cycle time exceeds maximum. | PLC Setup (Cycle time monitoring time) |
|         | 09   | Program Error Flag (fatal error)       | ON when program contents are incorrect.<br>CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light. The task number where the error occurred will be stored in A294 and the program address will be stored in A298 and A299.<br>The type of program error that occurred will be stored in A295.08 to A295.15. Refer to the description of A295 for more details on program errors.<br>This flag will be turned OFF when the error is cleared. | ON: Error<br>OFF: No error                             | Cleared                  | Cleared            | Refreshed when error occurs.                   | A294, A295, A298 and A299              |

| Address |      | Name                                   | Function   | Settings   | Status after mode change | Status at start-up | Write timing                 | Related flags, settings                       |
|---------|------|--|--|--|--------------------------|--------------------|------------------------------|---|
| Words   | Bits |  |  |  |                          |                    |                              |   |
| A401    | 11   | Too Many I/O Points Flag (fatal error) | ON when the number of Expansion Units and Expansion I/O Units exceeds the limit, when the number of words allocated to these Units exceeds the limit, are mounted.<br>CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light.<br>This flag will be turned OFF when the error is cleared.   | ON: Error<br>OFF: No error                         | Cleared                  | Cleared            | Refreshed when error occurs. | A407  |
|         | 14   | I/O Bus Error Flag (fatal error)       | ON in the following cases:<br><ul style="list-style-type: none"> <li>When an error occurs in a data transfer between the CPU Unit and a Expansion Unit or Expansion I/O Unit. If this happens, 0A0A hex will be output to A404.</li> </ul> CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light.<br>(This flag will be turned OFF when the error is cleared.)  | ON: Error<br>OFF: No error                         | Cleared                  | Cleared            | Refreshed when error occurs. | A404  |
|         | 15   | Memory Error Flag (fatal error)        | ON when an error occurred in memory or there was an error in automatic transfer from the Memory Cassette when the power was turned ON.<br>CPU Unit operation will stop and the ERR/ALM indicator on the front of the CPU Unit will light.<br>The location where the error occurred is indicated in A403.00 to A403.08, and A403.09 will be turned ON if there was an error during automatic transfer at startup.<br>This flag will be turned OFF when the error is cleared. (The automatic transfer at startup error cannot be cleared without turning OFF the PLC.) | ON: Error<br>OFF: No error                         | Cleared                  | Cleared            | Refreshed when error occurs. | A403.00 to A403.08, A403.09, A403.11, A403.12 |
| A402    | 00   | Other Fatal Error Flag                 | ON when a non-fatal error that is not defined for A402.01 to A402.15 occurs. Detailed information is output to the bits of A315.<br>There are no errors that affect this flag at this time. This flag is reserved by the system.   | OFF: No other fatal error<br>ON: Other fatal error | Cleared                  | Cleared            | Refreshed when error occurs. | A315  |
|         | 04   | Battery Error Flag (non-fatal error)   | ON if the CPU Unit's battery is disconnected or its voltage is low and the Detect Battery Error setting has been set in the PLC Setup.<br>The CPU Unit will continue operating and the ERR/ALM indicator on the front of the CPU Unit will flash.<br>This flag can be used to control an external warning light or other indicator to indicate that the battery needs to be replaced.<br>(This flag will be turned OFF when the error is cleared.)   | ON: Error<br>OFF: No error                         | Cleared                  | Cleared            | Refreshed when error occurs. | PLC Setup (Detect Battery Error)              |
|         | 10   | PLC Setup Error Flag (non-fatal error) | ON when there is a setting error in the PLC Setup. The CPU Unit will continue operating and the ERR/ALM indicator on the front of the CPU Unit will flash. The location of the error will be written to A406.<br>(This flag will be turned OFF when the error is cleared.)   | ON: Error<br>OFF: No error                         | Cleared                  | Cleared            | Refreshed when error occurs. | A406  |

| Address |          | Name  | Function   | Settings   | Status after mode change | Status at start-up | Write timing                       | Related flags, settings |
|---------|----------|---|--|--|--------------------------|--------------------|------------------------------------|-------------------------|
| Words   | Bits     |   |  |  |                          |                    |                                    |                         |
| A402    | 15       | FAL Error Flag (non-fatal error)            | ON when a non-fatal error is generated by executing FAL(006). The CPU Unit will continue operating and the ERR/ALM indicator on the front of the CPU Unit will flash.<br><br>The bit in A360 to A391 that corresponds to the FAL number specified in FAL(006) will be turned ON and the corresponding error code will be written to A400. Error codes 4101 to 42FF correspond to FAL numbers 001 to 2FF (0 to 511).<br>(This flag will be turned OFF when the error is cleared.) | ON: FAL(006) error occurred<br>OFF: FAL(006) not executed  | Cleared                  | Cleared            | Refreshed when error occurs.       | A360 to A391, A400      |
| A403    | 00 to 08 | Memory Error Location                       | When a memory error occurs, the Memory Error Flag (A40115) is turned ON and one of the following flags is turned ON to indicate the memory area where the error occurred<br><br>A403.00: User program<br>A403.04: PLC Setup<br>A403.07: Routing Table<br><br>When a memory error occurs, the CPU Unit will continue operating and the ERR/ALM indicator on the front of the CPU Unit will flash.<br>(The corresponding flag will be turned OFF when the error is cleared.)       | ON: Error<br>OFF: No error   | Cleared                  | Cleared            | Refreshed when error occurs.       | A401.15                 |
|         | 09       | Memory Cassette startup Transfer Error Flag | ON when automatic transfer at start-up has been selected and an error occurs during automatic transfer. An error will occur if there is a transfer error, the specified file does not exist, or the Memory Cassette is not installed.<br><br>(This flag will be turned OFF when the error is cleared by turning the power OFF. The error cannot be cleared without turning the power OFF.)   | ON: Error<br>OFF: No error   | Cleared                  | Cleared            | Refreshed when power is turned ON. | ---                     |
|         | 10       | Flash Memory Error Flag                     | ON when the flash memory is physically destroyed.  | ON: Error<br>OFF: No error   | Cleared                  | Cleared            | Refreshed when error is detected.  | ---                     |
|         | 11       | IP Address Table Checksum Error Flag        | ON when a checksum error has occurred in IP address table.   | ON: Error<br>OFF: No error   | Cleared                  | Cleared            | Refreshed when error occurs.       | A401.15                 |
|         | 12       | IP router Table Checksum Error Flag         | ON when a checksum error has occurred in IP router table.  | ON: Error<br>OFF: No error   | Cleared                  | Cleared            | Refreshed when error occurs.       | A401.15                 |
|         |          |   |  |  |                          |                    |                                    |                         |
| A404    | All      | I/O Bus Error Details                       | Contains information on I/O bus errors.<br><br>The CPU Unit will stop operating and the ERR/ALM indicator on the front of the CPU Unit will light.<br>(A401.14 (I/O Bus Error Flag) will turn ON.)<br>(This information will be cleared when the error is cleared.)  | 0A0A hex: CP-series Unit error<br>0000 hex: CJ-series Unit error, 1st Unit<br>0001 hex: CJ-series Unit error, 2nd Unit<br>0F0F hex: CJ-series Unit error, unknown Unit<br>0E0E hex: CJ-series Unit error, no End cover | Cleared                  | Cleared            | Refreshed when error is detected.  | A401.14                 |

| Address |          | Name   | Function   | Settings   | Status after mode change | Status at start-up | Write timing                         | Related flags, settings     |
|---------|----------|--|--|--|--------------------------|--------------------|--------------------------------------|-----------------------------|
| Words   | Bits     |  |  |  |                          |                    |                                      |                             |
| A406    | All      | PLC Setup Error Location   | When there is a setting error in the PLC Setup, the location of that error is written to A406 in 4-digit hexadecimal.<br>The CPU Unit will continue operating and the ERR/ALM indicator on the front of the CPU Unit will flash.<br>(A406 will be cleared when the cause of the error is eliminated.)          | 0000 to 01FF hexadecimal   | Cleared                  | Cleared            | Refreshed when error occurs.         | A402.10                     |
| A407    | 00 to 12 | Too Many I/O Points, Details   | Always 0000 hex.   | 0000 hex   | Cleared                  | Cleared            | ---                                  | A401.11, A407.13 to A407.15 |
|         | 13 to 15 | Too Many I/O Points, Cause   | The 3-digit binary value of these bits indicates the cause of the Too Many I/O Points Error.<br><b>Note</b> These bits will be cleared when the error is cleared.  | 010: Too many Expansion Unit and Expansion I/O Unit words<br>011: Too many Expansion Units and Expansion I/O Units | Cleared                  | Cleared            | Refreshed when error occurs.         | ---                         |
| A424    | 00 to 15 | Error Option Board Flags   | The bit corresponding to the option slot turns ON when an error occurs in an Option Board (A315.13 will be ON).<br>Bit 00: Option slot 1<br>Bit 01: Option slot 2  | ON: Error<br>OFF: No error   | Cleared                  | Cleared            | ---                                  | A353.13                     |
| A435    | 14       | I/O Option Board Run State Flag (CP1L-EM: Option 1/left)                     | Turn ON when the I/O Option Board works normally.<br>Turn OFF when the I/O Option Board is in initial state or abnormality state.  | ON: I/O option board works normally<br>OFF: In initial state or abnormality state                                  | ---                      | Cleared            | When I/O option board state changes. | ---                         |
|         | 15       | I/O Option Board Run State Flag (CP1L-EM: Option 2/right, CP1L-EL: Option 1) | Turn ON when the I/O Option Board works normally.<br>Turn OFF when the I/O Option Board is in initial state or abnormality state.  | ON: I/O option board works normally<br>OFF: In initial state or abnormality state                                  | ---                      | Cleared            | When I/O option board state changes. | ---                         |
| A436    | 00 to 05 | Unit Error Flags   | ON when an error occurs in a CP-series Expansion Unit or Expansion I/O Unit.<br>A436.00: 1st Unit<br>A436.01: 2nd Unit<br>A436.02: 3rd Unit<br>A436.03: 4th Unit<br>A436.04: 5th Unit<br>A436.05: 6th Unit<br>CP1W-AD041/DA041, CP1W-32ER/32ET/32ET1, CP1W-TS002 and CP1W-TS102 are each counted as two Units. | OFF: No error<br>ON: Error   | Retained                 | Cleared            | ---                                  | ---                         |
| A437    | All      | Number of Connected Units  | Stores the number of Expansion Units and Expansion I/O Units connected as a hexadecimal number.<br><b>Note</b> This information is valid only when a Too Many I/O Points error has occurred. CP1W-AD041/DA041, CP1W-32ER/32ET/32ET1, CP1W-TS002 and CP1W-TS102 are each counted as two Units.                  | 0000 to 0006 hex   | Retained                 | Cleared            | ---                                  | ---                         |

| Address |          | Name                                     | Function   | Settings                   | Status after mode change | Status at start-up | Write timing   | Related flags, settings |
|---------|----------|--|--|----------------------------|--------------------------|--------------------|--|-------------------------|
| Words   | Bits     |  |  |                            |                          |                    |  |                         |
| A438    | All      | Pulse Output 2 Stop Error Code           | If a Pulse Output Stop Error occurs for pulse output 2, the error code is stored.  | ---                        | Retained                 | Cleared            | Refreshed when origin search starts.<br>Refreshed when a pulse output stop error occurs. | ---                     |
| A439    | All      | Pulse Output 3 Stop Error Code           | If a Pulse Output Stop Error occurs for pulse output 3, the error code is stored.  | ---                        | Retained                 | Cleared            | Refreshed when origin search starts.<br>Refreshed when a pulse output stop error occurs. | ---                     |
| A440    | All      | Max. Interrupt Task Processing Time      | Contains the Maximum Interrupt Task Processing Time in units of 0.1 ms.<br>(This value is written after the interrupt task with the max. processing time is executed and cleared when PLC operation begins.)   | 0000 to FFFF hexadecimal   | Cleared                  | Cleared            | See Function column.   | ---                     |
| A441    | All      | Interrupt Task With Max. Processing Time | Contains the task number of the interrupt task with the maximum processing time. Hexadecimal values 8000 to 80FF correspond to task numbers 00 to FF. Bit 15 is turned ON when an interrupt has occurred.<br>(This value is written after the interrupt task with the max. processing time is executed and cleared when PLC operation begins.)   | 8000 to 80FF hexadecimal   | Cleared                  | Cleared            | See Function column.   | ---                     |
| A444    | All      | Pulse Output 0 Stop Error Code           | If a Pulse Output Stop Error occurs for pulse output 0, the error code is written to this word.  | ---                        | ---                      | Cleared            | Refreshed when origin search starts.   | ---                     |
| A445    | All      | Pulse Output 1 Stop Error Code           | If a Pulse Output Stop Error occurs for pulse output 1, the error code is written to this word.  | ---                        | ---                      | Cleared            | Refreshed when a pulse output stop error occurs.   | ---                     |
| A494    | 00 to 07 | Memory Cassette Verification Results     | Stores the results of comparing data in the Memory Cassette and CPU Unit. This information is cleared the next time the Memory Cassette is accessed normally (initialized, written, read, or compared).<br>A494.00: User program is different.<br>A494.01: Function block sources are different.<br>A494.02: Parameter area is different.<br>A494.03: Symbol table is different.<br>A494.04: Comments are different.<br>A494.05: Program indices are different.<br>A494.06: Data memory is different.<br>A494.07: DM initial values are different. | OFF: Match<br>ON: Mismatch | ---                      | ---                | When Memory Cassette is compared.  | ---                     |

## Read/Write Area (Set by User)

| Addresses |      | Name                                    | Function   | Settings                          | Status after mode change | Status at startup    | Write timing         | Related Flags, Settings                           |
|-----------|------|---|--|-----------------------------------|--------------------------|----------------------|----------------------|---|
| Word      | Bits |   |  |                                   |                          |                      |                      |   |
| A500      | 11   | Ethernet Communication Error Clear Flag | Turn this bit ON to clear Ethernet communication error (Ethernet communication error flag turns OFF).  | OFF to ON: Clear                  | Retained                 | Cleared              | ---                  | A40 to A44<br>A46.15                              |
|           | 12   | IOM Hold Bit                            | Turn this bit ON to preserve the status of the I/O Memory when shifting from PROGRAM to RUN or MONITOR mode or vice versa. The I/O Memory includes the CIO Area, Transition Flags, Timer Flags and PVs, Index Registers, and Data Registers.<br><br>(If the status of the IOM Hold Bit itself is preserved in the PLC Setup (IOM Hold Bit Status), the status of the I/O Memory Area will be retained when the PLC is turned ON or power is interrupted.)  | ON: Retained<br>OFF: Not retained | Retained                 | See Function column. | See Function column. | PLC Setup (IOM Hold Bit Status setting)           |
|           | 13   | Forced Status Hold Bit                  | Turn this bit ON to preserve the status of bits that have been force-set or force-reset when shifting from PROGRAM to MONITOR mode or vice versa. Bits that have been force-set or force-reset will always return to their default status when shifting to RUN mode.<br><br>(If the status of the Forced Status Hold Bit itself is preserved in the PLC Setup (Forced Status Hold Bit Status), the status of force-set and force-reset bits will be retained when the PLC is turned ON or power is interrupted.) | ON: Retained<br>OFF: Not retained | Retained                 | See Function column. | See Function column. | PLC Setup (Forced Status Hold Bit Status setting) |
|           | 14   | Error Log Reset Bit                     | Turn this bit ON to reset the Error Log Pointer (A300) to 00.<br>The contents of the Error Log Area itself (A100 to A199) are not cleared. (This bit is automatically reset to 0 after the Error Log Pointer is reset.)  | OFF to ON: Clear                  | Retained                 | Cleared              | ---                  | A100 to A199,<br>A300                             |
|           | 15   | Output OFF Bit                          | Turn this bit ON to turn OFF all outputs from the CPU Unit, and Special I/O Units. The INH indicator on the front of the CPU Unit will light while this bit is ON.<br><br>(The status of the Output OFF Bit is retained through power interruptions.)  | ---                               | Retained                 | Retained             | ---                  | ---   |



| Addresses    |      | Name                                 | Function   | Settings  | Status after mode change | Status at startup    | Write timing                       | Related Flags, Settings |
|--------------|------|--------------------------------------|--|---|--------------------------|----------------------|------------------------------------|-------------------------|
| Word         | Bits |                                      |  |   |                          |                      |                                    |                         |
| A508         | 09   | Differentiate Monitor Completed Flag | ON when the differentiate monitor condition has been established during execution of differentiation monitoring.<br>(This flag will be cleared to 0 when differentiation monitoring starts.)   | ON: Monitor condition established<br>OFF: Not yet established                 | Retained                 | Cleared              | ---                                | ---                     |
|              | 11   | Trace Trigger Monitor Flag           | ON when a trigger condition is established by the Trace Start Bit (A508.14). OFF when the next Data Trace is started by the Sampling Start bit (A508.15).  | ON: Trigger condition established<br>OFF: Not yet established or not tracing  | Retained                 | Cleared              | ---                                | ---                     |
|              | 12   | Trace Completed Flag                 | ON when sampling of a region of trace memory has been completed during execution of a Trace.<br>OFF when the next time the Sampling Start Bit (A508.15) is turned ON.  | ON: Trace completed<br>OFF: Not tracing or trace in progress                  | Retained                 | Cleared              | ---                                | ---                     |
|              | 13   | Trace Busy Flag                      | ON when the Sampling Start Bit (A508.15) is turned ON. OFF when the trace is completed.  | ON: Trace in progress<br>OFF: Not tracing (not sampling)                      | Retained                 | Cleared              | ---                                | ---                     |
|              | 14   | Trace Start Bit                      | Turn this bit ON to establish the trigger condition. The offset indicated by the delay value (positive or negative) determines which data samples are valid.   | ON: Trace trigger condition established<br>OFF: Not established               | Retained                 | Cleared              | ---                                | ---                     |
|              | 15   | Sampling Start Bit                   | When a data trace is started by turning this bit ON from the CX-Programmer, the PLC will begin storing data in Trace Memory by one of the three following methods:<br>1) Data is sampled at regular intervals (10 to 2,550 ms).<br>2) Data is sampled when TRSM(045) is executed in the program.<br>3) Data is sampled at the end of every cycle.<br>The operation of A508.15 can be controlled only from the CX-Programmer. | OFF to ON: Starts data trace (sampling)<br>Turned ON from Programming Device. | Retained                 | Cleared              | ---                                | ---                     |
| A510 to A511 | All  | startup Time                         | These words contain the time at which the power was turned ON. The contents are updated every time that the power is turned ON. The data is stored in BCD.<br>A510.00 to A510.07: Second (00 to 59)<br>A510.08 to A510.15: Minute (00 to 59)<br>A511.00 to A511.07: Hour (00 to 23)<br>A511.08 to A511.15: Day of month (01 to 31)   | See Function column.  | Retained                 | See Function column. | Refreshed when power is turned ON. | ---                     |
| A512 to A513 | All  | Power Interruption Time              | These words contain the time at which the power was interrupted. The contents are updated every time that the power is interrupted. The data is stored in BCD.<br>A512.00 to A512.07: Second (00 to 59)<br>A512.08 to A512.15: Minute (00 to 59)<br>A513.00 to A513.07: Hour (00 to 23)<br>A513.08 to A513.15: Day of month (01 to 31)<br>(These words are not cleared at startup.)  | See Function column.  | Retained                 | Retained             | Written at power interruption      | ---                     |

| Addresses    |      | Name                          | Function   | Settings                 | Status after mode change | Status at startup | Write timing                       | Related Flags, Settings |
|--------------|------|-------------------------------|--|--------------------------|--------------------------|-------------------|------------------------------------|-------------------------|
| Word         | Bits |                               |  |                          |                          |                   |                                    |                         |
| A514         | All  | Number of Power Interruptions | Contains the number of times that power has been interrupted since the power was first turned ON. The data is stored in binary. To reset this value, overwrite the current value with 0000.<br><br>(This word is not cleared at startup, but it is cleared when the Memory Corruption Detected Flag (A395.11) goes ON.)  | 0000 to FFFF hexadecimal | Retained                 | Retained          | Refreshed when power is turned ON. | A395.11                 |
| A515 to A517 | All  | Operation Start Time          | The time that operation started as a result of changing the operating mode to RUN or MONITOR mode is stored here in BCD.<br>A515.00 to A515.07: Seconds (00 to 59)<br>A515.08 to A515.15: Minutes (00 to 59)<br>A516.00 to A516.07: Hour (00 to 23)<br>A516.08 to A516.15: Day of month (01 to 31)<br>A517.00 to A517.07: Month (01 to 12)<br>A517.08 to A517.15: Year (00 to 99)<br><b>Note</b> The previous start time is stored after turning ON the power supply until operation is started.   | See at left.             | Retained                 | Retained          | See at left.                       | ---                     |
| A518 to A520 | All  | Operation End Time            | The time that operation stopped as a result of changing the operating mode to PROGRAM mode is stored here in BCD.<br>A518.00 to A518.07: Seconds (00 to 59)<br>A518.08 to A518.15: Minutes (01 to 59)<br>A519.00 to A519.07: Hour (00 to 23)<br>A519.08 to A519.15: Day of month (01 to 31)<br>A520.00 to A520.07: Month (01 to 12)<br>A520.08 to A520.15: Year (00 to 99)<br><b>Note</b> If an error occurs in operation, the time of the error will be stored. If the operating mode is then changed to PROGRAM mode, the time that PROGRAM mode was entered will be stored. | See at left.             | Retained                 | Retained          | See at left.                       | ---                     |
| A523         | All  | Total Power ON Time           | Contains the total time that the PLC has been ON in 10-hour units. The data is stored in binary and it is updated every 10 hours. To reset this value, overwrite the current value with 0000.<br><br>(This word is not cleared at startup, but it is cleared to 0000 when the Memory Corruption Detected Flag (A395.11) goes ON.)  | 0000 to FFFF hexadecimal | Retained                 | Retained          | ---                                | ---                     |

| Addresses |          | Name   | Function  | Settings  | Status after mode change | Status at startup | Write timing | Related Flags, Settings |
|-----------|----------|--|---|---|--------------------------|-------------------|--------------|-------------------------|
| Word      | Bits     |  |   |   |                          |                   |              |                         |
| A526      | 00       | Serial Port 2 Restart Bit (CP1L EM-type CPU Units) | Turn this bit ON to restart the serial port 2 of a CP1L EM-type CPU Unit. (Do not use this bit when the port is operating in Peripheral Bus Mode.)<br><b>Note</b> This bit is turned OFF automatically when the restart processing is completed.  | OFF to ON: Restart  | Retained                 | Cleared           | ---          | ---                     |
|           |          | Serial Port 1 Restart Bit (CP1L EL-type CPU Units) | Turn this bit ON to restart the serial port 1 of a CP1L EL-type CPU Unit. (Do not use this bit when the port is operating in Peripheral Bus Mode.)<br><b>Note</b> This bit is turned OFF automatically when the restart processing is completed.  |   |                          |                   |              |                         |
|           | 01       | Serial Port 1 Restart Bit (CP1L EM-type CPU Units) | Turn this bit ON to restart the serial port 1 of a CP1L EM-type CPU Unit.<br><b>Note</b> This bit is turned OFF automatically when the restart processing is completed.   | 0 to ON: Restart  | Retained                 | Cleared           | ---          | ---                     |
| A527      | 00 to 07 | Online Editing Disable Bit Validator               | The Online Editing Disable Bit (A527.09) is valid only when this byte contains 5A.<br><br>To disable online editing from the CX-Programmer, set this byte to 5A and turn ON A527.09.<br><br>(Online editing refers to changing or adding to the program while the PLC is operating in MONITOR mode.)  | 5A: A527.09 enabled<br>Other value: A527.09 disabled  | Retained                 | Cleared           | ---          | A527.09                 |
|           | 09       | Online Editing Disable Bit                         | Turn this bit ON to disable online editing. The setting of this bit is valid only when A527.00 to A527.07 have been set to 5A.  | ON: Disabled<br>OFF: Not disabled   | Retained                 | Cleared           | ---          | A527.00 to A527.07      |
| A528      | 00 to 07 | Serial Port 2 Error Flags (CP1L EM-type CPU Units) | These flags indicate what kind of error has occurred at the serial port 2 of a CP1L EM-type CPU Unit; they are automatically turned OFF when the serial port 2 is restarted.<br>(These flags are not valid in peripheral bus mode and only bit 5 is valid in NT Link mode.)<br>PLC Link Polling Unit:<br>Bit 05: ON for timeout error.<br>PLC Link Polled Unit:<br>Bit 03: ON for framing error.<br>Bit 04: ON for overrun error.<br>Bit 05: ON for timeout error.<br>These bits can be cleared by the CX-Programmer. | Bits 00 and 01: Not used.<br>Bit 02: ON for parity error.<br>Bit 03: ON for framing error.<br>Bit 04: ON for overrun error.<br>Bit 05: ON for timeout error.<br>Bits 06 and 07: Not used. | Retained                 | Cleared           | ---          | ---                     |
|           |          | Serial Port 1 Error Flags (CP1L EL-type CPU Units) | These flags indicate what kind of error has occurred at the serial port 1 of a CP1L EL-type CPU Unit; they are automatically turned OFF when the serial port 1 is restarted.<br>(These flags are not valid in peripheral bus mode and only bit 5 is valid in NT Link mode.)<br>PLC Link Polling Unit:<br>Bit 05: ON for timeout error.<br>PLC Link Polled Unit:<br>Bit 03: ON for framing error.<br>Bit 04: ON for overrun error.<br>Bit 05: ON for timeout error.<br>These bits can be cleared by the CX-Programmer. |   |                          |                   |              |                         |

| Addresses |          | Name  | Function  | Settings  | Status after mode change | Status at startup | Write timing | Related Flags, Settings |
|-----------|----------|---|---|---|--------------------------|-------------------|--------------|-------------------------|
| Word      | Bits     |   |   |   |                          |                   |              |                         |
| A528      | 08 to 15 | Serial Port 1 Error Code (CP1L EM-type CPU Units) | These flags indicate what kind of error has occurred at the serial port 1 of a CP1L EM-type CPU Unit; they are automatically turned OFF when the serial port 1 is restarted.<br>(These flags are not valid in peripheral bus mode and only bit 5 is valid in NT Link mode.)<br>PLC Link Polling Unit:<br>Bit 13: ON for timeout error.<br>PLC Link Polled Unit:<br>Bit 11: ON for framing error.<br>Bit 12: ON for overrun error.<br>Bit 13: ON for timeout error.<br>These bits can be cleared by the CX-Programmer. | Bits 08 and 09: Not used.<br>Bit 10: ON for parity error.<br>Bit 11: ON for framing error.<br>Bit 12: ON for overrun error.<br>Bit 13: ON for timeout error.<br>Bits 14 and 15: Not used. | Retained                 | Cleared           | ---          | ---                     |
| A529      | All      | FAL/FALS Number for System Error Simulation       | Set a dummy FAL/FALS number to use to simulate the system error using FAL(006) or FALS(007).<br>When FAL(006) or FALS(007) is executed and the number in A529 is the same as the one specified in the operand of the instruction, the system error given in the operand of the instruction will be generated instead of a user-defined error.   | 0001 to 01FF hex: FAL/FALS numbers 1 to 511<br>0000 or 0200 to FFFF hex: No FAL/FALS number for system error simulation. (No error will be generated.)                                    | Retained                 | Cleared           | ---          | ---                     |
| A531      | 00       | High-speed Counter 0 Reset Bit                    | When the reset method is set to Phase-Z signal + Software reset, the corresponding high-speed counter's PV will be reset if the phase-Z signal is received while this bit is ON.<br>When the reset method is set to Software reset, the corresponding high-speed counter's PV will be reset in the cycle when this bit turns ON.  | ---   | Retained                 | Cleared           | ---          | ---                     |
|           | 01       | High-speed Counter 1 Reset Bit                    |   | ---   | Retained                 | Cleared           | ---          | ---                     |
|           | 08       | High-speed Counter 0 Gate Bit                     | When a counter's Gate Bit is ON, the counter's PV will not be changed even if pulse inputs are received for the counter.  | ---   | Retained                 | Cleared           | ---          | ---                     |
|           | 09       | High-speed Counter 1 Gate Bit                     | When the bit is turned OFF again, counting will restart and the high-speed counter's PV will be refreshed.<br>When the reset method is set to Phase-Z signal + Software reset, the Gate Bit is disabled while the corresponding Reset Bit (A531.00 or A531.01) is ON.   | ---   | Retained                 | Cleared           | ---          | ---                     |
| A532      | All      | Interrupt Counter 0 Counter SV                    | Used for interrupt input 0 in counter mode.<br>Sets the count value at which the interrupt task will start. Interrupt task 140 will start when interrupt counter 0 has counted this number of pulses.<br>Retained when operation starts.  | ---   | Retained                 | Retained          | ---          | ---                     |
| A533      | All      | Interrupt Counter 1 Counter SV                    | Used for interrupt input 1 in counter mode.<br>Sets the count value at which the interrupt task will start. Interrupt task 141 will start when interrupt counter 1 has counted this number of pulses.   | ---   | Retained                 | Retained          | ---          | ---                     |
| A534      | All      | Interrupt Counter 2 Counter SV                    | Used for interrupt input 2 in counter mode.<br>Sets the count value at which the interrupt task will start. Interrupt task 142 will start when interrupt counter 2 has counted this number of pulses.   | ---   | Retained                 | Retained          | ---          | ---                     |

| Addresses |      | Name  | Function  | Settings | Status after mode change | Status at startup | Write timing   | Related Flags, Settings |
|-----------|------|---|---|----------|--------------------------|-------------------|--|-------------------------|
| Word      | Bits |   |   |          |                          |                   |  |                         |
| A535      | All  | Interrupt Counter 3 Counter SV              | Used for interrupt input 3 in counter mode.<br>Sets the count value at which the interrupt task will start. Interrupt task 143 will start when interrupt counter 3 has counted this number of pulses.                                 | ---      | Retained                 | Retained          | ---  | ---                     |
| A536      | All  | Interrupt Counter 0 Counter PV              | These words contain the interrupt counter PVs for interrupt inputs operating in counter mode.   | ---      | ---                      | Retained          | Refreshed when interrupt is generated.<br>Refreshed when INI(880) instruction is executed. | ---                     |
| A537      | All  | Interrupt Counter 1 Counter PV              | In increment mode, the counter PV starts incrementing from 0. When the counter PV reaches the counter SV, the PV is automatically reset to 0.   | ---      | ---                      |                   |  | ---                     |
| A538      | All  | Interrupt Counter 2 Counter PV              | In decrement mode, the counter PV starts decrementing from the counter SV. When the counter PV reaches the 0, the PV is automatically reset to the SV.  | ---      | ---                      |                   |  | ---                     |
| A539      | All  | Interrupt Counter 3 Counter PV              | Cleared when operation starts.  | ---      | ---                      |                   |  | ---                     |
| A540      | 00   | Pulse Output 0 Reset Bit                    | The pulse output 0 PV (contained in A276 and A277) will be cleared when this bit is turned ON.  | ---      | Retained                 | Cleared           | ---  | A276 and A277           |
|           | 08   | Pulse Output 0 CW Limit Input Signal Flag   | This is the CW limit input signal for pulse output 0, which is used in the origin search. To use this signal, write the input from the actual sensor as an input condition in the ladder program and output the result to this flag.  | ---      | Retained                 | Cleared           | ---  | ---                     |
|           | 09   | Pulse Output 0 CCW Limit Input Signal Flag  | This is the CCW limit input signal for pulse output 0, which is used in the origin search. To use this signal, write the input from the actual sensor as an input condition in the ladder program and output the result to this flag. | ---      | Retained                 | Cleared           | ---  | ---                     |
|           | 10   | Pulse Output 0 Positioning Completed Signal | This is the positioning completed input signal used in the origin search for pulse output 0. The input signal from the servo driver is output to this bit from the ladder program to enable using the signal.                         | ---      | Retained                 | Cleared           | ---  | ---                     |
| A541      | 00   | Pulse Output 1 Reset Bit                    | The pulse output 1 PV (contained in A278 and A279) will be cleared when this bit is turned ON.  | ---      | Retained                 | Cleared           | ---  | A278 and A279           |
|           | 08   | Pulse Output 1 CW Limit Input Signal Flag   | This is the CW limit input signal for pulse output 1, which is used in the origin search. To use this signal, write the input from the actual sensor as an input condition in the ladder program and output the result to this flag.  | ---      | Retained                 | Cleared           | ---  | ---                     |
|           | 09   | Pulse Output 1 CCW Limit Input Signal Flag  | This is the CCW limit input signal for pulse output 1, which is used in the origin search. To use this signal, write the input from the actual sensor as an input condition in the ladder program and output the result to this flag. | ---      | Retained                 | Cleared           | ---  | ---                     |
|           | 10   | Pulse Output 1 Positioning Completed Signal | This is the positioning completed input signal used in the origin search for pulse output 1. The input signal from the servo driver is output to this bit from the ladder program to enable using the signal.                         | ---      | Retained                 | Cleared           | ---  | ---                     |

| Addresses |      | Name                              | Function   | Settings  | Status after mode change | Status at startup | Write timing   | Related Flags, Settings |
|-----------|------|-----------------------------------|--|---|--------------------------|-------------------|--|-------------------------|
| Word      | Bits |                                   |  |   |                          |                   |  |                         |
| A562      | 00   | Error Counter 0 Reset Bit         | Turn ON this bit to reset the Error Counter 0 Present Value and turn OFF the Error Counter 0 Error Flag.   | ---   | ---                      | Cleared           | ---  | ---                     |
|           | 01   | Error Counter 0 Disable Bit       | Turn ON this bit to hold the present value of error counter 0.   | ON: Error counter value held.<br>OFF: Error counter value not held. | ---                      | Cleared           | ---  | ---                     |
| A563      | 00   | Error Counter 1 Reset Bit         | Turn ON this bit to reset the Error Counter 1 Present Value and turn OFF the Error Counter 0 Error Flag.   | ---   | ---                      | Cleared           | ---  | ---                     |
|           | 01   | Error Counter 1 Disable Bit       | Turn ON this bit to hold the present value of error counter 1.   | ON: Error counter value held.<br>OFF: Error counter value not held. | ---                      | Cleared           | ---  | ---                     |
| A566      | 02   | Socket Force-close Switch         | All sockets are forcibly closed when this bit turns ON. Turned OFF by Unit after sockets are closed.   | ON: Request to Close<br>OFF: Closed                                 | ---                      | Cleared           | When the bit sets ON, all the socket will close. Then the bit will OFF.                            | ---                     |
|           | 04   | Automatic Clock Adjustment Switch | The automatic clock adjustment is executed when this bit turns ON. Turned OFF by Unit after automatic clock adjustment has been completed.                   | ON: Execute<br>OFF: Complete  | ---                      | Cleared           | When the bit sets ON, PLC time update, Then update PLC time completely, the bit OFF.               | ---                     |
| A567      | 00   | Opening Flag (Socket 1)           | The status of TCP/UDP Socket 1 is ON during open processing. (Turns ON when open request is received.) OFF when open processing has been completed.          | ON: Opening<br>OFF: Closed  | ---                      | Cleared           | When socket 1 status is opening, the bit will ON. After socket 1 status is opened, the bit is OFF. | ---                     |
|           | 01   | Receiving Flag (Socket 1)         | The status of TCP/UDP Socket 1 is ON during receive processing. (Turns ON when receive request is received.) OFF when receive processing has been completed. | ON: Start receive<br>OFF: Receive                                   | ---                      | Cleared           | When socket 1 is waiting to receive data.  | ---                     |
|           | 02   | Sending Flag (Socket 1)           | The status of TCP/UDP Socket 1 is ON during send processing. (Turns ON when send request is received.) OFF when send processing has been completed.          | ON: Start send<br>OFF: Send   | ---                      | Cleared           | When socket 1 starts sending, the bit will ON. After data is sent, the bit will OFF.               | ---                     |

| Addresses |      | Name                                  | Function  | Settings                          | Status after mode change | Status at startup | Write timing   | Related Flags, Settings |
|-----------|------|---------------------------------------|---|-----------------------------------|--------------------------|-------------------|--|-------------------------|
| Word      | Bits |                                       |   |                                   |                          |                   |  |                         |
| A567      | 03   | Closing Flag (Socket 1)               | The status of TCP/UDP Socket 1 is ON during close processing. (Turns ON when close request is received.) OFF when close processing has been completed.  | ON: Start close<br>OFF: Close     | ---                      | Cleared           | When socket 1 starts to close, the bit is ON. When socket 1 closes completely, the bit will OFF.               | ---                     |
|           | 13   | Data Received Flag (Socket 1)         | The status of TCP/UDP Socket 1 is ON when data from a remote node has been received at an open TCP socket. OFF when receive processing has been requested for an open TCP socket.                                 | ON: Receiving<br>OFF: Received    | ---                      | Cleared           | When the data needs to be received by socket 1, the bit will ON. After receiving completely, the bit will OFF. | ---                     |
|           | 14   | Results Storage Error Flag (Socket 1) | The status of TCP/UDP Socket 1 is ON if there is an error in storing the results when socket services are used by means of the CMND (490) instruction. OFF when the next request is received. (Connected by TCP.) | ON: Error<br>OFF: Normal          | ---                      | Cleared           | If socket 1 is in error status, the bit will ON.   | ---                     |
|           | 15   | TCP/UDP Open Flag (Socket 1)          | The status of TCP/UDP Socket 1 is ON when open processing has been completed. OFF when close processing has been completed. (Stays OFF for abnormal open processing completion.)                                  | ON: Opened<br>OFF: Closed         | ---                      | Cleared           | When socket 1 status is opened, the bit will ON. When socket 1 is closed, the bit will OFF.                    | ---                     |
| A568      | 00   | Opening Flag (Socket 2)               | The status of TCP/UDP Socket 2 is ON during open processing. (Turns ON when open request is received.) OFF when open processing has been completed.   | ON: Opening<br>OFF: Closed        | ---                      | Cleared           | When socket 2 status is opening, the bit will ON. After socket 2 status is opened, the bit is OFF.             | ---                     |
|           | 01   | Receiving Flag (Socket 2)             | The status of TCP/UDP Socket 2 is ON during receive processing. (Turns ON when receive request is received.) OFF when receive processing has been completed.  | ON: Start receive<br>OFF: Receive | ---                      | Cleared           | When socket 2 is waiting to receive data.  | ---                     |
|           | 02   | Sending Flag (Socket 2)               | The status of TCP/UDP Socket 2 is ON during send processing. (Turns ON when send request is received.) OFF when send processing has been completed.   | ON: Start send<br>OFF: Send       | ---                      | Cleared           | When socket 2 starts sending, the bit will ON. After data is sent, the bit will OFF.                           | ---                     |

| Addresses |      | Name                                  | Function  | Settings                          | Status after mode change | Status at startup | Write timing   | Related Flags, Settings |
|-----------|------|---------------------------------------|---|-----------------------------------|--------------------------|-------------------|--|-------------------------|
| Word      | Bits |                                       |   |                                   |                          |                   |  |                         |
| A568      | 03   | Closing Flag (Socket 2)               | The status of TCP/UDP Socket 2 is ON during close processing. (Turns ON when close request is received.) OFF when close processing has been completed.  | ON: Start close<br>OFF: Close     | ---                      | Cleared           | When socket 2 starts to close, the bit is ON. When socket 2 closes completely, the bit will OFF.               | ---                     |
|           | 13   | Data Received Flag (Socket 2)         | The status of TCP/UDP Socket 2 is ON when data from a remote node has been received at an open TCP socket. OFF when receive processing has been requested for an open TCP socket.                                 | ON: Receiving<br>OFF: Received    | ---                      | Cleared           | When the data needs to be received by socket 2, the bit will ON. After receiving completely, the bit will OFF. | ---                     |
|           | 14   | Results Storage Error Flag (Socket 2) | The status of TCP/UDP Socket 2 is ON if there is an error in storing the results when socket services are used by means of the CMND (490) instruction. OFF when the next request is received. (Connected by TCP.) | ON: Error<br>OFF: Normal          | ---                      | Cleared           | If socket 2 is in error status, the bit will ON.   | ---                     |
|           | 15   | TCP/UDP Open Flag (Socket 2)          | The status of TCP/UDP Socket 2 is ON when open processing has been completed. OFF when close processing has been completed. (Stays OFF for abnormal open processing completion.)                                  | ON: Opened<br>OFF: Closed         | ---                      | Cleared           | When socket 2 status is opened, the bit will ON. When socket 2 is closed, the bit will OFF.                    | ---                     |
| A569      | 00   | Opening Flag (Socket 3)               | The status of TCP/UDP Socket 3 is ON during open processing. (Turns ON when open request is received.) OFF when open processing has been completed.   | ON: Opening<br>OFF: Closed        | ---                      | Cleared           | When socket 3 status is opening, the bit will ON. After socket 3 status is opened, the bit is OFF.             | ---                     |
|           | 01   | Receiving Flag (Socket 3)             | The status of TCP/UDP Socket 3 is ON during receive processing. (Turns ON when receive request is received.) OFF when receive processing has been completed.  | ON: Start receive<br>OFF: Receive | ---                      | Cleared           | When socket 3 is waiting to receive data.  | ---                     |
|           | 02   | Sending Flag (Socket 3)               | The status of TCP/UDP Socket 3 is ON during send processing. (Turns ON when send request is received.) OFF when send processing has been completed.   | ON: Start send<br>OFF: Send       | ---                      | Cleared           | When socket 3 starts sending, the bit will ON. After data is sent, the bit will OFF.                           | ---                     |



| Addresses |      | Name                                       | Function  | Settings   | Status after mode change | Status at startup | Write timing   | Related Flags, Settings |
|-----------|------|--|---|--|--------------------------|-------------------|--|-------------------------|
| Word      | Bits |  |   |  |                          |                   |  |                         |
| A569      | 03   | Closing Flag (Socket 3)                    | The status of TCP/UDP Socket 3 is ON during close processing. (Turns ON when close request is received.) OFF when close processing has been completed.  | ON: Start close<br>OFF: Close                    | ---                      | Cleared           | When socket 3 starts to close, the bit is ON. When socket 3 closes completely, the bit will OFF.               | ---                     |
|           | 13   | Data Received Flag (Socket 3)              | The status of TCP/UDP Socket 3 is ON when data from a remote node has been received at an open TCP socket. OFF when receive processing has been requested for an open TCP socket.                                 | ON: Receiving<br>OFF: Received                   | ---                      | Cleared           | When the data needs to be received by socket 3, the bit will ON. After receiving completely, the bit will OFF. | ---                     |
|           | 14   | Results Storage Error Flag (Socket 3)      | The status of TCP/UDP Socket 3 is ON if there is an error in storing the results when socket services are used by means of the CMND (490) instruction. OFF when the next request is received. (Connected by TCP.) | ON: Error<br>OFF: Normal                         | ---                      | Cleared           | If socket 3 is in error status, the bit will ON.   | ---                     |
|           | 15   | TCP/UDP Open Flag (Socket 3)               | The status of TCP/UDP Socket 3 is ON when open processing has been completed. OFF when close processing has been completed. (Stays OFF for abnormal open processing completion.)                                  | ON: Opened<br>OFF: Closed                        | ---                      | Cleared           | When socket 3 status is opened, the bit will ON. When socket 3 is closed, the bit will OFF.                    | ---                     |
| A571      | 00   | UDP Open Request Switch (Socket 1)         | UDP socket opened when socket service request switch 1 is turned ON. Unit turns OFF switch 1 when open processing has been completed (i.e., when a connection has been made).                                     | ON: Request UDP open<br>OFF: Finish open         | ---                      | Cleared           | When UDP socket is opened, the bit will OFF.   | ---                     |
|           | 01   | TCP Passive Open Request Switch (Socket 1) | Passive TCP socket opened when socket service request switch 1 is turned ON. Unit turns OFF switch 1 when open processing has been completed (i.e., when a connection has been made).                             | ON: Request TCP Passive open<br>OFF: Finish open | ---                      | Cleared           | When TCP Passive socket is opened, the bit will OFF.   | ---                     |
|           | 02   | TCP Active Open Request Switch (Socket 1)  | Active TCP socket opened when socket service request switch 1 is turned ON. Unit turns OFF switch 1 when open processing has been completed (i.e., when a connection has been made).                              | ON: Request TCP Active open<br>OFF: Finish open  | ---                      | Cleared           | When TCP Active is opened, the bit will OFF.   | ---                     |
|           | 03   | Send Request Switch (Socket 1)             | Send processing executed when socket service request switch 1 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 1 when send processing has been completed.    | ON: Request send<br>OFF: Finish send             | ---                      | Cleared           | When the data is sent, the bit will OFF.   | ---                     |

| Addresses |      | Name  | Function   | Settings   | Status after mode change | Status at startup | Write timing  | Related Flags, Settings |
|-----------|------|---|--|--|--------------------------|-------------------|---|-------------------------|
| Word      | Bits |   |  |  |                          |                   |   |                         |
| A571      | 04   | Receive Request Switch (Socket 1)               | Receive processing executed when socket service request switch 1 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 1 when receive processing has been completed. | ON: Request receive<br>OFF: Finish receive       | ---                      | Cleared           | When the data is received, the bit will OFF.              | ---                     |
|           | 05   | Close Request Switch (Socket 1)                 | Close processing executed when socket service request switch 1 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 1 when close processing has been completed.     | ON: Request close<br>OFF: Finish close           | ---                      | Cleared           | When socket is closed, the bit will OFF.                  | ---                     |
|           | 08   | UDP Open Request Switch (Socket 2)              | UDP socket opened when socket service request switch 2 is turned ON. Unit turns OFF switch 2 when open processing has been completed (i.e., when a connection has been made).  | ON: Request UDP open<br>OFF: Finish open         | ---                      | Cleared           | When UDP socket is opened, the bit will OFF.              | ---                     |
|           | 09   | TCP Pas-<br>sive Open Request Switch (Socket 2) | Passive TCP socket opened when socket service request switch 2 is turned ON. Unit turns OFF switch 2 when open processing has been completed (i.e., when a connection has been made).                                | ON: Request TCP Passive open<br>OFF: Finish open | ---                      | Cleared           | When TCP Pas-<br>sive socket is opened, the bit will OFF. | ---                     |
|           | 10   | TCP Active Open Request Switch (Socket 2)       | Active TCP socket opened when socket service request switch 2 is turned ON. Unit turns OFF switch 2 when open processing has been completed (i.e., when a connection has been made).                                 | ON: Request TCP Active open<br>OFF: Finish open  | ---                      | Cleared           | When TCP Active is opened, the bit will OFF.              | ---                     |
|           | 11   | Send Request Switch (Socket 2)                  | Send processing executed when socket service request switch 2 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 2 when send processing has been completed.       | ON: Request send<br>OFF: Finish send             | ---                      | Cleared           | When the data is sent, the bit will OFF.                  | ---                     |
|           | 12   | Receive Request Switch (Socket 2)               | Receive processing executed when socket service request switch 2 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 2 when receive processing has been completed. | ON: Request receive<br>OFF: Finish receive       | ---                      | Cleared           | When the data is received, the bit will OFF.              | ---                     |
|           | 13   | Close Request Switch (Socket 2)                 | Close processing executed when socket service request switch 2 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 2 when close processing has been completed.     | ON: Request close<br>OFF: Finish close           | ---                      | Cleared           | When socket is closed, the bit will OFF.                  | ---                     |
| A572      | 00   | UDP Open Request Switch (Socket 3)              | UDP socket opened when socket service request switch 3 is turned ON. Unit turns OFF switch 3 when open processing has been completed (i.e., when a connection has been made).  | ON: Request UDP open<br>OFF: Finish open         | ---                      | Cleared           | When UDP socket is opened, the bit will OFF.              | ---                     |
|           | 01   | TCP Pas-<br>sive Open Request Switch (Socket 3) | Passive TCP socket opened when socket service request switch 3 is turned ON. Unit turns OFF switch 3 when open processing has been completed (i.e., when a connection has been made).                                | ON: Request TCP Passive open<br>OFF: Finish open | ---                      | Cleared           | When TCP Pas-<br>sive socket is opened, the bit will OFF. | ---                     |
|           | 02   | TCP Active Open Request Switch (Socket 3)       | Active TCP socket opened when socket service request switch 3 is turned ON. Unit turns OFF switch 3 when open processing has been completed (i.e., when a connection has been made).                                 | ON: Request TCP Active open<br>OFF: Finish open  | ---                      | Cleared           | When TCP Active is opened, the bit will OFF.              | ---                     |

| Addresses    |          | Name   | Function  | Settings  | Status after mode change | Status at startup | Write timing                                 | Related Flags, Settings |
|--------------|----------|--|---|---|--------------------------|-------------------|--|-------------------------|
| Word         | Bits     |  |   |   |                          |                   |  |                         |
| A572         | 03       | Send Request Switch (Socket 3)                         | Send processing executed when socket service request switch 3 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 3 when send processing has been completed.  | ON: Request send<br>OFF: Finish send                                  | ---                      | Cleared           | When the data is sent, the bit will OFF.     | ---                     |
|              | 04       | Receive Request Switch (Socket 3)                      | Receive processing executed when socket service request switch 3 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 3 when receive processing has been completed.  | ON: Request receive<br>OFF: Finish receive                            | ---                      | Cleared           | When the data is received, the bit will OFF. | ---                     |
|              | 05       | Close Request Switch (Socket 3)                        | Close processing executed when socket service request switch 3 is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.) Unit turns OFF switch 3 when close processing has been completed.  | ON: Request close<br>OFF: Finish close                                | ---                      | Cleared           | When socket is closed, the bit will OFF.     | ---                     |
| A580         | 00 to 03 | FB Communications Instruction Retries                  | Automatically stores the number of retries in the FB communications instruction settings specified in the PLC Setup.  | 0 to F hex  | ---                      | Cleared           | Written at start of operation                |                         |
| A581         | All      | FB Communications Instruction Response Monitoring Time | Automatically stores the FB communications instruction response monitoring time set in the PLC Setup.   | 0001 to FFFF hex (Unit: 0.1 s; Range: 0.1 to 6553.5)<br>0000 hex: 2 s | ---                      | Cleared           | Written at start of operation                | ---                     |
| A598         | 00       | FPD Teaching Bit                                       | Turn this bit ON to set the monitoring time automatically with the teaching function.<br><br>While A598.00 is ON, FPD(269) measures how long it takes for the diagnostic output to go ON after the execution condition goes ON. If the measured time exceeds the monitoring time, the measured time is multiplied by 1.5 and that value is stored as the new monitoring time.<br><br>(The teaching function can be used only when a word address has been specified for the monitoring time operand.) | ON: Teach monitoring time<br>OFF: Teaching function OFF               | Cleared                  | Cleared           | ---  | ---                     |
| A600 to A603 | All      | Macro Area Input Words                                 | Before the subroutine specified in MCRO(099) is executed, the source words for the subroutine are transferred to A600 through A603 (input parameter words).   | Input data:<br>4 words  | Cleared                  | Cleared           | ---  | ---                     |
| A604 to A607 | All      | Macro Area Output Words                                | After the subroutine specified in MCRO(099) has been executed, the results of the subroutine are transferred from A604 through A607 to the specified destination words (output parameter words).  | Output data:<br>4 words   | Cleared                  | Cleared           | ---  | ---                     |

| Addresses |      | Name  | Function  | Settings  | Status after mode change | Status at startup | Write timing | Related Flags, Settings  |
|-----------|------|---|---|---|--------------------------|-------------------|--------------|--|
| Word      | Bits |   |   |   |                          |                   |              |  |
| A619      | 01   | Serial Port 1 Settings Changing Flag (CP1L EM-type CPU Units)                 | ON while the serial port 1's communications settings are being changed for a CP1L EM-type CPU Unit. This flag will be turned ON when STUP(237) is executed and it will be turned OFF after the settings have been changed.  | ON: Changing<br>OFF: Not changing   | Retained                 | Cleared           | ---          | ---  |
|           | 02   | Serial Port 2 Settings Changing Flag (CP1L EM-type CPU Units)                 | ON while the serial port 2's communications settings are being changed for a CP1L EM-type CPU Unit. This flag will be turned ON when STUP(237) is executed and it will be turned OFF after the settings have been changed.  | ON: Changing<br>OFF: Not changing   | Retained                 | Cleared           | ---          | ---  |
|           |      | Serial Port 1 Settings Changing Flag (CP1L EL-type CPU Units)                 | ON while the serial port 1's communications settings are being changed for a CP1L EL-type CPU Unit. This flag will be turned ON when STUP(237) is executed and it will be turned OFF after the settings have been changed.  |   |                          |                   |              |  |
| A640      | 00   | Serial Port 2 Modbus-RTU Easy Master Execution Bit (CP1L EM-type CPU Units)   | Turn ON this bit to send a command and receive a response for serial port 2 of a CP1L EM-type CPU Unit using the Modbus-RTU easy master function.<br><b>Note</b> This bit will be turned OFF automatically by the system when communications have been completed. | Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. | Retained                 | Cleared           | ---          | DM fixed allocation words for Modbus-RTU Easy Master: D32300 to D32399 |
|           |      | Serial Port 1 Modbus-RTU Easy Master Execution Bit (CP1L EL-type CPU Units)   | Turn ON this bit to send a command and receive a response for serial port 1 of a CP1L EL-type CPU Unit using the Modbus-RTU easy master function.<br><b>Note</b> This bit will be turned OFF automatically by the system when communications have been completed. |   |                          |                   |              |  |
|           | 01   | Serial Port 2 Modbus-RTU Easy Master Normal End Flag (CP1L EM-type CPU Units) | ON when one command has been sent and the response received for serial port 2 of a CP1L EM-type CPU Unit using the Modbus-RTU easy master function.   | ON: Execution normal.<br>OFF: Execution error or still in progress.                                     | Retained                 | Cleared           | ---          |  |
|           |      | Serial Port 1 Modbus-RTU Easy Master Normal End Flag (CP1L EL-type CPU Units) | ON when one command has been sent and the response received for serial port 1 of a CP1L EL-type CPU Unit using the Modbus-RTU easy master function.   |   |                          |                   |              |  |
|           | 02   | Serial Port 2 Modbus-RTU Easy Master Error End Flag (CP1L EM-type CPU Units)  | ON when an error has occurred in communications for serial port 2 of a CP1L EM-type CPU Unit using the Modbus-RTU easy master function. The error code is output to D32252 in the DM fixed allocation words for Modbus-RTU Easy Master.                           | ON: Execution error.<br>OFF: Execution normal or still in progress.                                     | Retained                 | Cleared           | ---          |  |
|           |      | Serial Port 1 Modbus-RTU Easy Master Error End Flag (CP1L EL-type CPU Units)  | ON when an error has occurred in communications for serial port 1 of a CP1L EL-type CPU Unit using the Modbus-RTU easy master function. The error code is output to D32252 in the DM fixed allocation words for Modbus-RTU Easy Master.                           |   |                          |                   |              |  |

| Addresses    |      | Name   | Function   | Settings  | Status after mode change | Status at startup | Write timing                     | Related Flags, Settings  |
|--------------|------|--|--|---|--------------------------|-------------------|----------------------------------|--|
| Word         | Bits |  |  |   |                          |                   |                                  |  |
| A641         | 00   | Serial Port 1 Modbus-RTU Master Execution Bit (CP1L EM-type CPU Units)         | Turn ON this bit to send a command and receive a response for serial port 1 of a CP1L EM-type CPU Unit using the Modbus-RTU easy master function.<br><br>This bit will be turned OFF automatically by the system when communications have been completed.  | Turned ON: Execution started<br>ON: Execution in progress.<br>OFF: Not executed or execution completed. | Retained                 | Cleared           | ---                              | DM fixed allocation words for Modbus-RTU Easy Master: D32200 to D32299 |
|              | 01   | Serial Port 1 Modbus-RTU Master Execution Normal Flag (CP1L EM-type CPU Units) | ON when one command has been sent and the response received for serial port 1 of a CP1L EM-type CPU Unit using the Modbus-RTU easy master function.  | ON: Execution normal.<br>OFF: Execution error or still in progress.                                     | Retained                 | Cleared           | ---                              |  |
|              | 02   | Serial Port 1 Modbus-RTU Master Execution Error Flag (CP1L EM-type CPU Units)  | ON when an error has occurred in communications for serial port 1 of a CP1L EM-type CPU Unit using the Modbus-RTU easy master function.<br>The error code is output to D32352 in the DM fixed allocation words for Modbus-RTU Easy Master.   | ON: Execution error.<br>OFF: Execution normal or still in progress.                                     | Retained                 | Cleared           | ---                              |  |
| A642         | All  | Analog Input 1 PV  | Stores the value set from the analog input 1 as a hexadecimal value (resolution: 1/1000).  | 0000 to 03E8 hex  | Retained                 | Cleared           | ---                              | ---  |
| A643         | All  | Analog Input 2 PV  | Stores the value set from the analog input 2 as a hexadecimal value (resolution: 1/1000).  | 0000 to 03E8 hex  | Retained                 | Cleared           | ---                              | ---  |
| A720 to A722 | All  | Power ON Clock Data 1  | These words contain the time at which the power was turned ON one time before the startup time stored in words A510 to A511.<br>A720.00 to A720.07: Seconds (00 to 59)<br>A720.08 to A720.15: Minutes (00 to 59)<br>A721.00 to A721.07: Hour (00 to 23)<br>A721.08 to A721.15: Day of month (00 to 31)<br>A722.00 to A722.07: Month (01 to 12)<br>A722.08 to A722.15: Year (00 to 99)    | See at left.  | Retained                 | Retained          | Written when power is turned ON. |  |
| A723 to A725 | All  | Power ON Clock Data 2  | These words contain the time at which the power was turned ON two times before the startup time stored in words A510 to A511.<br>A723.00 to A723.07: Seconds (00 to 59)<br>A723.08 to A723.15: Minutes (00 to 59)<br>A724.00 to A724.07: Hour (00 to 23)<br>A724.08 to A724.15: Day of month (00 to 31)<br>A725.00 to A725.07: Month (01 to 12)<br>A725.08 to A725.15: Year (00 to 99)   | See at left.  | Retained                 | Retained          | Written when power is turned ON. |  |
| A726 to A728 | All  | Power ON Clock Data 3  | These words contain the time at which the power was turned ON three times before the startup time stored in words A510 to A511.<br>A726.00 to A726.07: Seconds (00 to 59)<br>A726.08 to A726.15: Minutes (00 to 59)<br>A727.00 to A727.07: Hour (00 to 23)<br>A727.08 to A727.15: Day of month (00 to 31)<br>A728.00 to A728.07: Month (01 to 12)<br>A728.08 to A728.15: Year (00 to 99) | See at left.  | Retained                 | Retained          | Written when power is turned ON. |  |

| Addresses    |      | Name                  | Function   | Settings     | Status after mode change | Status at startup | Write timing                     | Related Flags, Settings |
|--------------|------|-----------------------|--|--------------|--------------------------|-------------------|----------------------------------|-------------------------|
| Word         | Bits |                       |  |              |                          |                   |                                  |                         |
| A729 to A731 | All  | Power ON Clock Data 4 | These words contain the time at which the power was turned ON four times before the startup time stored in words A510 to A511.<br>A729.00 to A729.07: Seconds (00 to 59)<br>A729.08 to A729.15: Minutes (00 to 59)<br>A730.00 to A730.07: Hour (00 to 23)<br>A730.08 to A730.15: Day of month (00 to 31)<br>A731.00 to A731.07: Month (01 to 12)<br>A731.08 to A731.15: Year (00 to 99)  | See at left. | Retained                 | Retained          | Written when power is turned ON. |                         |
| A732 to A734 | All  | Power ON Clock Data 5 | These words contain the time at which the power was turned ON five times before the startup time stored in words A510 to A511.<br>A732.00 to A732.07: Seconds (00 to 59)<br>A732.08 to A732.15: Minutes (00 to 59)<br>A733.00 to A733.07: Hour (00 to 23)<br>A733.08 to A733.15: Day of month (00 to 31)<br>A734.00 to A734.07: Month (01 to 12)<br>A734.08 to A734.15: Year (00 to 99)  | See at left. | Retained                 | Retained          | Written when power is turned ON. |                         |
| A735 to A737 | All  | Power ON Clock Data 6 | These words contain the time at which the power was turned ON six times before the startup time stored in words A510 to A511.<br>A735.00 to A735.07: Seconds (00 to 59)<br>A735.08 to A735.15: Minutes (00 to 59)<br>A736.00 to A736.07: Hour (00 to 23)<br>A736.08 to A736.15: Day of month (00 to 31)<br>A737.00 to A737.07: Month (01 to 12)<br>A737.08 to A737.15: Year (00 to 99)   | See at left. | Retained                 | Retained          | Written when power is turned ON. |                         |
| A738 to A740 | All  | Power ON Clock Data 7 | These words contain the time at which the power was turned ON seven times before the startup time stored in words A510 to A511.<br>A738.00 to A738.07: Seconds (00 to 59)<br>A738.08 to A738.15: Minutes (00 to 59)<br>A739.00 to A739.07: Hour (00 to 23)<br>A739.08 to A739.15: Day of month (00 to 31)<br>A740.00 to A740.07: Month (01 to 12)<br>A740.08 to A740.15: Year (00 to 99) | See at left. | Retained                 | Retained          | Written when power is turned ON. |                         |
| A741 to A743 | All  | Power ON Clock Data 8 | These words contain the time at which the power was turned ON eight times before the startup time stored in words A510 to A511.<br>A741.00 to A741.07: Seconds (00 to 59)<br>A741.08 to A741.15: Minutes (00 to 59)<br>A742.00 to A742.07: Hour (00 to 23)<br>A742.08 to A742.15: Day of month (00 to 31)<br>A743.00 to A743.07: Month (01 to 12)<br>A743.08 to A743.15: Year (00 to 99) | See at left. | Retained                 | Retained          | Written when power is turned ON. |                         |

| Addresses    |      | Name  | Function  | Settings   | Status after mode change | Status at startup | Write timing                     | Related Flags, Settings |
|--------------|------|---|---|--|--------------------------|-------------------|----------------------------------|-------------------------|
| Word         | Bits |   |   |  |                          |                   |                                  |                         |
| A744 to A746 | All  | Power ON Clock Data 9                       | These words contain the time at which the power was turned ON nine times before the startup time stored in words A510 to A511.<br>A744.00 to A744.07: Seconds (00 to 59)<br>A744.08 to A744.15: Minutes (00 to 59)<br>A745.00 to A745.07: Hour (00 to 23)<br>A745.08 to A745.15: Day of month (00 to 31)<br>A746.00 to A746.07: Month (01 to 12)<br>A746.08 to A746.15: Year (00 to 99) | See at left.   | Retained                 | Retained          | Written when power is turned ON. |                         |
| A747 to A749 | All  | Power ON Clock Data 10                      | These words contain the time at which the power was turned ON ten times before the startup time stored in words A510 to A511.<br>A747.00 to A747.07: Seconds (00 to 59)<br>A747.08 to A747.15: Minutes (00 to 59)<br>A748.00 to A748.07: Hour (00 to 23)<br>A748.08 to A748.15: Day of month (00 to 31)<br>A749.00 to A749.07: Month (01 to 12)<br>A749.08 to A749.15: Year (00 to 99)  | See at left.   | Retained                 | Retained          | Written when power is turned ON. |                         |
| A751         | 11   | DM Initial Values Read Error Flag           | ON when an error occurred in transferring DM initial values from the DM initial value area in flash memory to the DM Area.  | OFF: Normal<br>ON: Error (failed to load)                                | Retained                 | Cleared           | ---                              | ---                     |
|              | 12   | DM Initial Values Save Execution Error Flag | ON when the DM Initial Values Transfer Password (A752) is incorrect or when the DM Initial values area was not specified when starting to transfer DM initial values from the DM Area to the DM initial value area in flash memory.   | OFF: Normal<br>ON: Error (failed to save)                                | Retained                 | Cleared           | ---                              | ---                     |
|              | 13   | DM Initial Values Save Error Flag           | ON when an error occurred in transferring DM initial values from the DM Area to the DM initial value area in flash memory.  | OFF: Normal<br>ON: Error (failed to save)                                | Retained                 | Cleared           | ---                              | ---                     |
|              | 14   | DM Initial Values Save Flag                 | ON while DM initial values are being transferred from the DM Area to the DM initial value area in flash memory.<br>OFF when the transfer has been completed.  | OFF: Not being saved<br>ON: Being saved                                  | Retained                 | Cleared           | ---                              | ---                     |
|              | 15   | DM Initial Values Save Start Bit            | Turn ON this bit to start transferring DM initial values. This bit is valid only when a correct password is stored in A752 and the DM Area Initial Value Area is specified (i.e., when A753.00 is ON).<br>The system will turn this bit OFF automatically when the transfer has been completed.   | Turned ON: Transfer started<br>OFF: Not transferring<br>ON: Transferring | Retained                 | Cleared           | ---                              | ---                     |
| A752         | All  | DM Initial Values Save Password             | Set the passwords here to transfer DM initial values between the DM area and the DM initial value area in flash memory. The transfer will not be started unless the correct password is set.<br>The transfer is started when A751.15 is turned ON.<br>The password will be cleared by the system when the transfer has been completed.  | A5A5 hex: Save initial values from DM to flash                           | Retained                 | Cleared           | ---                              | ---                     |
| A753         | All  | DM Initial Values Save Area Specification   | Specifies the area to be transferred to flash memory.   | 0001 hex: DM Area specified  | Retained                 | Cleared           | ---                              | ---                     |

**Note** The following flags are provided in a special read-only area and can be specified with the labels given in the table. These flags are not contained in the Auxiliary Area. Refer to *4-14 Condition Flags* and *4-15 Clock Pulses* for details.

| Flag area           | Name                        | Label           | Meaning  |
|---------------------|-----------------------------|-----------------|--|
| Condition Code Area | Error Flag                  | <b>ER</b>       | Turns ON when an error occurs in processing an instructions, indicating an error end to the instruction.   |
|                     | Access Error Flag           | <b>AER</b>      | Turns ON when an attempt is made to access an illegal area. The status of this flag is maintain only during the current cycle and only in the task in which it occurred. |
|                     | Carry Flag                  | <b>CY</b>       | Turns ON when there is a carry or borrow in a math operation, when a bit is shifted into the Carry Flag, etc.  |
|                     | Greater Than Flag           | <b>&gt;</b>     | Turns ON when the result of comparing two values is “greater than”, when a value exceeds a specified range, etc.   |
|                     | Equals Flag                 | <b>=</b>        | Turns ON when the result of comparing two values is “equals”, when the result of a math operation is 0, etc.   |
|                     | Less Than Flag              | <b>&lt;</b>     | Turns ON when the result of comparing two values is “less than”, when a value is below a specified range, etc.   |
|                     | Negative Flag               | <b>N</b>        | Turns ON when the MSB in the result of a math operation is 1.  |
|                     | Overflow Flag               | <b>OF</b>       | Turns ON when the result of a math operation overflows.  |
|                     | Underflow Flag              | <b>UF</b>       | Turns ON when the result of a math operation underflows.   |
|                     | Greater Than or Equals Flag | <b>&gt;=</b>    | Turns ON when the result of comparing two values is “greater than or equals”.  |
|                     | Not Equal Flag              | <b>&lt;&gt;</b> | Turns ON when the result of comparing two values is “not equal”.   |
|                     | Less than or Equals Flag    | <b>&lt;=</b>    | Turns ON when the result of comparing two values is “less than or equals”.   |
|                     | Always ON Flag              | <b>A1</b>       | This flag is always ON.  |
|                     | Always OFF Flag             | <b>A0</b>       | This flag is always OFF.   |
| Clock Pulse Area    | 0.02-s clock pulse          | <b>0.02s</b>    | Repeatedly turns ON for 0.02 s and OFF for 0.02 s.   |
|                     | 0.1-s clock pulse           | <b>0.1s</b>     | Repeatedly turns ON for 0.1 s and OFF for 0.1 s.   |
|                     | 0.2-s clock pulse           | <b>0.2s</b>     | Repeatedly turns ON for 0.2 s and OFF for 0.2 s.   |
|                     | 1-s clock pulse             | <b>1s</b>       | Repeatedly turns ON for 1 s and OFF for 1 s.   |
|                     | 1-min clock pulse           | <b>1min</b>     | Repeatedly turns ON for 1 min and OFF for 1 min.   |



## Details on Auxiliary Area Operation

### A100 to A199: Error Log Area

|      |                     |    |                |
|------|---------------------|----|----------------|
| A100 | Error code          |    | } Error record |
| A101 | Error flag contents |    |                |
| A102 | min                 | s  |                |
| A103 | day                 | hr |                |
| A104 | yr                  | mo |                |
| ⋮    |                     |    | ⋮              |
| A195 | Error code          |    | } Error record |
| A196 | Error flag contents |    |                |
| A197 | min                 | s  |                |
| A198 | day                 | hr |                |
| A199 | yr                  | mo |                |

The following data would be generated in an error record if a memory error (error code 80F1) occurred on 1 April 1998 at 17:10:30 with the error located in the PLC Setup (04 hex).

|    |    |
|----|----|
| 80 | F1 |
| 00 | 04 |
| 10 | 30 |
| 01 | 17 |
| 98 | 04 |

The following data would be generated in an error record if an FALS error with FALS number 001 occurred on 2 May 1997 at 8:30:15.

|    |    |
|----|----|
| C1 | 01 |
| 00 | 00 |
| 30 | 15 |
| 02 | 08 |
| 97 | 05 |

## Error Codes and Error Flags

| Classification                  | Error code       | Meaning                                 | Error flags                |
|---------------------------------|------------------|---|----------------------------|
| System-defined fatal errors     | 80F1             | Memory error                            | A403                       |
|                                 | 80CA             | I/O bus error                           | A404                       |
|                                 | 80E1             | Too many I/O error                      | A407                       |
|                                 | 80E0             | I/O setting error                       | ---                        |
|                                 | 80F0             | Program error                           | A295 to A299 (See note 3.) |
|                                 | 809F             | Cycle time too long error               | ---                        |
|                                 | 80F6             | Ethernet controller stop error          | A401                       |
| User-defined fatal errors       | C101 to C2FF     | FALS instruction executed (See note 1.) | ---                        |
| User-defined non-fatal errors   | 4101 to 42FF     | FAL instruction executed (See note 2.)  | ---                        |
| System-defined non-fatal errors | 008B             | Interrupt task error                    | A426                       |
|                                 | 009A             | Basic I/O error                         | A408                       |
|                                 | 009B             | PLC Setup setting error                 | A406                       |
|                                 | 0200 to 020F     | CPU Bus Unit error                      | A417                       |
|                                 | 021A             | Logic errors in setting table           | A315                       |
|                                 | 03C0, 03C1, 03C4 | Built-in Ethernet error                 | A315                       |
|                                 | 00F7             | Battery error                           | ---                        |
|                                 | 0400 to 040F     | CPU Bus Unit setup error                | A427                       |

- Note**
1. C101 to C2FF will be stored for FALS numbers 001 to 511.
  2. 4101 to 42FF will be stored for FAL numbers 001 to 511.
  3. Only the contents of A295 is stored as the error flag contents for program errors.

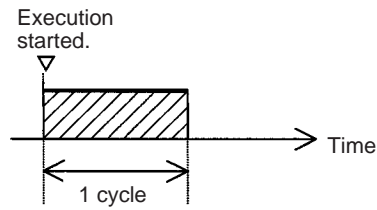
## Ethernet Communication Error

The details of Ethernet communication errors are shown as the following table.

| Error code<br>(Hex) | Error content   | Detailed information   |          | EE-<br>PROM |
|---------------------|---|--|----------|-------------|
|                     |   | 1st byte   | 2nd byte |             |
| 0103                | Resend count exceeded (send failed)                     | Commands<br>Bit 15: OFF<br>Bits 08 to 14: SNA<br>Bits 00 to 07: SA1<br><br>Responses<br>Bit 15: ON<br>Bits 08 to 14: DNA<br>Bits 00 to 07: DA1 |          | ---         |
| 0105                | Node address setting error (send failed)                |  |          | ---         |
| 0107                | Remote node not in network (send failed)                |  |          | ---         |
| 0108                | No Unit with specified unit address (send failed)       |  |          | ---         |
| 010B                | CPU Unit error (send failed)                            |  |          | ---         |
| 010D                | Destination address not in routing tables (send failed) |  |          | ---         |
| 010E                | No routing table entry (send failed)                    |  |          | ---         |
| 010F                | Routing table error (send failed)                       |  |          | ---         |
| 0110                | Too many relay points (send failed)                     |  |          | ---         |
| 0111                | Command too long (send failed)                          |  |          | ---         |
| 0112                | Header error (send failed)                              |  |          | ---         |
| 0117                | Internal buffers full; packet discarded                 |  |          | ---         |
| 0118                | Illegal packet discarded                                |  |          | ---         |
| 0119                | Local node busy (send failed)                           |  |          | ---         |
| 0120                | Unexpected routing error                                |  |          | ---         |
| 0121                | No setting in IP address table; packet discarded        |  |          | ---         |
| 0122                | Service not supported in current mode; packet discarded |  |          | ---         |
| 0123                | Internal send buffer full; packet discarded             |  |          | ---         |
| 0124                | Maximum frame size exceeded; routing failed             |  |          | ---         |
| 0300                | Parameter error; packet discarded                       |  |          | ---         |

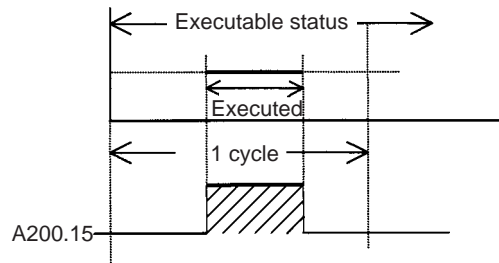
| Error code<br>(Hex) | Error content             | Detailed information   |  | EE-<br>PROM |
|---------------------|---------------------------|--|--|-------------|
|                     |                           | 1st byte   | 2nd byte   |             |
| 03C2                | FINS/TCP packet discarded | 01 to 03:<br>Connection number   | 02:<br>Reopened because<br>remote node closed<br>03:<br>Reopened because of<br>reception error<br>04:<br>Reopened because of<br>transmission error<br>05:<br>Reopened because<br>RST received from<br>remote node<br>06:<br>Reopened because of<br>no keep-alive response<br>07:<br>Illegal FINS/TCP pro-<br>cedure<br>08:<br>Insufficient memory<br>during server process-<br>ing<br>09:<br>Insufficient memory<br>during client process-<br>ing<br>0A:<br>Insufficient memory<br>during node switching | ---         |
| 03C6                | Clock data write error    | 0001: Clock data cannot be refreshed because<br>of a CPU Unit error.<br>0002: Clock data cannot be refreshed because<br>the current CPU mode do not support operation. |  | ---         |

## A200.11: First Cycle Flag

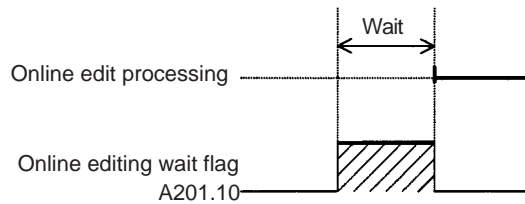


## A200.15: Initial Task Flag

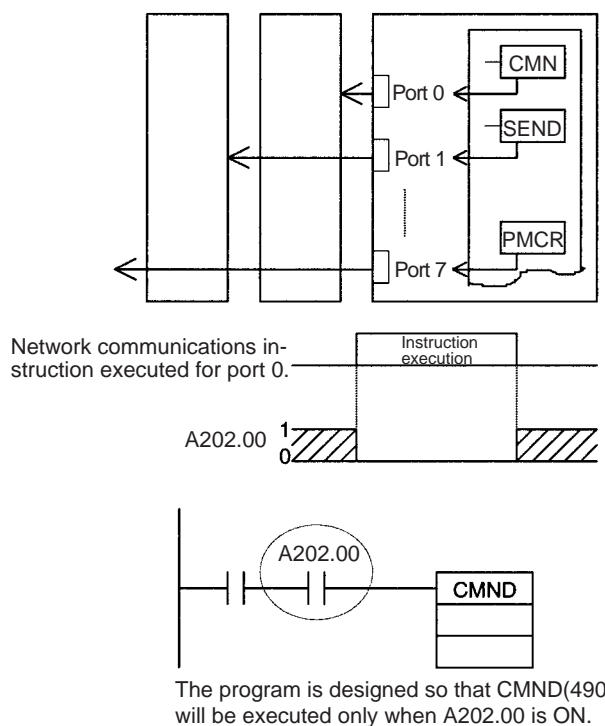
A200.15 will turn ON during the first time a task is executed after it has reached executable status. It will be ON only while the task is being executed and will not turn ON if following cycles.



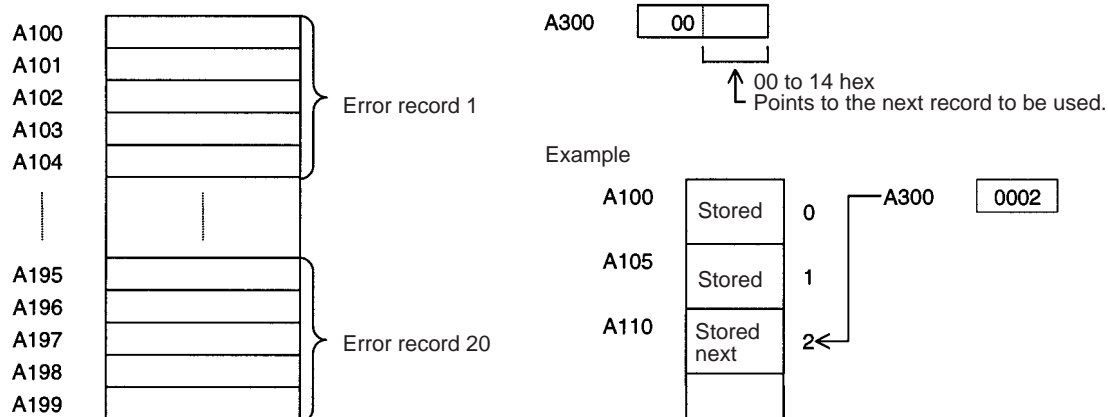
## A201.10: Online Editing Wait Flag



## A202.00 to A202.07: Communications Port Enabled Flags



## A300: Error Record Pointer



## A401.09: Program Error Flag

|                                  | Error   | Address |
|----------------------------------|---|---------|
| Program Error Flag (A401.09): ON | UM Overflow Error Flag                              | A295.15 |
|                                  | Illegal Instruction Flag                            | A295.14 |
|                                  | Distribution Overflow Error Flag                    | A295.13 |
|                                  | Task Error Flag                                     | A259.12 |
|                                  | No END(001) Error Flag                              | A295.11 |
|                                  | Illegal Area Access Error Flag                      | A295.10 |
|                                  | Indirect DM Addressing Error Flag                   | A295.09 |
|                                  | Instruction Processing Error Flag (ER Flag goes ON) | A295.08 |

# Appendix E

## Memory Map

### PLC Memory Addresses

PLC memory addresses are set in Index Registers (IR00 to IR15) to indirectly address I/O memory. Normally, use the MOVE TO REGISTER (MOVW(560)) and MOVE TIMER/COUNTER PV TO REGISTER (MOVW(561)) instructions to set PLC memory addresses into the Index Registers.

Some instructions, such as DATA SEARCH (SRCH(181)), FIND MAXIMUM (MAX(182)), and FIND MINIMUM (MIN(183)), output the results of processing to an Index Register to indicate an PLC memory address.

There are also instructions for which Index Registers can be directly designated to use the PLC memory addresses stored in them by other instructions. These instructions include DOUBLE MOVE (MOVL(498)), some symbol comparison instructions (=L, <>L, <L, >L, <=L, and >=L), DOUBLE COMPARE (CMPL(060)), DOUBLE DATA EXCHANGE (XCGL(562)), DOUBLE INCREMENT BINARY (++L(591)), DOUBLE DECREMENT BINARY (--L(593)), DOUBLE SIGNED BINARY ADD WITHOUT CARRY (+L(401)), DOUBLE SIGNED BINARY SUBTRACT WITHOUT CARRY (-L(411)), SET RECORD LOCATION (SETR(635)), and GET RECORD LOCATION (GETR(636)).

The PLC memory addresses all are continuous and the user must be aware of the order and boundaries of the memory areas. As reference, the PLC memory addresses are provided in a table at the end of this appendix.

**Note** Directly setting PLC memory addresses in the program should be avoided whenever possible. If PLC memory addresses are set in the program, the program will be less compatible with new CPU Unit models or CPU Units for which changes have been made to the layout of the memory.

### Memory Configuration

There are two classifications of the RAM memory (with battery backup) in a CP-series CPU Unit.

**Parameter Areas:** These areas contain CPU Unit system setting data, such as the PLC Setup, CPU Bus Unit Setups, etc. An illegal access error will occur if an attempt is made to access any of the parameter areas from an instruction in the user program.

**I/O Memory Areas:** These are the areas that can be specified as operands in the instructions in user programs.

## Memory Map

**Note** Do not access the areas indicated *Reserved for system*.

| Classification   | PLC memory addresses (hex) | User addresses    | Area                      |
|------------------|----------------------------|-------------------|---------------------------|
| I/O memory areas | 0B100 to 0B7FF             | ---               | Reserved for system.      |
|                  | 0B800 to 0B801             | TK00 to TK31      | Task Flag Area            |
|                  | 0B802 to 0B83F             | ---               | Reserved for system.      |
|                  | 0B840 to 0B9FF             | A0 to A447        | Read-only Auxiliary Area  |
|                  | 0BA00 to 0BBFF             | A448 to A959      | Read/Write Auxiliary Area |
|                  | 0BC00 to 0BDFF             | ---               | Reserved for system.      |
|                  | 0BE00 to 0BEFF             | T0000 to T4095    | Timer Completion Flags    |
|                  | 0BF00 to 0BFFF             | C0000 to C4095    | Counter Completion Flags  |
|                  | 0C000 to 0D7FF             | CIO 0 to CIO 6143 | CIO Area                  |
|                  | 0D800 to 0D9FF             | H0 to H511        | Holding Area              |
|                  | 0DA00 to 0DDFF             | ---               | Reserved for system.      |
|                  | 0DE00 to 0DFFF             | W0 to W511        | Work Area                 |
|                  | 0E000 to 0EFFF             | T0000 to T4095    | Timer PVs                 |
|                  | 0F000 to 0FFFF             | C0000 to C4095    | Counter PVs               |
|                  | 10000 to 17FFF             | D0 to D32767      | DM Area (See note 2.)     |
|                  | 18000 to FFFFF             | ---               | Reserved for system.      |

**Note** (1) Do not access areas reserved for the system.

(2) D10000 to D31999 (PLC memory addresses 12710 to 17CFF hex) cannot be used with CPU Units with 20 I/O Points.



# Appendix F

## Connections to Serial Communications Option Boards

### Connection Methods

#### Communications Modes and Ports

The following table shows the relationship between the communications ports and the communications modes for the Serial Communications Option Boards.

| Communications mode | RS-232C<br>CP1W-CIF01 |                      | RS-422A/485<br>CP1W-CIF11/CIF12 |            |            |            |
|---------------------|-----------------------|----------------------|---------------------------------|------------|------------|------------|
|                     | 1:1                   | 1:N<br>(See note 1.) | 1:1 4-wire                      | 1:N 4-wire | 1:1 2-wire | 1:N 2-wire |
| Host Link           | YES                   | YES<br>(See note 2.) | YES                             | YES        | No         | No         |
| Serial PLC Links    | YES                   | YES                  | YES                             | YES        | YES        | YES        |
| Serial Gateway      | YES                   | YES                  | YES                             | YES        | YES        | YES        |
| No-protocol         | YES                   | YES                  | YES                             | YES        | YES        | YES        |
| 1:N NT Link         | YES                   | YES                  | YES                             | YES        | YES        | YES        |
| 1:1 NT Link         | YES                   | No                   | YES                             | No         | YES        | No         |
| 1:1 Link Master     | YES                   | No                   | YES                             | No         | YES        | No         |
| 1:1 Link Slave      | YES                   | No                   | YES                             | No         | YES        | No         |

- Note** (1) The NT-AL001 Link Adapter can be used to convert between RS-232C and RS-422A/485 to enable 1:N communications.
- (2) Use 4-wire connections between Link Adapters.

#### Models of Serial Communications Option Board

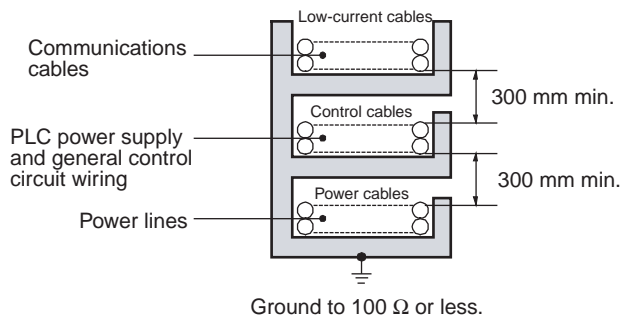
| Model      | Port                 | Maximum transmission distance | Connection method               |
|------------|----------------------|-------------------------------|---------------------------------|
| CP1W-CIF01 | One RS-232C port     | 15 m                          | Connector (D-sub, 9-pin female) |
| CP1W-CIF11 | One RS-422A/485 port | 50 m (See note.)              | Terminal block (using ferrules) |
| CP1W-CIF12 | One RS-422A/485 port | 500 m                         | Terminal block (using ferrules) |

- Note** The CP1W-CIF11 is a non-isolated board, so the maximum transmission distance is 50 m. For distances over 50 m, use the RS-232C port on the CP1W-CIF01 and then connect through the NT-AL001 Link Adapter, which is isolated. Doing so will enable a maximum transmission distance of 500 m.

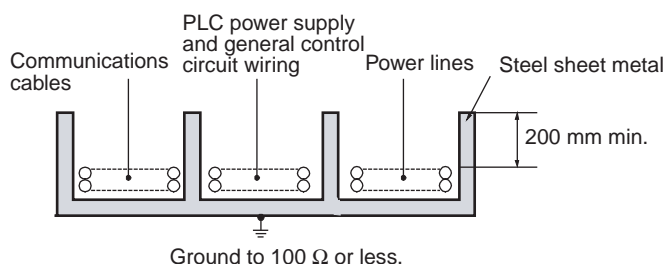
## Reducing Electrical Noise for External Wiring

Observe the following precautions when wiring communications cables, PLC power lines, and high-power lines. When multi-conductor signal cable is being used, avoid using I/O wires and other control wires in the same cable.

- If wiring racks are running in parallel, allow at least 300 mm between them.

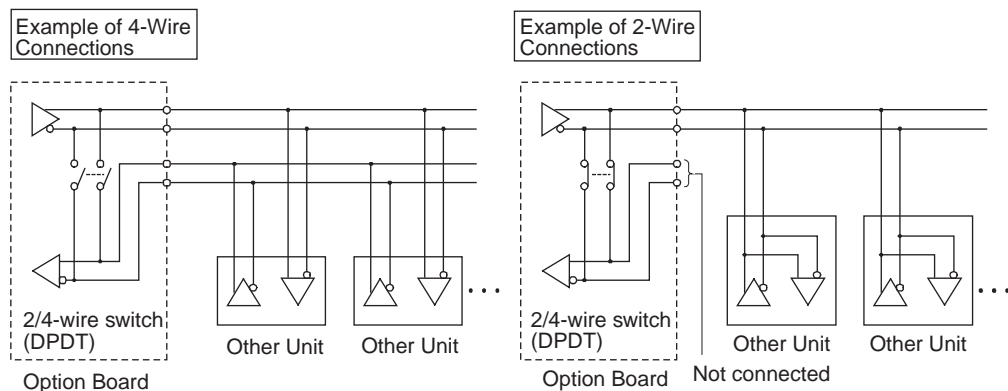


- If the I/O wiring and power cables must be placed in the same duct, they must be shielded from each other using grounded steel sheet metal.



## 2-Wire and 4-Wire Connections

The transmission circuits for 2-wire and 4-wire connections are different, as shown in the following diagram.



- Note**
- (1) Use the same transmission circuit (2-wire or 4-wire) for all nodes.
  - (2) Do not use 4-wire connections when the 2/4-wire switch on the Board is set to 2-wire.

**NT-AL001 Link Adapter Settings**

The NT-AL001 Link Adapter has a DIP switch for setting RS-422A/485 communications conditions. When connecting the Serial Communications Option Board, refer to the DIP switch settings shown in the following table.

| Pin | Function  | Factory setting |
|-----|---|-----------------|
| 1   | Not used. Always set this pin to ON.  | ON              |
| 2   | Built-in terminating resistance setting<br>ON: Connects terminating resistance.<br>OFF: Disconnects terminating resistance.   | ON              |
| 3   | 2/4-wire setting  | OFF             |
| 4   | 2-wire: Set both pins to ON.<br>4-wire: Set both pins to OFF.   | OFF             |
| 5   | Transmission mode (See note.)<br>Constant transmission: Set both pins to OFF.<br>Transmission performed when CTS signal in RS-232C interface is at high level:<br>Set pin 5 to OFF and pin 6 to ON. | ON              |
| 6   | Transmission performed when CTS signal in RS-232C interface is at low level:<br>Set pin 5 to ON and pin 6 to OFF.   | OFF             |

**Note** When connecting to a CP-series CPU Unit, turn OFF pin 5 and turn ON pin 6.

**Connections for Host Link Communications**

Port connections for Host Link communications are shown in the following table. Up to 32 nodes can be connected for 1:N connections.

| Port   | Configuration | Schematic diagram, RS-232C ports | Schematic diagram, RS-422A/485 ports |
|--|---------------|----------------------------------|--------------------------------------|
| Computer to PLC: C-mode or FINS commands<br>PLC to computer: FINS commands | 1:1           |                                  |                                      |
| Computer to PLC: C-mode or FINS commands                                   | 1:N           |                                  |                                      |

- Note**
- (1) Four-wire connections must be used for RS-422A/485 connections with Host Link communications.
  - (2) "Resistance ON" indicates the terminating resistance must be turned ON.
  - (3) "5 V power" indicates that a 5 V power supply is required for the Link Adapter. Refer to the Link Adapter manual for details. A 5 V power supply is not required for a Link Adapter connected to an RS-232C Option Board mounted on the CPU Unit because power is supplied from pin 6 of the connector.
  - (4) The maximum cable length for RS-232C is 15 m. The RS-232C standard, however, does not cover baud rates above 19.2 Kbps. Refer to the manual for the device being connected to confirm support.

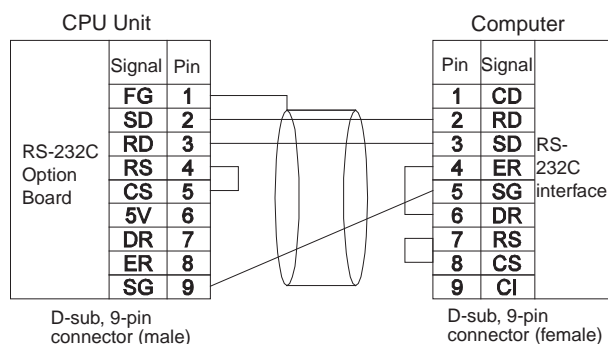
## Connection Examples

The connection examples in the remainder of this section show only the basic connection diagrams. We recommend that appropriate noise countermeasures be taken in actual applications, including the use of shielded twisted-pair cables. Refer to *Recommended RS-422A/485 Wiring Examples* on page 767 for actual wiring methods.

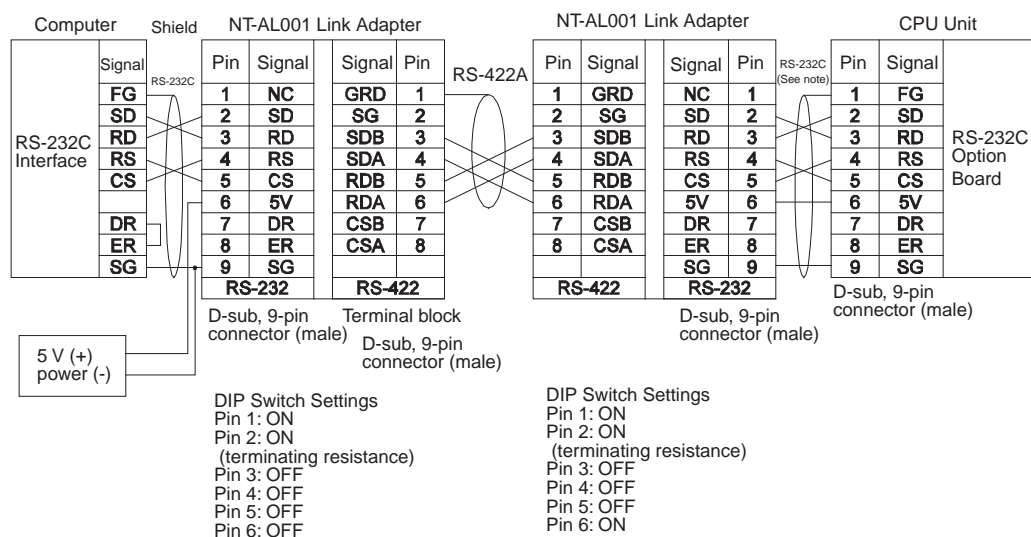
## Host Computer Connections

### 1:1 Connections Using RS-232C Ports

- IBM PC/AT or Compatible Computers



- Using NT-AL001 Converting Link Adapters



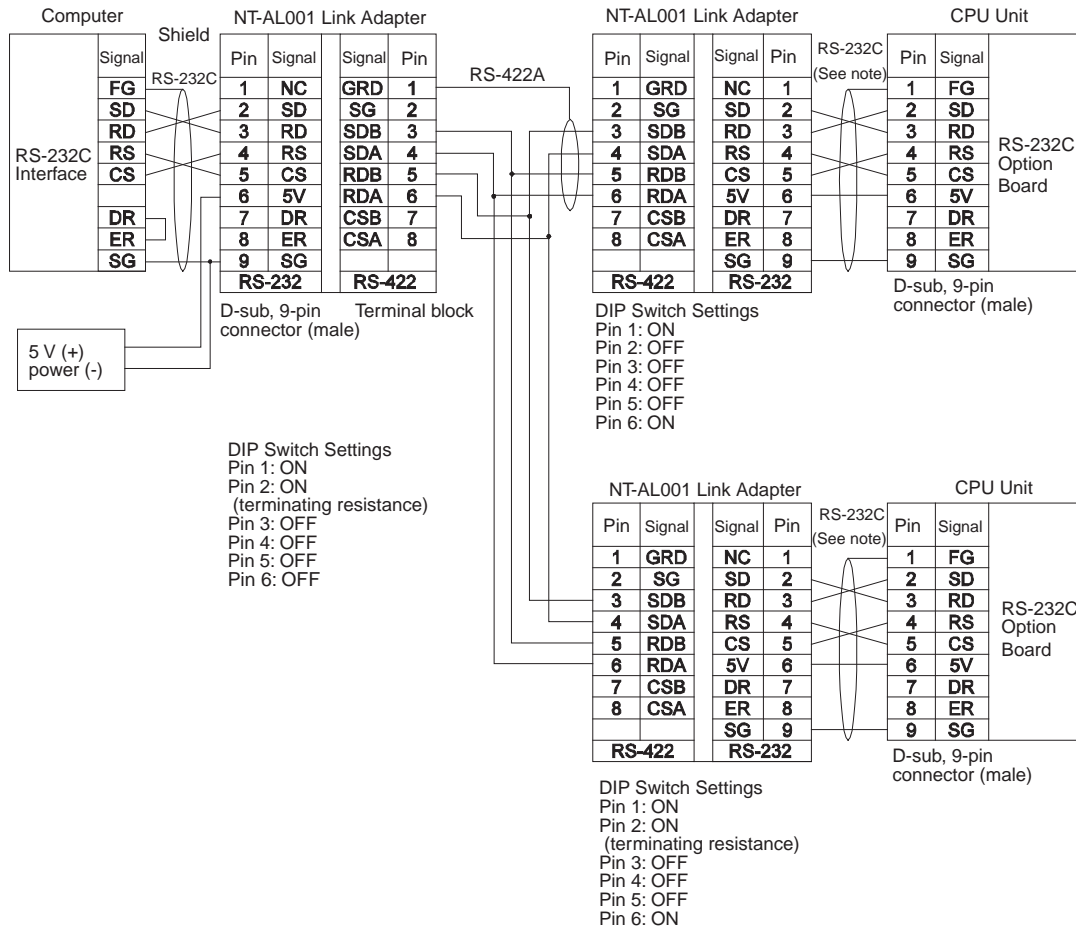
**Note** We recommend using the following NT-AL001 Link Adapter Connecting Cables to connect to NT-AL001 Link Adapters.

XW2Z-070T-1: 0.7 m

XW2Z-200T-1: 2 m

**Caution** Do not use the 5 V power from pin 6 of the RS-232C Option Board for anything but the NT-AL001 Link Adapter. Using this power supply for any other external device may damage the RS-232C Option Board or the external device.

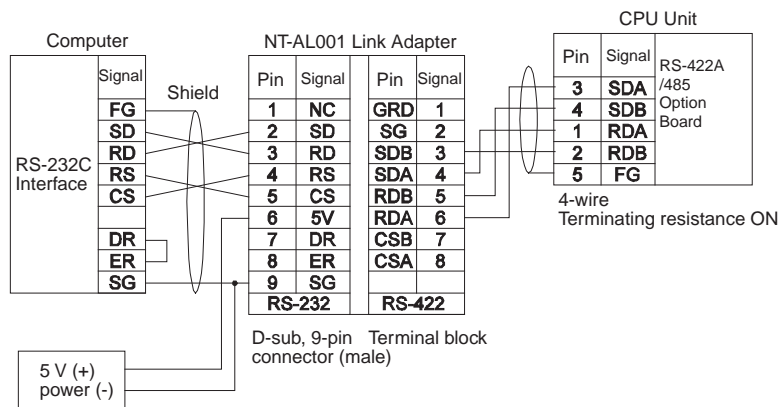
## 1:N Connections Using RS-232C Ports



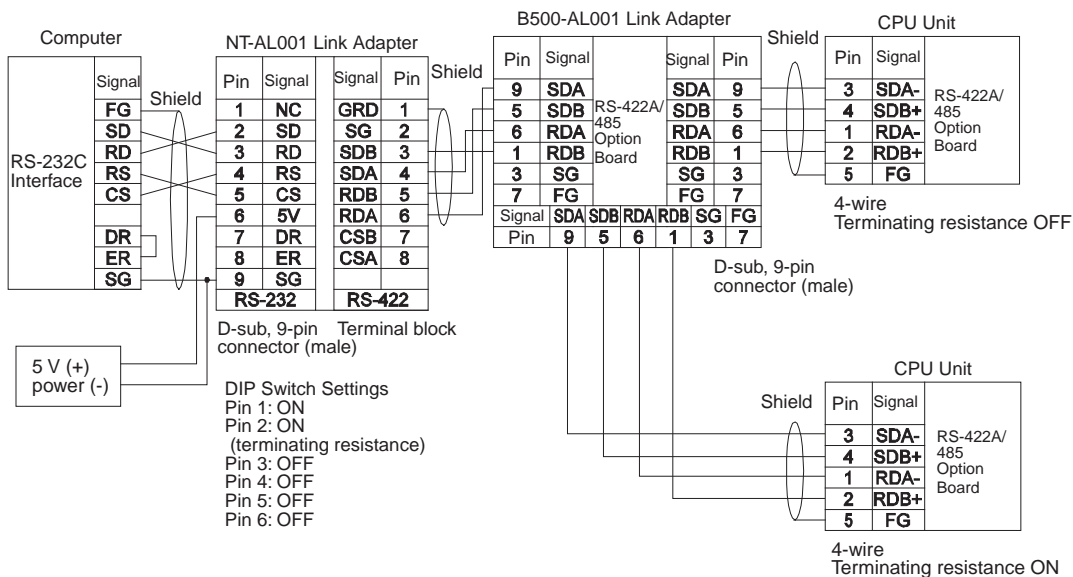
**Note** We recommend using the following NT-AL001 Link Adapter Connecting Cables to connect to NT-AL001 Link Adapters.

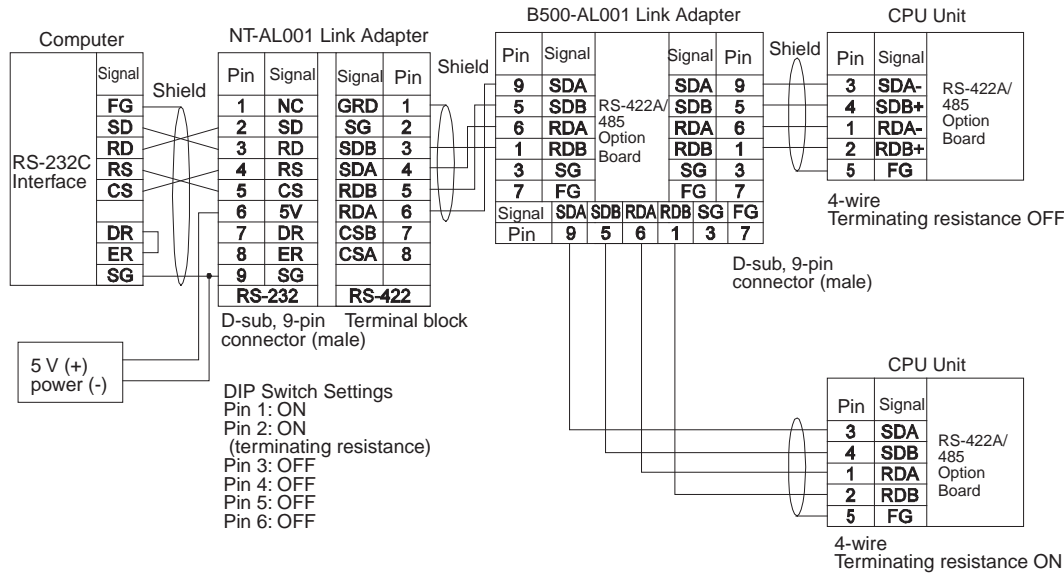
XW2Z-070T-1: 0.7 m

XW2Z-200T-1: 2 m

**1:1 Connections Using RS-422A/485 Port**

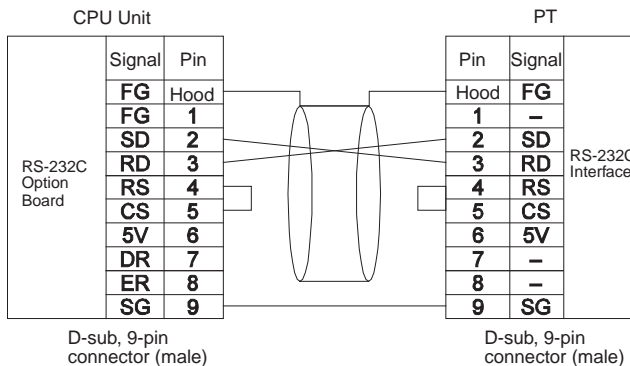
DIP Switch Settings  
 Pin 1: ON  
 Pin 2: ON  
 (terminating resistance)  
 Pin 3: OFF  
 Pin 4: OFF  
 Pin 5: OFF  
 Pin 6: OFF

**1:N Connections Using RS-422A/485 Ports**



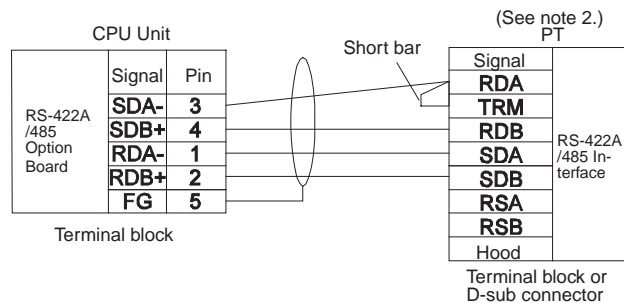
## Programmable Terminal (PT) Connections

### Direct Connections from RS-232C to RS-232C Ports



- Communications Mode: Host Link (unit number 0 only for Host Link)  
NT Link (1:N, N = 1 Unit only)
- OMRON Cables with Connectors:  
XW2Z-200T-1: 2 m  
XW2Z-500T-1: 5 m

### 1:1 Connections from RS-422A/485 to RS-422A/485 Ports

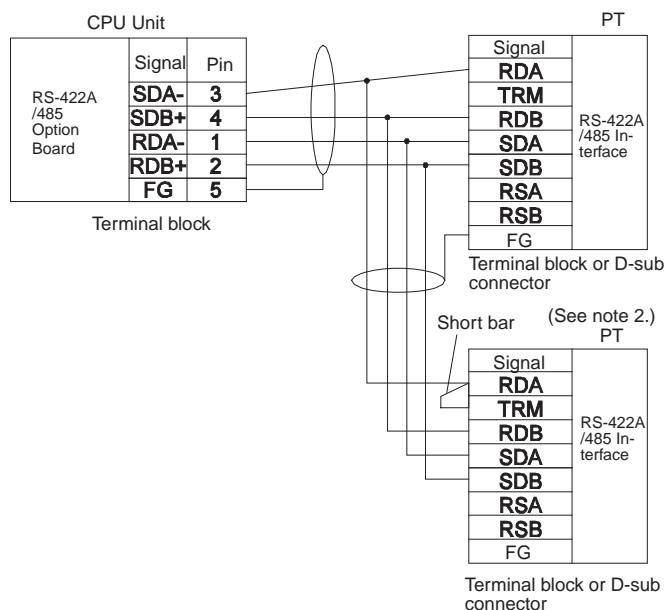


- Communications Mode: Host Link (unit number 0 only for Host Link)  
NT Link (1:N, N = 1 Unit only)

**Note** (1) RS-422A/485 Option Board settings:

Terminating resistance ON, 4-wire.

- (2) The terminating resistant setting shown above is an example for the NT631/NT631C. The setting method varies with the PT. Refer to the manual for you PT for details.

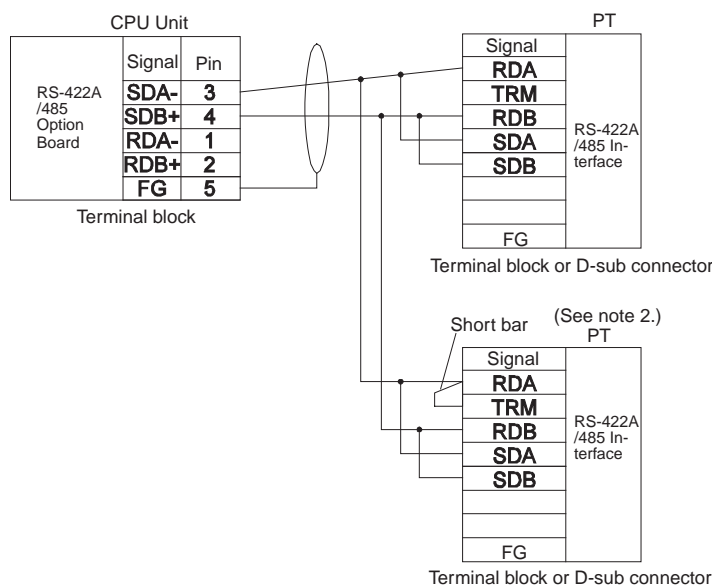
**1:N, 4-wire Connections from RS-422A/485 to RS-422A/485 Ports**

- Communications Mode: 1:N NT Link

**Note** (1) RS-422A/485 Option Board settings:

Terminating resistance ON, 4-wire.

- (2) The terminating resistant setting shown above is an example for the NT631/NT631C. The setting method varies with the PT. Refer to the manual for you PT for details.

**1:N, 2-wire Connections from RS-422A/485 to RS-422A/485 Ports**

- Communications Mode: 1:N NT Link

**Note** (1) RS-422A/485 Option Board settings:

Terminating resistance ON, 2-wire.



- (2) The terminating resistant setting shown above is an example for the NT631/NT631C. The setting method varies with the PT. Refer to the manual for you PT for details.

### Connections for Serial Gateway and No-protocol Communications

This section describes the connections for Serial Gateway, and no-protocol communications. Up to 32 nodes can be used for 1:N connections.

| Port    | Configuration | Schematic diagram |
|---------|---------------|-------------------|
| RS-232C | 1:1           |                   |
| RS-232C | 1:N           |                   |

- Note**
- (1) The maximum cable length for RS-232C is 15 m. The RS-232C standard, however, does not cover baud rates above 19.2 Kbps. Refer to the manual for the device being connected to confirm support.
  - (2) The combined cable length for RS-422A/485 is 500 m including branch lines.
  - (3) The maximum cable length is limited to 2 m when an NT-AL001 Link Adapter is connected.
  - (4) Branch lines must be a maximum of 10 m long.

| Port        | Configuration | Schematic diagram |
|-------------|---------------|-------------------|
| RS-422A/485 | 1:1           |                   |
| RS-422A/485 | 1:N           |                   |

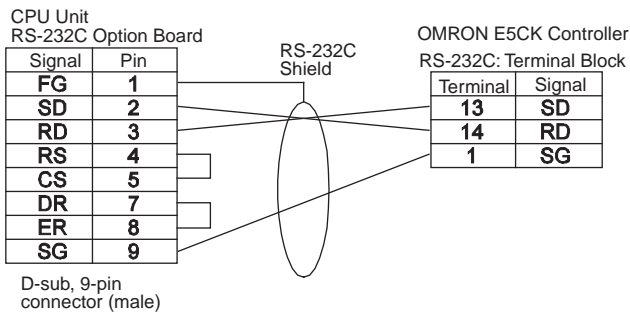
- Note**
- (1) The maximum cable length for RS-232C is 15 m. The RS-232C standard, however, does not cover baud rates above 19.2 Kbps. Refer to the manual for the device being connected to confirm support.
  - (2) The CP1W-CIF11 is a non-isolated board, so the maximum transmission distance is 50 m. The CP1W-CIF12 is an isolated board, so the maximum transmission distance is 500 m. For distances over 50 m, use the RS-422A/485 port on the CP1W-CIF12 directly, or the RS-232C port on the CP1W-CIF01 and then connect through the NT-AL001 Link Adapter, which is isolated. Doing so will enable a maximum transmission distance of 500 m.
  - (3) The maximum cable length is limited to 2 m when an NT-AL001 Link Adapter is connected.
  - (4) Branch lines must be a maximum of 10 m long.

### Connection Examples

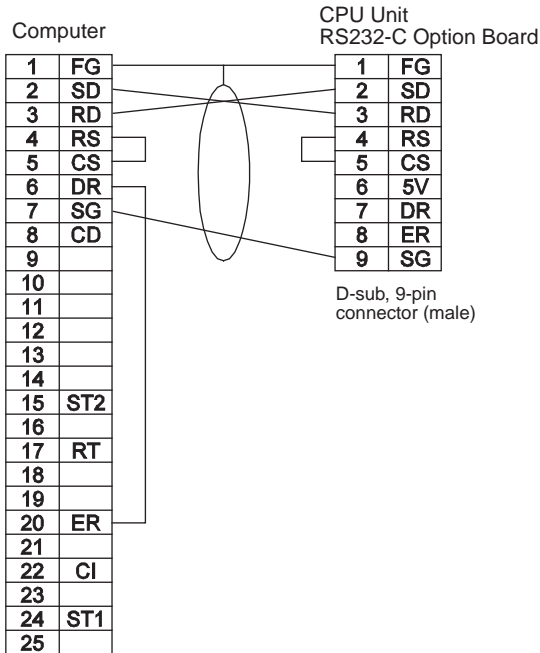
The connection examples in the remainder of this section show only the basic connection diagrams. We recommend that appropriate noise countermeasures be taken in actual applications, including the use of shielded twisted-pair cables. Refer to *RS-232C and RS-422A/485 Wiring* for actual wiring methods.

Connecting RS-232C Ports 1:1

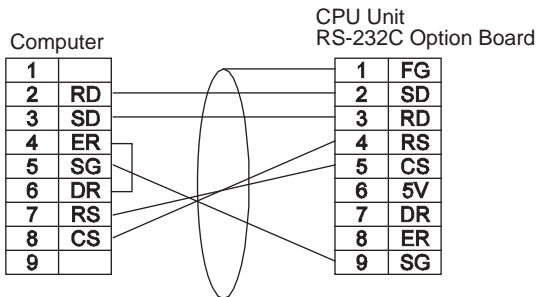
Connections to E5CK Controller



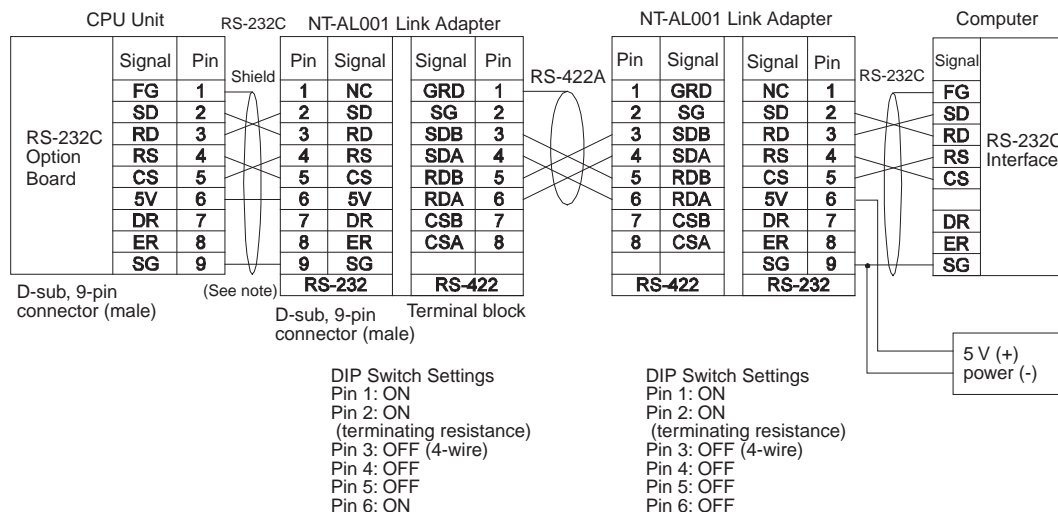
Connections to a Host Computer



Connections to a Personal Computer with RTS-CTS Flow Control



## Connecting a Host Computer with NT-AL001 Converting Link Adapters

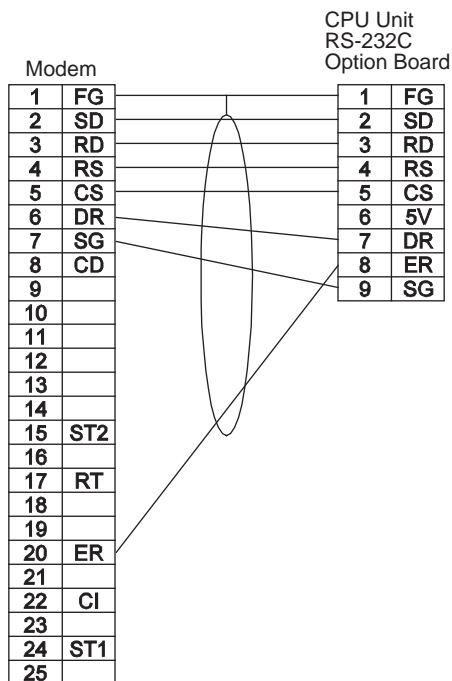


**Note** We recommend using the following NT-AL001 Link Adapter Connecting Cables to connect to NT-AL001 Link Adapters.

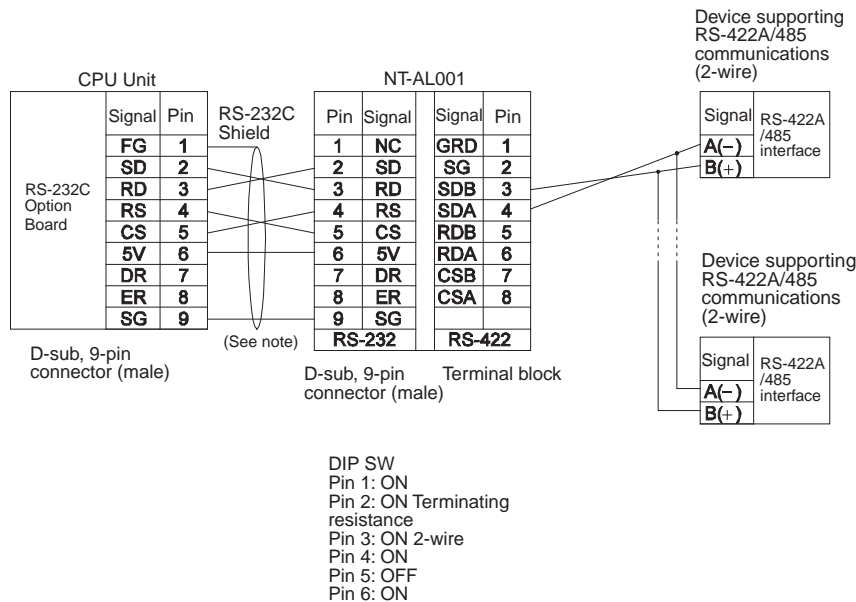
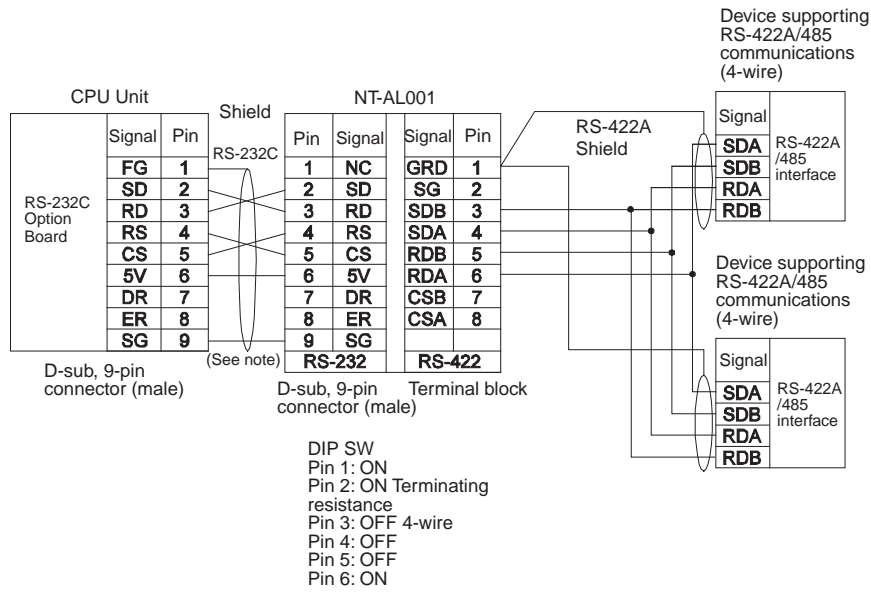
XW2Z-200T-1: 2 m

XW2Z-500T-1: 5 m

## Connections to a Modem



## 1:N Connections Using RS-232C Ports

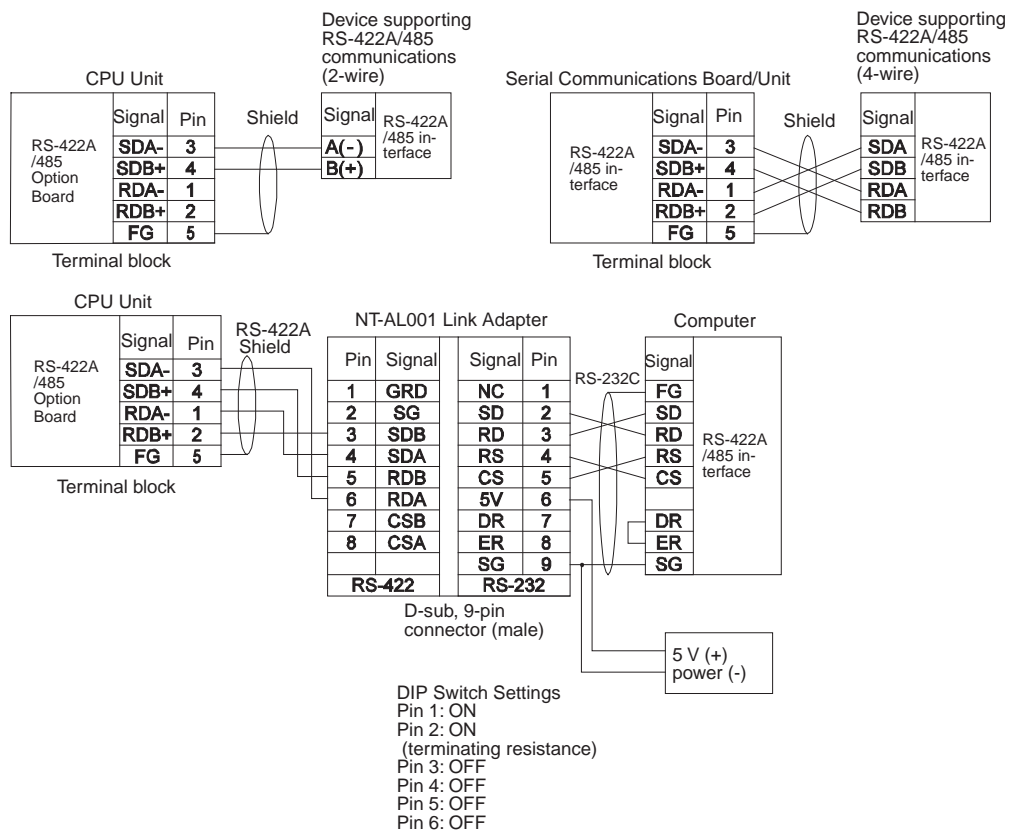


**Note** We recommend using the following NT-AL001 Link Adapter Connecting Cables to connect to NT-AL001 Link Adapters.

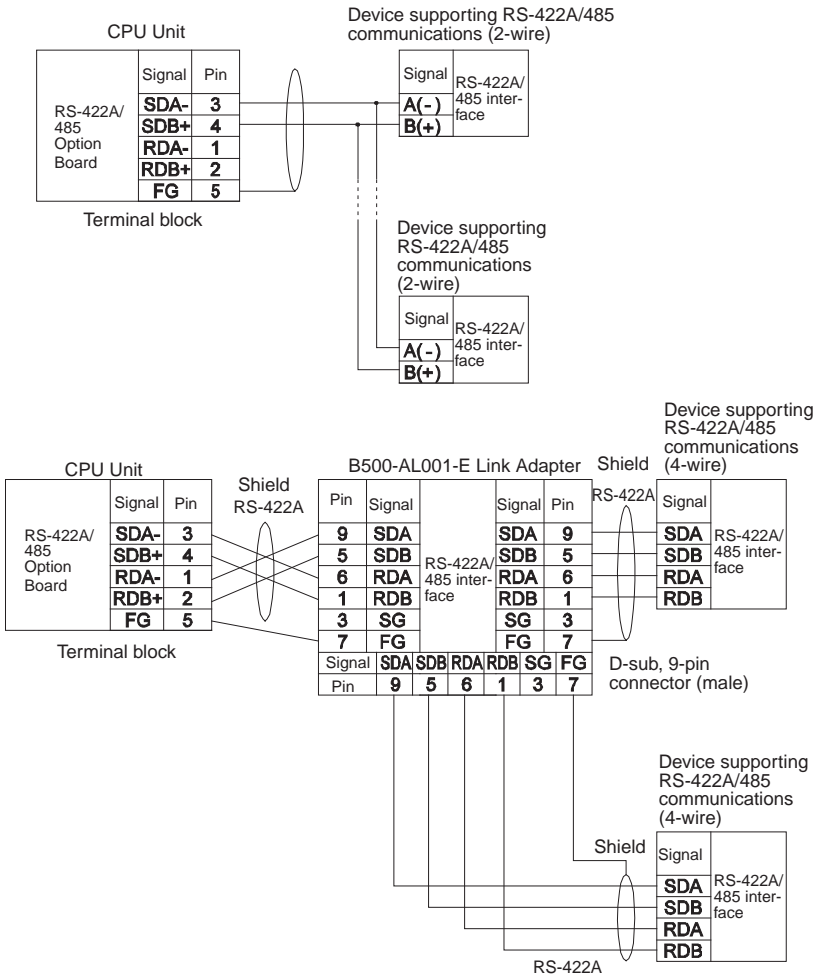
XW2Z-070T-1: 0.7 m

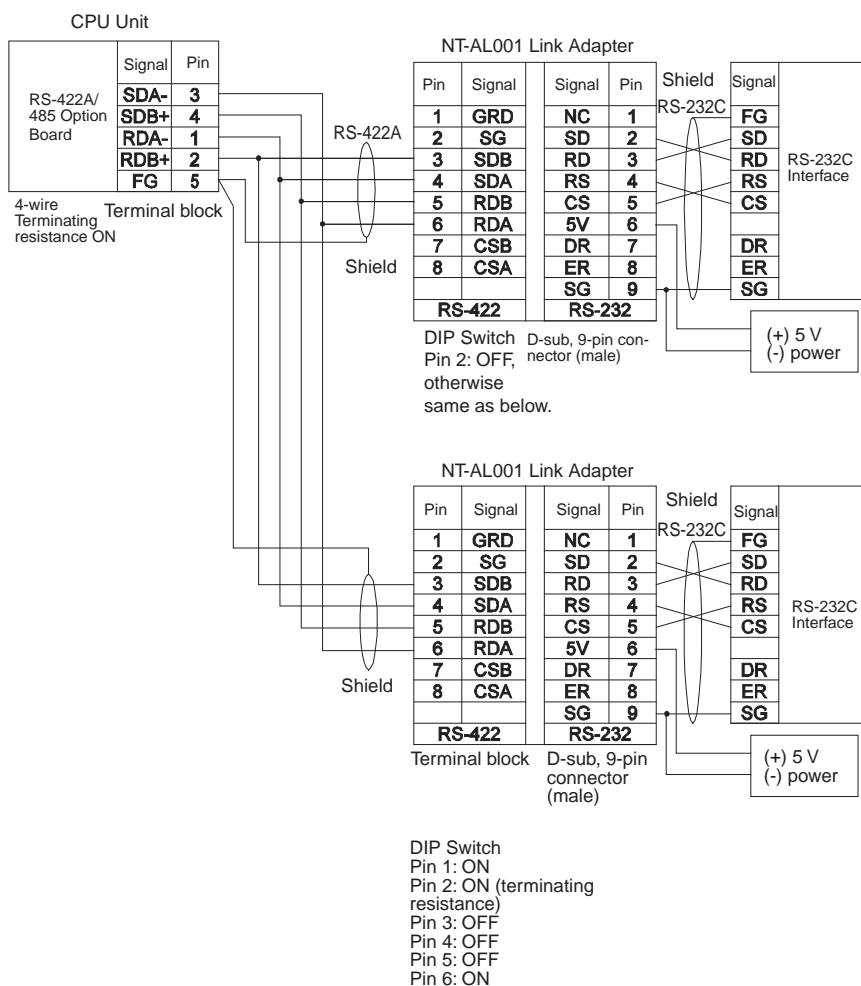
XW2Z-200T-1: 2 m

## 1:1 Connections Using RS-422A/485 Ports



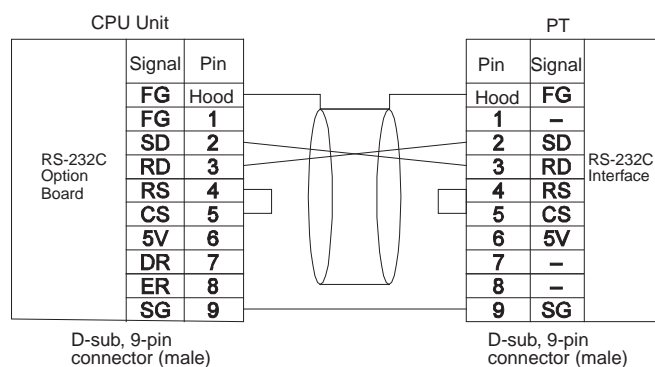
1:N Connections Using RS-422A/485 Ports





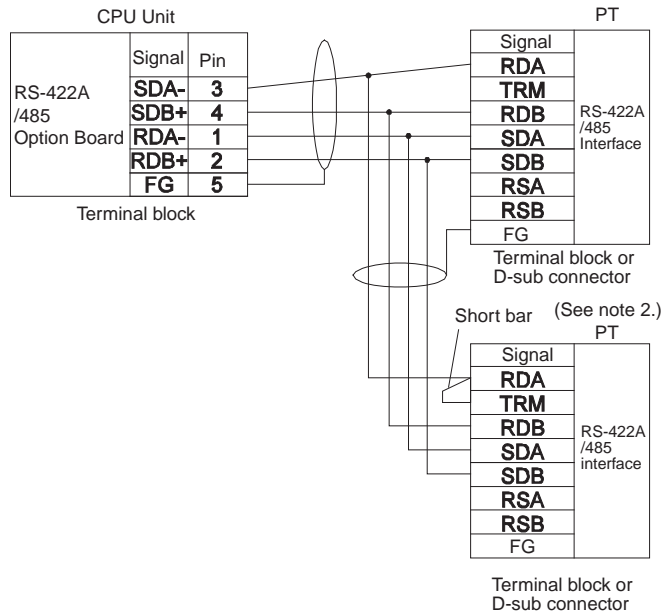
## 1:N NT Link Connections with Programmable Terminals

### Direct Connections from RS-232C to RS-232C Ports



- Communications Mode: Host Link (unit number 0 only for Host Link)  
NT Link (1:N, N = 1 Unit only)
- OMRON Cables with Connectors:  
XW2Z-070T-1: 0.7 m  
XW2Z-200T-1: 2 m



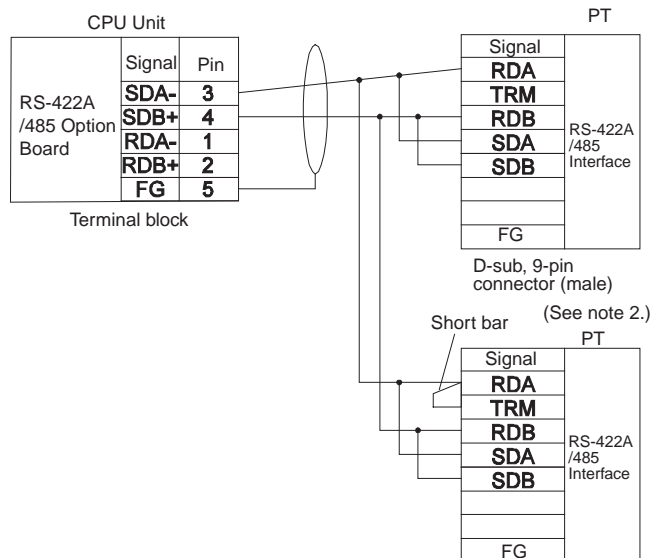
**1:N, 4-wire Connections from RS-422A/485 to RS-422A/485 Ports**

- Communications Mode: 1:N NT Link

**Note** (1) RS-422A/485 Option Board settings:

Terminating resistance ON, 4-wire.

- (2) The terminating resistant setting shown above is an example for the NT631/NT631C. The setting method varies with the PT. Refer to the manual for you PT for details.

**1:N, 2-wire Connections from RS-422A/485 to RS-422A/485 Ports**

- Communications Mode: 1:N NT Link

**Note** (1) RS-422A/485 Option Board settings:

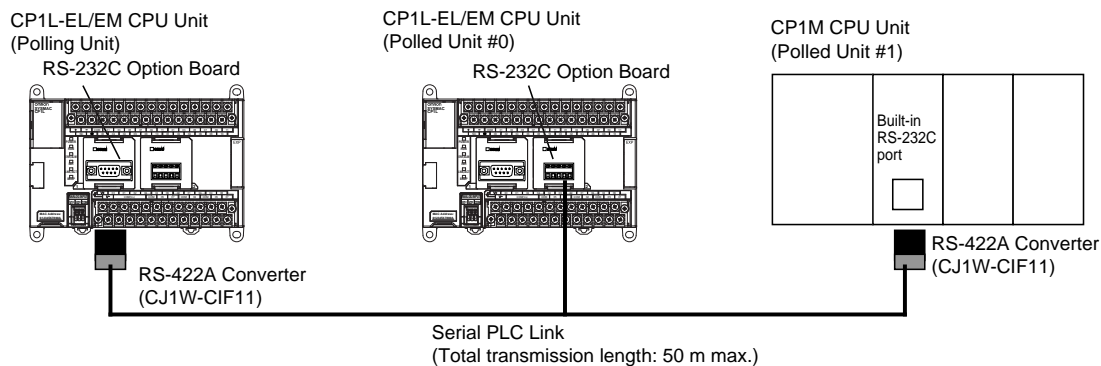
Terminating resistance ON, 2-wire.

- (2) The terminating resistant setting shown above is an example for the NT631/NT631C. The setting method varies with the PT. Refer to the manual for you PT for details.

## Serial PLC Link Connection Examples

This section provides connection examples for using Serial PLC Link. The communications mode used here is Serial PLC Link.

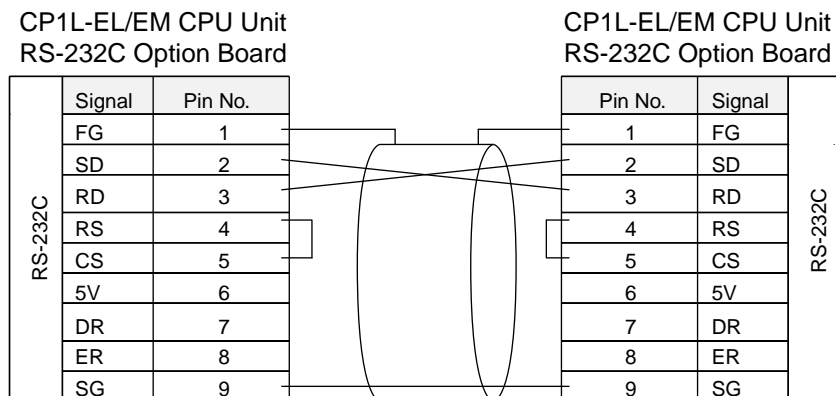
### Connecting an RS-422A Converter



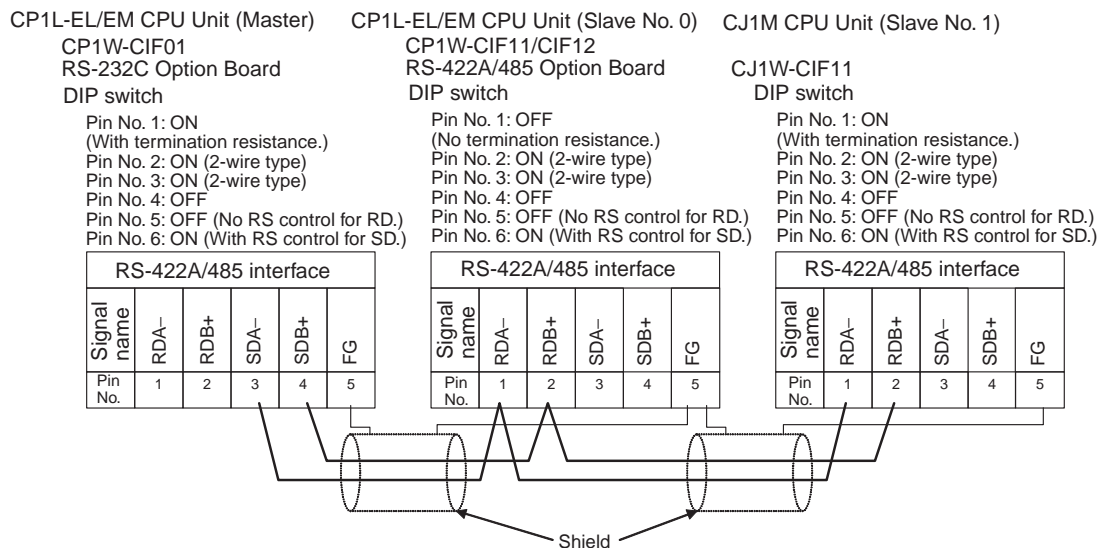
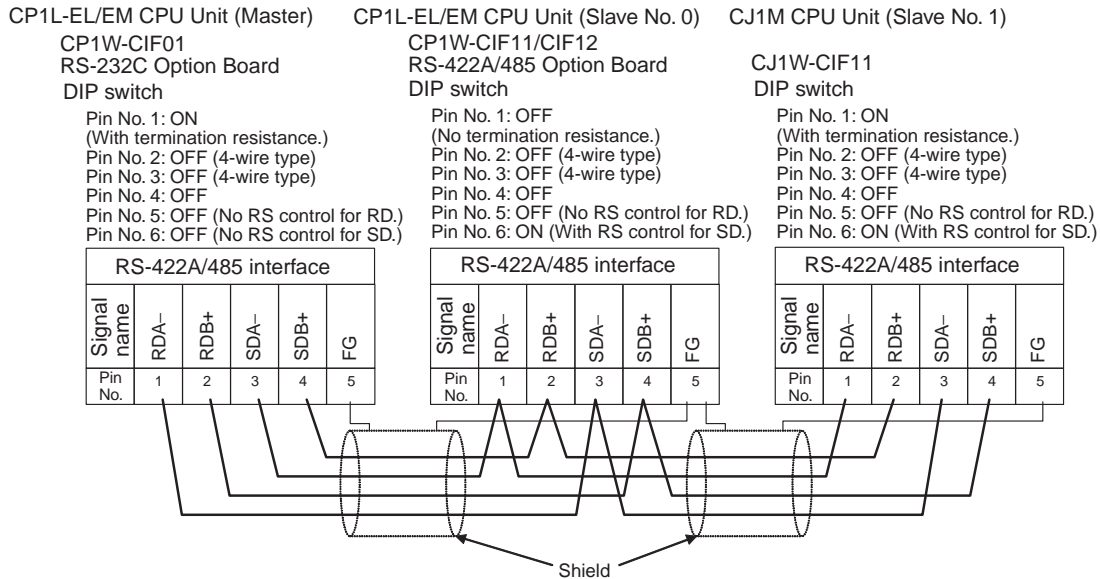
**Note** The CP1W-CIF11 is not insulated, so the total transmission distance for the whole transmission path is 50 m max. If the total transmission distance is greater than 50 m, use the RS-422A/485 port on the CP1W-CIF12 directly, or the insulated NT-AL001, and do not use the CP1W-CIF11. If the CP1W-CIF12 or NT-AL001 is used, the total transmission distance for the whole transmission path is 500 m max.

### Connection with an RS-232C Port

RS-232C connection is also possible when using a Serial PLC Link to connect two CP1L-EL/EM CPU Units.

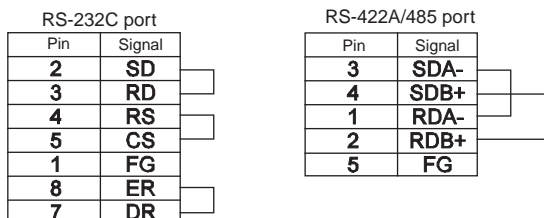


## Connection Examples



## Connections in Loopback Test

Connect the communications ports as shown below.



## RS-232C and RS-422A/485 Wiring

### Recommended RS-232C Wiring Examples

It is recommended that RS-232C cables be connected as described below especially when the Option Board is used in an environment where it is likely to be subject to electrical noise.

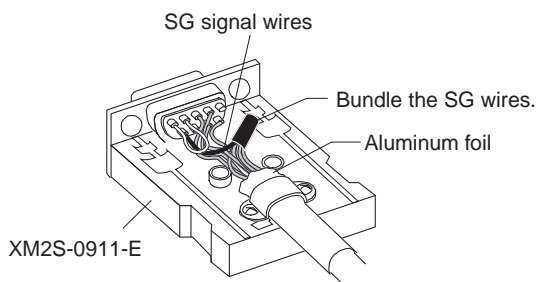
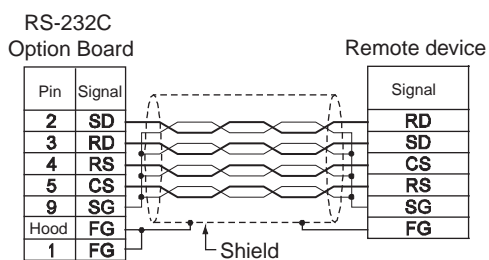
1. Always use shielded twisted-pair cables as communications cables.

| Model   | Manufacturer        |
|---|---------------------|
| UL2464 AWG28x5P IFS-RVV-SB (UL product)<br>AWG28x5P IFVV-SB (non-UL product)                      | Fujikura Ltd.       |
| UL2464-SB (MA) 5Px28AWG (7/0.127) (UL product) CO-MA-VV-SB<br>5Px28AWG (7/0.127) (non-UL product) | Hitachi Cable, Ltd. |

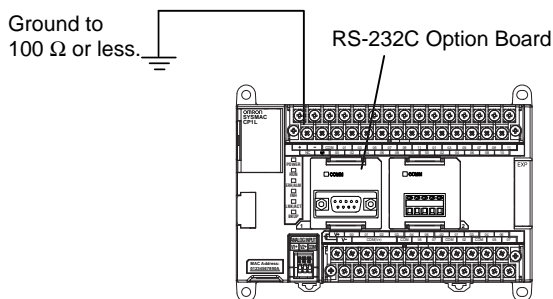
2. Combine signal wires and SG (signal ground) wires in a twisted-pair cable. At the same time, bundle the SG wires to the connectors on Option Board and the remote device.
3. Connect the shield of the communications cable to the Hood (FG) terminal of the RS-232C connector on the Option Board. At the same time, ground the ground (GR) terminal of the CPU Unit to 100  $\Omega$  or less.
4. A connection example is shown below.

Example: Twisted-pair Cable Connecting SD-SG, RD-SG, RTS-SG, and CTS-SG Terminals in Toolbus Mode

#### Actual Wiring Example



**Note** The Hood (FG) is internally connected to the ground terminal (GR) on the CPU Unit. Therefore, FG is grounded by grounding the ground terminal (GR) on the power supply terminal block. Although there is conductivity between the Hood (FG) and pin 1 (FG), connect the Hood (FG) to the shield because the Hood (FG) has smaller contact resistance with the shield than pin 1 (FG), and thus provides better noise resistance.



## Recommended RS-422A/485 Wiring Examples

Use the following wiring methods for RS-422A/485 to maintain transmission quality.

1. Always use shielded twisted-pair cables as communications cables.

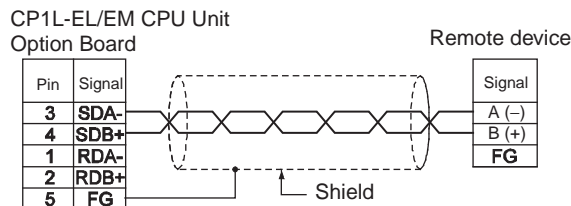
| Model              | Manufacturer           |
|--------------------|------------------------|
| CO-HC-ESV-3Px7/0.2 | Hirakawa Hewtech Corp. |

2. Connect the shield of the communications cable to the FG terminal on the RS-422A/485 Option Board. At the same time, ground the ground (GR) terminal of the CPU Unit to 100  $\Omega$  or less.

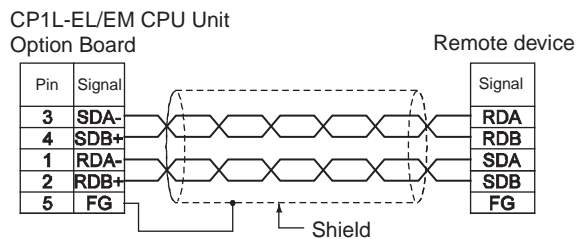
**Note** Always ground the shield only at the RS-422A/485 Option Board end. Grounding both ends of the shield may damage the device due to the potential difference between the ground terminals.

Connection examples are shown below.

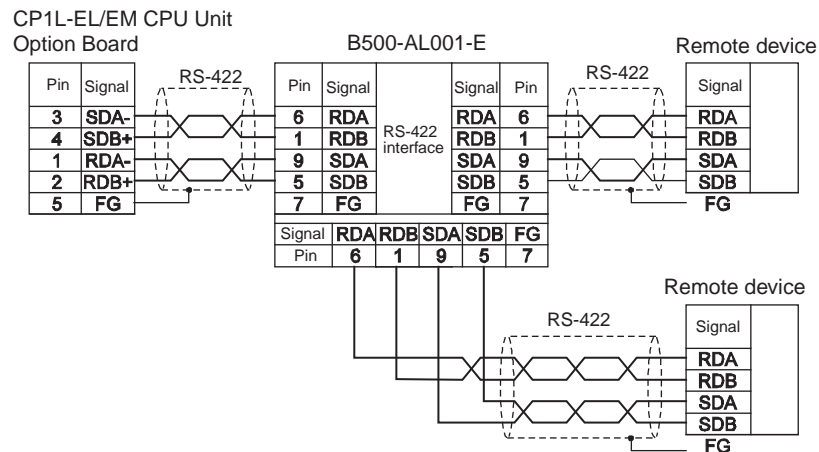
### • 2-Wire Connections



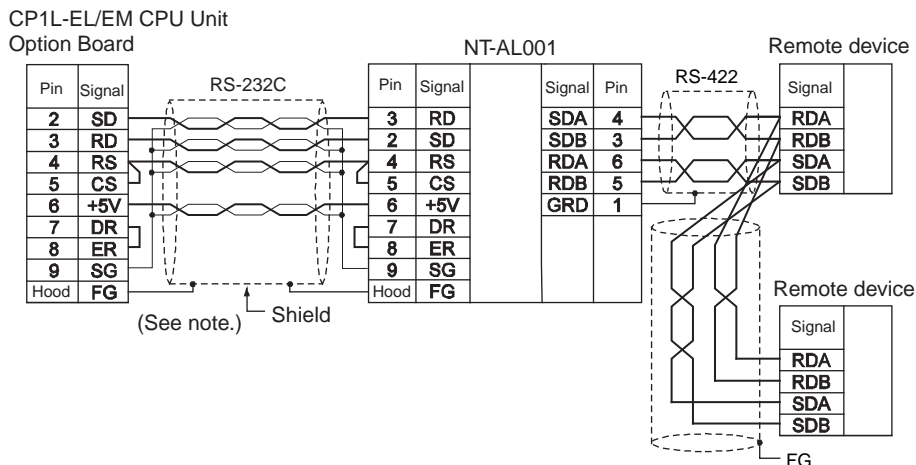
### • 4-Wire Connections



### • Using a B500-AL001-E Link Adapter



- With NT-AL001 RS-232C/RS-422 Link Adapter

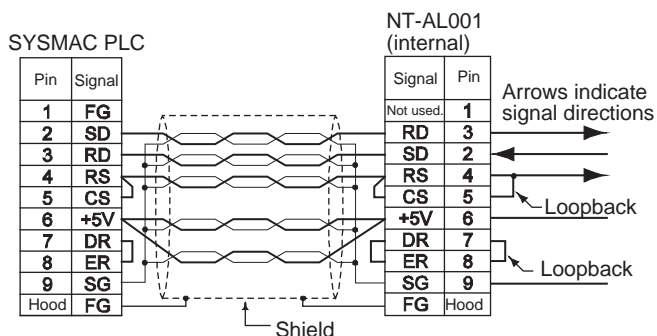


**Note** (1) The following cables are available for this connection.

| Length | Model       |
|--------|-------------|
| 70 cm  | XW2Z-070T-1 |
| 2 m    | XW2Z-200T-1 |

It is recommended that one of these cables be used to connect the RS-232C port on the Option Board to the NT-AL001 RS-232C/RS-422 Link Adapter. The recommended wiring for these cables is shown below.

- Wiring for the Recommended Cables (XW2Z-070T-1 and XW2Z-200T-1, 10-conductor Cables)



- (2) The XW2Z-070T-1 and XW2Z-200T-1 Connecting Cables for the NT-AL001 Link Adapter uses special wiring for the DTS and RTS signals. Do not use these signals with other devices; they may be damaged.
- (3) The Hood (FG) is internally connected to the ground terminal (GR) on the CPU Unit. Therefore, FG is grounded by grounding the ground terminal (GR) on the power supply terminal block.

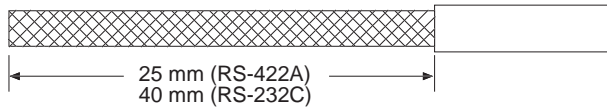
## Wiring Connectors

Use the following steps to wire connectors.

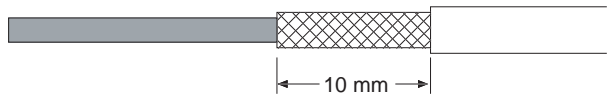
See the following diagrams for the length of the cable portion to be cut in each step.

### Shield Connected to Hood (FG)

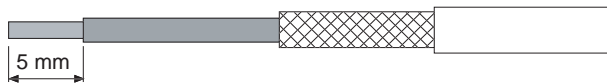
1. Cut the cable to the required length.
2. Remove the specified length of the sheath from the cable using a knife. Be careful not to scratch the braided shield.



3. Trim off the braided shield using scissors so that the remaining shield length is 10 mm.



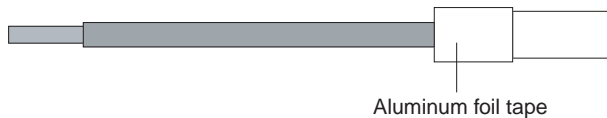
4. Remove the insulation from each conductor using a stripper so that the exposed conductor length is 5 mm.



5. Fold back the braided shield.

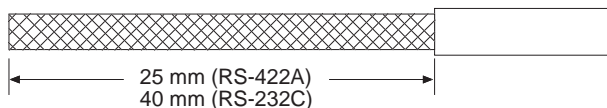


6. Wrap aluminum foil tape around the folded shield.



### Shield Not Connected to Hood (FG)

1. Cut the cable to the required length.
2. Remove the specified length of the sheath from the cable using a knife. Be careful not to scratch the braided shield.



3. Trim off all the braided shield using scissors.



4. Remove the insulation from each conductor using a stripper so that the exposed conductor length is 5 mm.

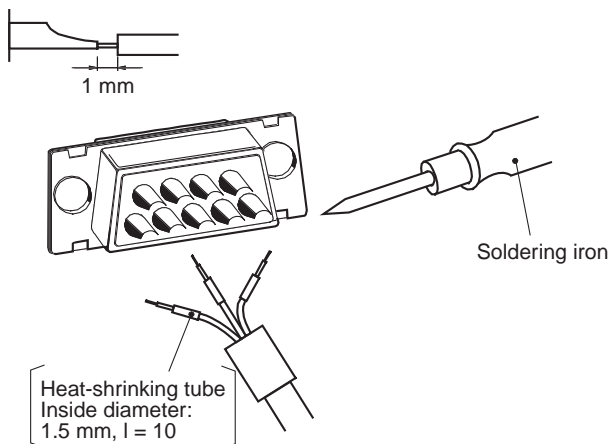


5. Wrap adhesive tape around the conductor from which the braided shield was removed.

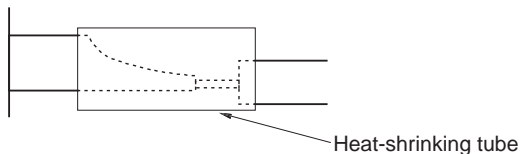


## Soldering

1. Thread a heat-shrinking tube through each conductor.
2. Temporarily solder each conductor to the corresponding connector terminals.
3. Completely solder each conductor.

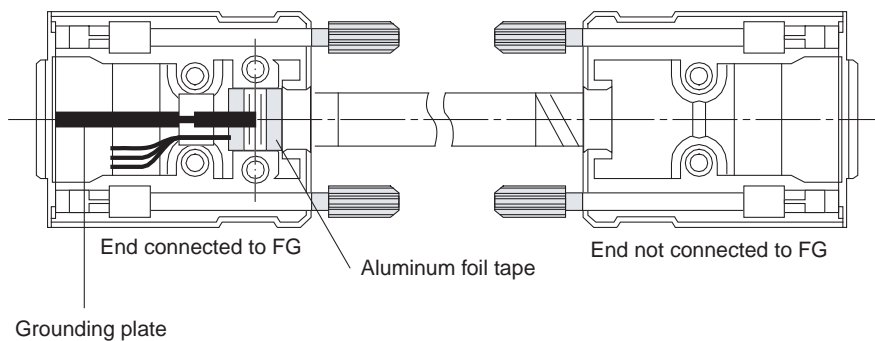


4. Return the heat-shrinking tube to the soldered portion, then heat the tube to shrink it in place.



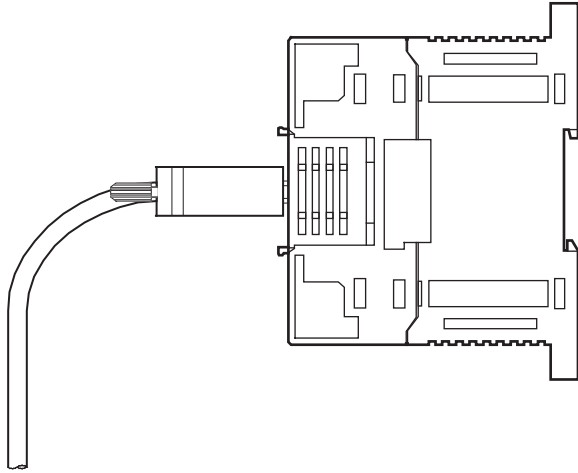
## Assembling Connector Hood

Assemble the connector hood as shown below.





**Connecting to Unit**





# Appendix G

## PLC Setup

### Startup Settings

#### Startup Hold Settings

|   | Name                  | Default   | Settings  | When setting is read by CPU Unit | Internal address | Bits | Settings |
|---|-----------------------|-----------|-----------|----------------------------------|------------------|------|----------|
| 1 | Force Status Hold Bit | Not held. | Not held. | When power is turned ON          | 80               | 14   | 0        |
|   |                       |           | Held.     |                                  |                  |      | 1        |
| 2 | IOM Hold Bit          | Not held. | Not held. | When power is turned ON          | 80               | 15   | 0        |
|   |                       |           | Held.     |                                  |                  |      | 1        |

#### Startup Data Read Setting

|   | Name                      | Default      | Settings     | When setting is read by CPU Unit | Internal address | Bits | Settings |
|---|---------------------------|--------------|--------------|----------------------------------|------------------|------|----------|
| 1 | Read DM from flash memory | Do not read. | Do not read. | When power is turned ON          | 82               | 15   | 0        |
|   |                           |              | Read.        |                                  |                  |      | 1        |

#### Mode: CPU Unit Operating Mode

|   | Name                               | Default  | Settings                          | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|------------------------------------|--|-----------------------------------|----------------------------------|------------------|----------|----------|
| 1 | Use programming console (RUN mode) | Use programming console (RUN mode) (See note.) | Use programming console: RUN mode | When power is turned ON          | 81               | 00 to 15 | 0000 hex |
|   |                                    |  | Program: PROGRAM mode             |                                  |                  |          | 8000 hex |
|   |                                    |  | Monitor: MONITOR mode             |                                  |                  |          | 8001 hex |
|   |                                    |  | Run: RUN mode                     |                                  |                  |          | 8002 hex |

**Note** A Programming Console cannot be connected to the CP1L-EL/EM. If the default setting, "Use programming console," is set, the CPU Unit will start in RUN mode.

## Settings: CPU Unit Settings

### Execute Process Settings

|   | Name  | Default      | Settings         | When setting is read by CPU Unit | Internal address | Bits | Settings |
|---|---|--------------|------------------|----------------------------------|------------------|------|----------|
| 1 | Do not detect Low Battery (run without battery) | Detect.      | Detect           | Every cycle                      | 128              | 15   | 0        |
|   |   |              | Do not detect.   |                                  |                  |      | 1        |
| 2 | Detect Interrupt Task Error                     | Detect.      | Detect           | Every cycle                      | 128              | 14   | 0        |
|   |   |              | Do not detect.   |                                  |                  |      | 1        |
| 3 | Stop CPU on Instruction Error                   | Do not stop. | Do not stop.     | At start of operation            | 197              | 15   | 0        |
|   |   |              | Stop             |                                  |                  |      | 1        |
| 4 | Don't register FAL to error log                 | Register.    | Register.        | Every cycle                      | 129              | 15   | 0        |
|   |   |              | Do not register. |                                  |                  |      | 1        |

### Comms Instructions Settings in FB: Settings for Communications Instructions in Function Blocks

|   | Name   | Default | Settings              | When setting is read by CPU Unit | Internal address | Bits     | Settings            |
|---|--|---------|-----------------------|----------------------------------|------------------|----------|---------------------|
| 1 | Retry Counts: Number of retries                                  | 0       | 0 to 15               | At start of operation            | 200              | 00 to 03 | 0 hex<br>:<br>F hex |
| 2 | Response Timeout (default 2s), Comms Instructions in FB          | 2 s     | 2 s                   | At start of operation            | 201              | 00 to 15 | 0000 hex            |
|   |  |         | 1: 1 × 0.1 s          |                                  |                  |          | 0001 hex            |
|   |  |         | :                     |                                  |                  |          | :                   |
|   |  |         | 65535: 65,535 × 0.1 s |                                  |                  |          | FFFF hex            |
| 3 | Response Timeout (default 2s), DeviceNet Comms Instruction in FB | 2 s     | 2 s                   | At start of operation            | 202              | 00 to 15 | 0000 hex            |
|   |  |         | 1: 1 × 0.1 s          |                                  |                  |          | 0001 hex            |
|   |  |         | :                     |                                  |                  |          | :                   |
|   |  |         | 65535: 65,535 × 0.1 s |                                  |                  |          | FFFF hex            |

## Timings: Time and Interrupt Settings

### Cycle Time Settings

|   | Name                               |                                    | Default               | Settings                    | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|------------------------------------|------------------------------------|-----------------------|-----------------------------|----------------------------------|------------------|----------|----------|
| 1 | Watch Cycle Time (default 1000 ms) |                                    | Use default.          | Use default. (Default: 1 s) | At start of operation            | 209              | 15       | 0        |
|   |                                    |                                    |                       | Use user setting.           |                                  |                  |          | 1        |
|   | 1-1                                | Watch Cycle Time (default 1000 ms) | 1,000 ms              | 1: 1 × 10 ms                | At start of operation            | 209              | 00 to 14 | 001 hex  |
|   |                                    |                                    |                       | :                           |                                  |                  |          | :        |
|   |                                    |                                    |                       | 40,000: 40,000 × 10 ms      |                                  |                  |          | FA0 hex  |
| 2 | Cycle Time (No Setting)            |                                    | No minimum cycle time | No minimum cycle time       | At start of operation            | 208              | 00 to 15 | 0000 hex |
|   |                                    |                                    |                       | 1 ms                        |                                  |                  |          | 0001 hex |
|   |                                    |                                    |                       | :                           |                                  |                  |          | :        |
|   |                                    |                                    |                       | 32,000 ms                   |                                  |                  |          | 7D00 hex |

### Interrupt Setting

|   | Name                         |  | Default | Settings | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|------------------------------|--|---------|----------|----------------------------------|------------------|----------|----------|
| 1 | Scheduled Interrupt Interval |  | 10 ms   | 10 ms    | At start of operation            | 195              | 00 to 03 | 0 hex    |
|   |                              |  |         | 1 ms     |                                  |                  |          | 1 hex    |
|   |                              |  |         | 0.1 ms   |                                  |                  |          | 2 hex    |

## Input Constant Settings

|    | Name          | Default               | Settings   | When setting is read by CPU Unit | Internal address | Bits     | Settings   |
|----|---------------|-----------------------|--|----------------------------------|------------------|----------|--|
| 1  | 0CH: CIO 0    | 8 ms<br>Default (8ms) | No filter (0 ms)<br>0.5 ms<br>1 ms<br>2 ms<br>4 ms<br>8 ms<br>16 ms<br>32 ms | When power is turned ON          | 10               | 00 to 07 | 10 hex<br>11 hex<br>12 hex<br>13 hex<br>14 hex<br>15 hex<br>16 hex<br>17 hex |
| 2  | 1 CH: CIO 1   | Same as above.        | Same as above.   | Same as above.                   | 10               | 08 to 15 | Same as above.   |
| 3  | 2 CH: CIO 2   |                       |  |                                  | 11               | 00 to 07 |  |
| 4  | 3 CH: CIO 3   |                       |  |                                  | 11               | 08 to 15 |  |
| 5  | 4 CH: CIO 4   |                       |  |                                  | 12               | 00 to 07 |  |
| 6  | 5 CH: CIO 5   |                       |  |                                  | 12               | 08 to 15 |  |
| 7  | 6 CH: CIO 6   |                       |  |                                  | 13               | 00 to 07 |  |
| 8  | 7 CH: CIO 7   |                       |  |                                  | 13               | 08 to 15 |  |
| 9  | 8 CH: CIO 8   |                       |  |                                  | 14               | 00 to 07 |  |
| 10 | 9 CH: CIO 9   |                       |  |                                  | 14               | 08 to 15 |  |
| 11 | 10 CH: CIO 10 |                       |  |                                  | 15               | 00 to 07 |  |
| 12 | 11 CH: CIO 11 |                       |  |                                  | 15               | 08 to 15 |  |
| 13 | 12 CH: CIO 12 |                       |  |                                  | 16               | 00 to 07 |  |
| 14 | 13 CH: CIO 13 |                       |  |                                  | 16               | 08 to 15 |  |
| 15 | 14 CH: CIO 14 |                       |  |                                  | 17               | 00 to 07 |  |
| 16 | 15 CH: CIO 15 |                       |  |                                  | 17               | 08 to 15 |  |
| 17 | 16 CH: CIO 16 |                       |  |                                  | 18               | 00 to 07 |  |
| 18 | 17 CH: CIO 17 |                       |  |                                  | 18               | 08 to 15 |  |

## Built-in Ethernet Settings

### Ethernet Port Settings

|   | Name                |              | Default  | Settings | When setting is read by CPU Unit                  | Internal address | Bits     | Settings |          |
|---|---------------------|--------------|----------|----------|---|------------------|----------|----------|----------|
| 1 | Broadcast Address   |              | 4.3BSD   | 4.3BSD   | When power is turned ON or when Ethernet is reset | 170              | 01       | 0        |          |
|   |                     |              |          | 4.2BSD   |   |                  |          | 1        |          |
| 2 | IP Address          |              |          |          |   |                  |          |          |          |
|   | 2-1                 | IP1/highest  | 0        | 0        | When power is turned ON or when Ethernet is reset | 173              | 08 to 15 | 00 hex   |          |
|   |                     |              |          | :        |   |                  |          | :        |          |
|   |                     |              |          | 255      |   |                  |          | FF hex   |          |
|   | 2-2                 | IP2          | 0        | 0        |   |                  |          | 00 to 07 | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          |          | FF hex   |
|   | 2-3                 | IP3          | 0        | 0        |   | 174              | 08 to 15 |          | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          |          | FF hex   |
|   | 2-4                 | IP4/lowest   | 0        | 0        |   |                  |          | 00 to 07 | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          |          | FF hex   |
| 3 | Subnet Mask         |              |          |          |   |                  |          |          |          |
|   | 3-1                 | Msk1/highest | 0        | 0        | When power is turned ON or when Ethernet is reset | 175              | 08 to 15 |          | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          | FF hex   |          |
|   | 3-2                 | Msk2         | 0        | 0        |   |                  |          | 00 to 07 | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          |          | FF hex   |
|   | 3-3                 | Msk3         | 0        | 0        |   | 176              | 08 to 15 |          | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          |          | FF hex   |
|   | 3-4                 | Msk4/lowest  | 0        | 0        |   |                  |          | 00 to 07 | 00 hex   |
|   |                     |              |          | :        |   |                  |          |          | :        |
|   |                     |              |          | 255      |   |                  |          |          | FF hex   |
| 4 | TCP Keep-alive Time |              | 120 ms   | 120 ms   | When power is turned ON or when Ethernet is reset | 177              | 00 to 15 |          | 0000 hex |
|   |                     | 1 ms         | 0001 hex |          |   |                  |          |          |          |
|   |                     | :            | :        |          |   |                  |          |          |          |
|   |                     | 65,535 ms    | FFFF hex |          |   |                  |          |          |          |

## FINS/TCP and FINS/UDP

|   | Name                         | Default     | Settings                          | When setting is read by CPU Unit                  | Internal address | Bits     | Settings |
|---|------------------------------|-------------|-----------------------------------|---|------------------|----------|----------|
| 1 | IP Address Conversion Method | Auto Method | Auto Method                       | When power is turned ON or when Ethernet is reset | 170              | 02 to 03 | 00 hex   |
|   |                              |             | Auto Method (Static)              |   |                  |          | 01 hex   |
|   |                              |             | IP Address Table Reference Method |   |                  |          | 02 hex   |
|   |                              |             | Combined Method                   |   |                  |          | 03 hex   |
| 2 | FINS/UDP Port Number Mode    | Default     | Default                           | When power is turned ON or when Ethernet is reset | 170              | 04       | 0        |
|   |                              |             | User                              |   |                  |          | 1        |
| 3 | FINS/TCP Port Number Mode    | Default     | Default                           | When power is turned ON or when Ethernet is reset | 170              | 05       | 0        |
|   |                              |             | User                              |   |                  |          | 1        |
| 4 | FINS/UDP Destination IP Mode | Dynamically | Dynamically                       | When power is turned ON or when Ethernet is reset | 170              | 06       | 0        |
|   |                              |             | Static                            |   |                  |          | 1        |
| 5 | FINS/UDP Port Number         | 9,600       | 9,600                             | When power is turned ON or when Ethernet is reset | 171              | 00 to 15 | 0000 hex |
|   |                              |             | 1                                 |   |                  |          | 0001 hex |
|   |                              |             | :                                 |   |                  |          | :        |
|   |                              |             | 65,535                            |   |                  |          | FFFF hex |
| 6 | FINS/TCP Port Number         | 9,600       | 9,600                             | When power is turned ON or when Ethernet is reset | 172              | 00 to 15 | 0000 hex |
|   |                              |             | 1                                 |   |                  |          | 0001 hex |
|   |                              |             | :                                 |   |                  |          | :        |
|   |                              |             | 65,535                            |   |                  |          | FFFF hex |
| 7 | FINS Node Address            | 1           | 1                                 | When power is turned ON or when Ethernet is reset | 178              | 00 to 07 | 00 hex   |
|   |                              |             | 1                                 |   |                  |          | 01 hex   |
|   |                              |             | :                                 |   |                  |          | :        |
|   |                              |             | 254                               |   |                  |          | FE hex   |



## FINS/TCP Connection

|     | Name                  |                                  | Default                    | Settings | When setting is read by CPU Unit                  | Internal address                                  | Bits     | Settings |        |
|-----|-----------------------|----------------------------------|----------------------------|----------|---|---|----------|----------|--------|
| 1   | FINS/TCP Connection 1 |                                  |                            |          |   |   |          |          |        |
|     | 1-1                   | FINS/TCP Connection 1 Mode       | Server                     | Server   | When power is turned ON or when Ethernet is reset | 179   | 00       | 0        |        |
|     |                       |                                  |                            | Client   |   |   |          | 1        |        |
|     | 1-2                   | FINS/TCP Connection 1 Protect    | Disable                    | Disable  | When power is turned ON or when Ethernet is reset | 179   | 01       | 0        |        |
|     |                       |                                  |                            | Enable   |   |   |          | 1        |        |
|     | 1-3                   | FINS/TCP Connection 1 Keep-alive | Disable                    | Disable  | When power is turned ON or when Ethernet is reset | 179   | 02       | 0        |        |
|     |                       |                                  |                            | Enable   |   |   |          | 1        |        |
|     | 1-4                   | FINS/TCP Connection 1 Auto Node  | 251                        | 251      | When power is turned ON or when Ethernet is reset | 180   | 00 to 07 | 00 hex   |        |
|     |                       |                                  |                            | 1        |   |   |          | 01 hex   |        |
|     |                       |                                  |                            | :        |   |   |          | :        |        |
|     |                       |                                  |                            | 253      |   |   |          | FD hex   |        |
|     | 1-5                   | FINS/TCP Connection 1 IP Address |                            |          |   |   |          |          |        |
|     |                       | 1-5-1                            | IP1/highest                | 0        | 0   | When power is turned ON or when Ethernet is reset | 182      | 08 to 15 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | 255   |   |          |          | FF hex |
|     |                       | 1-5-2                            | IP2                        | 0        | 0   | When power is turned ON or when Ethernet is reset | 182      | 00 to 07 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | 255   |   |          |          | FF hex |
|     |                       | 1-5-3                            | IP3                        | 0        | 0   | When power is turned ON or when Ethernet is reset | 183      | 08 to 15 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | 255   |   |          |          | FF hex |
|     |                       | 1-5-4                            | IP4/lowest                 | 0        | 0   | When power is turned ON or when Ethernet is reset | 183      | 00 to 07 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
| 255 |                       |                                  |                            |          | FF hex  |   |          |          |        |
| 2   |                       | FINS/TCP Connection 2            |                            |          |   |   |          |          |        |
|     |                       | 2-1                              | FINS/TCP Connection 2 Mode | Server   | Server  | When power is turned ON or when Ethernet is reset | 179      | 04       | 0      |
|     | Client                |                                  |                            |          | 1   |   |          |          |        |
|     | 2-2                   | FINS/TCP Connection 2 Protect    | Disable                    | Disable  | When power is turned ON or when Ethernet is reset | 179   | 05       | 0        |        |
|     |                       |                                  |                            | Enable   |   |   |          | 1        |        |
|     | 2-3                   | FINS/TCP Connection 2 Keep-alive | Disable                    | Disable  | When power is turned ON or when Ethernet is reset | 179   | 06       | 0        |        |
|     |                       |                                  |                            | Enable   |   |   |          | 1        |        |
|     | 2-4                   | FINS/TCP Connection 2 Auto Node  | 252                        | 252      | When power is turned ON or when Ethernet is reset | 180   | 08 to 15 | 00 hex   |        |
|     |                       |                                  |                            | 1        |   |   |          | 01 hex   |        |
|     |                       |                                  |                            | :        |   |   |          | :        |        |
|     |                       |                                  |                            | 253      |   |   |          | FD hex   |        |
|     | 2-5                   | FINS/TCP Connection 2 IP Address |                            |          |   |   |          |          |        |
|     |                       | 2-5-1                            | IP1/highest                | 0        | 0   | When power is turned ON or when Ethernet is reset | 184      | 08 to 15 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | 255   |   |          |          | FF hex |
|     |                       | 2-5-2                            | IP2                        | 0        | 0   | When power is turned ON or when Ethernet is reset | 184      | 00 to 07 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | 255   |   |          |          | FF hex |
|     |                       | 2-5-3                            | IP3                        | 0        | 0   | When power is turned ON or when Ethernet is reset | 185      | 08 to 15 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | 255   |   |          |          | FF hex |
|     |                       | 2-5-4                            | IP4/lowest                 | 0        | 0   | When power is turned ON or when Ethernet is reset | 185      | 00 to 07 | 00 hex |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
|     |                       |                                  |                            |          | :   |   |          |          | :      |
| 255 |                       |                                  |                            |          | FF hex  |   |          |          |        |

|   | Name                  |                                  | Default     | Settings | When setting is read by CPU Unit                  | Internal address                                  | Bits     | Settings |        |
|---|-----------------------|----------------------------------|-------------|----------|---|---|----------|----------|--------|
| 3 | FINS/TCP Connection 3 |                                  |             |          |   |   |          |          |        |
|   | 3-1                   | FINS/TCP Connection 3 Mode       | Server      | Server   | When power is turned ON or when Ethernet is reset | 179   | 08       | 0        |        |
|   |                       |                                  |             | Client   |   |   |          | 1        |        |
|   | 3-2                   | FINS/TCP Connection 3 Protect    | Disable     | Disable  | When power is turned ON or when Ethernet is reset | 179   | 09       | 0        |        |
|   |                       |                                  |             | Enable   |   |   |          | 1        |        |
|   | 3-3                   | FINS/TCP Connection 3 Keep-alive | Disable     | Disable  | When power is turned ON or when Ethernet is reset | 179   | 10       | 0        |        |
|   |                       |                                  |             | Enable   |   |   |          | 1        |        |
|   | 3-4                   | FINS/TCP Connection 3 Auto Node  | 253         | 253      | When power is turned ON or when Ethernet is reset | 181   | 00 to 07 | 00 hex   |        |
|   |                       |                                  |             | 1        |   |   |          | 01 hex   |        |
|   |                       |                                  |             | :        |   |   |          | :        |        |
|   |                       |                                  |             | 253      |   |   |          | FD hex   |        |
|   | 3-5                   | FINS/TCP Connection 3 IP Address |             |          |   |   |          |          |        |
|   |                       | 3-5-1                            | IP1/highest | 0        | 0   | When power is turned ON or when Ethernet is reset | 186      | 08 to 15 | 00 hex |
|   |                       |                                  |             |          | :   |   |          |          | :      |
|   |                       |                                  |             |          | 255   |   |          |          | FF hex |
|   |                       | 3-5-2                            | IP2         | 0        | 0   | When power is turned ON or when Ethernet is reset | 186      | 00 to 07 | 00 hex |
|   |                       |                                  |             |          | :   |   |          |          | :      |
|   |                       |                                  |             |          | 255   |   |          |          | FF hex |
|   |                       | 3-5-3                            | IP3         | 0        | 0   | When power is turned ON or when Ethernet is reset | 187      | 08 to 15 | 00 hex |
|   |                       |                                  |             |          | :   |   |          |          | :      |
|   |                       |                                  |             |          | 255   |   |          |          | FF hex |
|   |                       | 3-5-4                            | IP4/lowest  | 0        | 0   | When power is turned ON or when Ethernet is reset | 187      | 00 to 07 | 00 hex |
|   |                       |                                  |             |          | :   |   |          |          | :      |
|   |                       |                                  |             |          | 255   |   |          |          | FF hex |

## DNS Server

|     | Name                  |             | Default | Settings | When setting is read by CPU Unit                  | Internal address | Bits     | Settings |
|-----|-----------------------|-------------|---------|----------|---|------------------|----------|----------|
| 1   | DNS Server IP Address |             |         |          |   |                  |          |          |
|     | 1-1                   | IP1/highest | 0       | 0        | When power is turned ON or when Ethernet is reset | 154              | 08 to 15 | 00 hex   |
|     |                       |             |         | :        |   |                  |          | :        |
|     |                       |             |         | 255      |   |                  |          | FF hex   |
|     | 1-2                   | IP2         | 0       | 0        |   | 155              | 00 to 07 | 00 hex   |
|     |                       |             |         | :        |   |                  |          | :        |
|     |                       |             |         | 255      |   |                  |          | FF hex   |
|     | 1-3                   | IP3         | 0       | 0        |   | 155              | 08 to 15 | 00 hex   |
|     |                       |             |         | :        |   |                  |          | :        |
|     |                       |             |         | 255      |   |                  |          | FF hex   |
|     | 1-4                   | IP4/lowest  | 0       | 0        |   | 155              | 00 to 07 | 00 hex   |
|     |                       |             |         | :        |   |                  |          | :        |
| 255 |                       |             |         | FF hex   |   |                  |          |          |
| 2   | DNS Port Number       |             | 53      | 53       | When power is turned ON or when Ethernet is reset | 156              | 00 to 15 | 0000 hex |
|     |                       |             |         | 1        |   |                  |          | 0001 hex |
|     |                       |             |         | :        |   |                  |          | :        |
|     |                       |             |         | 65,535   |   |                  |          | FFFF hex |
| 3   | Retry Time            |             | 10 s    | 10 s     | When power is turned ON or when Ethernet is reset | 156              | 00 to 15 | 0000 hex |
|     |                       |             |         | 1 s      |   |                  |          | 0001 hex |
|     |                       |             |         | :        |   |                  |          | :        |
|     |                       |             |         | 65,535 s |   |                  |          | FFFF hex |

## SNTP Server

|           | Name   |                 | Default    | Settings   | When setting is read by CPU Unit                  | Internal address                                  | Bits     | Settings |        |
|-----------|--|-----------------|------------|------------|---|---|----------|----------|--------|
| 1         | SNTP Server Specify Method   |                 | IP Address | IP Address | When power is turned ON or when Ethernet is reset | 170   | 11       | 0        |        |
| Host Name |  |                 |            | 1          |   |   |          |          |        |
| 2         | Auto Adjust Time Mode  |                 | Disable    | Disable    | When power is turned ON or when Ethernet is reset | 481   | 00       | 0        |        |
| Enable    |  |                 |            | 1          |   |   |          |          |        |
| 3         | Broadcast Mode   |                 | Disable    | Disable    | When power is turned ON or when Ethernet is reset | 481   | 01       | 0        |        |
| Enable    |  |                 |            | 1          |   |   |          |          |        |
| 4         | Auto Adjust Time   |                 |            |            |   |   |          |          |        |
|           | 4-1  | Hour            | 0          | 0          | When power is turned ON or when Ethernet is reset | 482   | 08 to 15 | 00 hex   |        |
|           |  |                 |            | :          |   |   |          | :        |        |
|           |  |                 |            | 23         |   |   |          | 17 hex   |        |
|           | 4-2  | Minute          | 0          | 0          | When power is turned ON or when Ethernet is reset | 482   | 00 to 07 | 00 hex   |        |
|           |  |                 |            | :          |   |   |          | :        |        |
|           |  |                 |            | 59         |   |   |          | 3B hex   |        |
|           | 4-3  | Second          | 0          | 0          | When power is turned ON or when Ethernet is reset | 483   | 08 to 15 | 00 hex   |        |
|           |  |                 |            | :          |   |   |          | :        |        |
|           |  |                 |            | 59         |   |   |          | 3B hex   |        |
|           | 5  | Difference Time |            |            |   |   |          |          |        |
|           |  | 5-1             | Hour       | 0          | -12   | When power is turned ON or when Ethernet is reset | 484      | 08 to 15 | -12    |
| :         |  |                 |            |            | :   |   |          |          |        |
| 13        |  |                 |            |            | 13  |   |          |          |        |
| 5-2       |  | Minute          | 0          | -59        | When power is turned ON or when Ethernet is reset | 484   | 00 to 07 | -59      |        |
|           |  |                 |            | :          |   |   |          | :        |        |
|           |  |                 |            | 59         |   |   |          | 59       |        |
| 6         |  | Retry Time      |            | 10 s       | 10 s  | When power is turned ON or when Ethernet is reset | 485      | 00 to 07 | 00 hex |
|           | 1 s  |                 |            |            | 01 hex  |   |          |          |        |
|           | :  |                 |            |            | :   |   |          |          |        |
|           | 255 s  |                 |            |            | FF hex  |   |          |          |        |
| 7         | SNTP Port Number   |                 | 123        | 123        | When power is turned ON or when Ethernet is reset | 486   | 00 to 15 | 0000 hex |        |
|           |  |                 |            | 1          |   |   |          | 0001 hex |        |
|           |  |                 |            | :          |   |   |          | :        |        |
|           |  |                 |            | 65,535     |   |   |          | FFFF hex |        |
| 8         | SNTP Server IP Address (4 bytes) /SNTP Server Host Name (46 ASCII) |                 |            |            | When power is turned ON or when Ethernet is reset | 487~509   | 00 to 15 |          |        |

# Serial Port 1 Settings

## Serial Communications Settings

|  | Name                    |                                       | Default                     | Settings   | When setting is read<br>by CPU Unit | Internal<br>address                   | Bits  | Settings    |   |   |  |             |                                      |             |
|--|-------------------------|---------------------------------------|-----------------------------|--|-------------------------------------|---------------------------------------|---|-------------|---|---|--|-------------|--------------------------------------|-------------|
| 1  | Communications Settings |                                       | Standard<br>(9600; 1,7,2,E) | Standard (9600; 1,7,2,E)<br>(The standard settings<br>are as follows: 9,600<br>baud, 1 start bit, 7-bit<br>data, even parity, and 2<br>stop bits.) | Every cycle                         | 144<br>(CP1L<br>EM-type<br>CPU Unit)  | 15  | 0           |   |   |  |             |                                      |             |
|  |                         |                                       |                             | Custom   |                                     | 160<br>(CP1L EL-<br>type CPU<br>Unit) |   | 1           |   |   |  |             |                                      |             |
|  |                         |                                       |                             |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 2  | Mode                    |                                       | Host Link                   | Host Link  | Every cycle                         | 144<br>(CP1L<br>EM-type<br>CPU Unit)  | 08 to<br>11                                   | 0 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             | NT Link (1:N)  |                                     |                                       |   | 5 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             | RS-232C  |                                     |                                       |   | 2 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             | ToolBus (peripheral bus)   |                                     | 160<br>(CP1L EL-<br>type CPU<br>Unit) |   | 3 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             | Serial Gateway   |                                     |                                       |   | 4 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             | PC Link (Slave)  |                                     |                                       |   | 9 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             | PC Link (Master)   |                                     |                                       |   | 7 hex       |   |   |  |             |                                      |             |
|  |                         |                                       |                             |  |                                     |                                       |   | 8 hex       |   |   |  |             |                                      |             |
|  | 2-1                     | Host Link                             |                             |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
|  |                         | 2-1-1                                 | Baud                        | 9,600 bps  | 300 bps                             | Every cycle                           | 145<br>(CP1L<br>EM-type<br>CPU Unit)          | 00 to<br>07 | 01 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 600 bps                             |                                       |   |             | 02 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 1,200 bps                           |                                       |   |             | 03 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 2,400 bps                           |                                       | 161<br>(CP1L EL-<br>type CPU<br>Unit)         |             | 04 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 4,800 bps                           |                                       |   |             | 05 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 9,600 bps                           |                                       |   |             | 00 or<br>06 hex                                     |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 19,200 bps                          |                                       |   |             | 07 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 38,400 bps                          |                                       |   |             | 08 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 57,600 bps                          |                                       |   |             | 09 hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 115,200 bps                         |                                       |   |             | 0A hex  |   |  |             |                                      |             |
|  |                         |                                       |                             |  | 2-1-2                               |                                       |   |             | Format<br>(data<br>length,<br>stop bits,<br>parity) | 7,2,E: 7-bit<br>data, 2 stop<br>bits, even parity | 7,2,E: 7-bit data, 2 stop<br>bits, even parity | Every cycle | 144<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>03 |
|  |                         |                                       |                             |  |                                     |                                       | 7,2,O: 7-bit data, 2 stop<br>bits, odd parity |             |   |   |  |             | 1 hex                                |             |
| 7,2,N: 7-bit data, 2 stop<br>bits, no parity   |                         |                                       | 2 hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 7,1,E: 7-bit data, 2 stop<br>bits, even parity |                         | 160<br>(CP1L EL-<br>type CPU<br>Unit) | 4 hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 7,1,O: 7-bit data, 1 stop<br>bit, odd parity   |                         |                                       | 5 hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 7,1,N: 7-bit data, 1 stop<br>bit, no parity    |                         |                                       | 6 hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 8,2,E: 8-bit data, 2 stop<br>bits, even parity |                         |                                       | 8 hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 8,2,O: 8-bit data, 2 stop<br>bits, odd parity  |                         |                                       | 9 hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 8,2,N: 8-bit data, 2 stop<br>bits, no parity   |                         |                                       | A hex                       |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 8,1,E: 8-bit data, 1 stop<br>bit, even parity  | C hex                   |                                       |                             |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 8,1,O: 8-bit data, 1 stop<br>bit, odd parity   | D hex                   |                                       |                             |  |                                     |                                       |   |             |   |   |  |             |                                      |             |
| 8,1,N: 8-bit data, 1 stop<br>bit, no parity    | E hex                   |                                       |                             |  |                                     |                                       |   |             |   |   |  |             |                                      |             |

|             | Name                                    |   |                  | Default                                     | Settings             | When setting is read by CPU Unit | Internal address            | Bits     | Settings |
|-------------|---|---|------------------|---|----------------------|----------------------------------|-----------------------------|----------|----------|
| 2           | 2-1                                     | 2-1-3                                       | Unit Number      | 0   | 0                    | Every cycle                      | 147 (CP1L EM-type CPU Unit) | 00 to 07 | 00 hex   |
|             |   |   |                  |   | :                    |                                  |                             |          | :        |
|             |   |   |                  |   | 31                   |                                  | 161 (CP1L EL-type CPU Unit) |          | 1F hex   |
|             | 2-2                                     | NT Link (1:N): 1:N NT Links                 |                  |   |                      |                                  |                             |          |          |
|             | 2-2-1                                   | Baud  | 9,600 (disabled) |   | 38,400 (standard)    | Every cycle                      | 145 (CP1L EM-type CPU Unit) | 00 to 07 | 00 hex   |
|             |   |   |                  |   | 115,200 (high speed) |                                  |                             |          | 0A hex   |
|             |   |   |                  |   |                      |                                  | 161 (CP1L EL-type CPU Unit) |          |          |
|             | 2-2-2                                   | NT/PC Link Max: Highest unit number         | 0                |   | 0                    | Every cycle                      | 150 (CP1L EM-type CPU Unit) | 00 to 03 | 0 hex    |
|             |   |   |                  |   | :                    |                                  |                             |          | :        |
|             |   |   |                  |   | 7                    |                                  | 166 (CP1L EL-type CPU Unit) |          | 7 hex    |
|             | 2-3                                     | RS-232C                                     |                  |   |                      |                                  |                             |          |          |
|             | 2-3-1                                   | Baud  | 9600 bps         |   | 300 bps              | Every cycle                      | 145 (CP1L EM-type CPU Unit) | 00 to 07 | 01 hex   |
|             |   |   |                  |   | 600 bps              |                                  |                             |          | 02 hex   |
|             |   |   |                  |   | 1,200 bps            |                                  |                             |          | 03 hex   |
|             |   |   |                  |   | 2,400 bps            |                                  |                             |          | 04 hex   |
| 4,800 bps   |   |   |                  |   |                      |                                  | 05 hex                      |          |          |
| 9,600 bps   |   |   |                  |   |                      |                                  | 00 or 06 hex                |          |          |
| 19,200 bps  |   |   |                  |   |                      |                                  | 07 hex                      |          |          |
| 38,400 bps  |   |   |                  |   |                      |                                  | 08 hex                      |          |          |
| 57,600 bps  |   |   |                  |   |                      |                                  | 09 hex                      |          |          |
| 115,200 bps |   |   |                  |   |                      |                                  | 0A hex                      |          |          |
| 2-3-2       | Format (data length, stop bits, parity) | 7,2,E: 7-bit data, 2 stop bits, even parity |                  | 7,2,E: 7-bit data, 2 stop bits, even parity | Every cycle          | 144 (CP1L EM-type CPU Unit)      | 00 to 03                    | 0 hex    |          |
|             |   |   |                  | 7,2,O: 7-bit data, 2 stop bits, odd parity  |                      |                                  |                             | 1 hex    |          |
|             |   |   |                  | 7,2,N: 7-bit data, 2 stop bits, no parity   |                      |                                  |                             | 2 hex    |          |
|             |   |   |                  | 7,1,E: 7-bit data, 2 stop bits, even parity |                      |                                  |                             | 4 hex    |          |
|             |   |   |                  | 7,1,O: 7-bit data, 1 stop bit, odd parity   |                      | 160 (CP1L EL-type CPU Unit)      |                             | 5 hex    |          |
|             |   |   |                  | 7,1,N: 7-bit data, 1 stop bit, no parity    |                      |                                  |                             | 6 hex    |          |
|             |   |   |                  | 8,2,E: 8-bit data, 2 stop bits, even parity |                      |                                  |                             | 8 hex    |          |
|             |   |   |                  | 8,2,O: 8-bit data, 2 stop bits, odd parity  |                      |                                  |                             | 9 hex    |          |
|             |   |   |                  | 8,2,N: 8-bit data, 2 stop bits, no parity   |                      |                                  |                             | A hex    |          |
|             |   |   |                  | 8,1,E: 8-bit data, 1 stop bit, even parity  |                      |                                  |                             | C hex    |          |
|             |   |   |                  | 8,1,O: 8-bit data, 1 stop bit, odd parity   |                      |                                  |                             | D hex    |          |
|             |   |   |                  | 8,1,N: 8-bit data, 1 stop bit, no parity    |                      |                                  |                             | E hex    |          |

|   | Name |       |                          | Default   | Settings   | When setting is read<br>by CPU Unit | Internal<br>address                   | Bits                                  | Settings    |                 |  |
|---|------|-------|--------------------------|---|--|-------------------------------------|---------------------------------------|---------------------------------------|-------------|-----------------|--|
| 2 | 2-3  | 2-3-3 | Start Code               | Disable.  | Disable.   | Every cycle                         | 149<br>(CP1L<br>EM-type<br>CPU Unit)  | 12                                    | 0           |                 |  |
|   |      |       |                          |   | Set.   |                                     | 165<br>(CP1L EL-<br>type CPU<br>Unit) |                                       | 1           |                 |  |
|   |      | 2-3-4 | Start Code               | 00 hex0x0000  | 0x0000   | Every cycle                         | 148<br>(CP1L<br>EM-type<br>CPU Unit)  | 08 to<br>15                           | 00 hex      |                 |  |
|   |      |       |                          |   | :  |                                     |                                       |                                       | :           |                 |  |
|   |      |       |                          |   | 0x00FF   |                                     | 164<br>(CP1L EL-<br>type CPU<br>Unit) |                                       | FF hex      |                 |  |
|   |      | 2-3-5 | End Code                 | Received<br>Bytes: Receive<br>specified num-<br>ber of bytes. | Received Bytes: Receive<br>specified number of<br>bytes. | Every cycle                         | 149<br>(CP1L<br>EM-type<br>CPU Unit)  | 08 and<br>09                          | 00          |                 |  |
|   |      |       |                          |   | CR,LF  |                                     |                                       |                                       | 10          |                 |  |
|   |      |       |                          |   | Set End Code   |                                     | 165<br>(CP1L EL-<br>type CPU<br>Unit) |                                       | 01          |                 |  |
|   |      | 2-3-6 | Received<br>Bytes        | 256 bytes   | 256 bytes  | Every cycle                         | 149<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>07                           | 00 hex      |                 |  |
|   |      |       |                          |   | 1 byte   |                                     |                                       |                                       | 01 hex      |                 |  |
|   |      |       |                          |   | :  |                                     |                                       |                                       | :           |                 |  |
|   |      |       |                          |   | 255 bytes  |                                     | 165<br>(CP1L EL-<br>type CPU<br>Unit) |                                       | FF hex      |                 |  |
|   |      | 2-3-7 | Set End<br>Code          | 0x0000  | 1 byte   | Every cycle                         | 148<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>07                           | 00 hex      |                 |  |
|   |      |       |                          |   | :  |                                     |                                       |                                       | :           |                 |  |
|   |      |       |                          |   | 255 bytes  |                                     | 164<br>(CP1L EL-<br>type CPU<br>Unit) |                                       | FF hex      |                 |  |
|   |      | 2-3-8 | Delay                    | 0 ms  | 0: 0 × 10 ms   | Every cycle                         | 146<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>15                           | 0000 hex    |                 |  |
|   |      |       |                          |   | :  |                                     |                                       |                                       | :           |                 |  |
|   |      |       |                          |   | 9999: 9999 × 10 ms                                       |                                     | 162<br>(CP1L EL-<br>type CPU<br>Unit) |                                       | 270F hex    |                 |  |
|   |      | 2-4   | ToolBus (peripheral bus) |   |  |                                     |                                       |                                       |             |                 |  |
|   |      |       | 2-4-1                    | Baud  | 9,600 bps  | 9,600 bps                           | Every cycle                           | 145<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>07 | 00 or<br>06 hex |  |
|   |      |       |                          |   |  | 19,200 bps                          |                                       |                                       |             | 07 hex          |  |
|   |      |       |                          |   |  | 38,400 bps                          |                                       | 161<br>(CP1L EL-<br>type CPU<br>Unit) |             | 08 hex          |  |
|   |      |       |                          |   |  | 57,600 bps                          |                                       |                                       |             | 09 hex          |  |
|   |      |       |                          |   |  | 115,200 bps                         |                                       |                                       |             | 0A hex          |  |
|   |      |       |                          |   |  |                                     |                                       |                                       |             |                 |  |

|   | Name |  | Default             | Settings                              | When setting is read<br>by CPU Unit | Internal<br>address  | Bits  | Settings                              |   |  |
|---|------|--|---------------------|---------------------------------------|-------------------------------------|----------------------|---|---------------------------------------|---|--|
| 2 | 2-5  | Serial Gateway                                 |                     |                                       |                                     |                      |   |                                       |   |  |
|   |      | 2-5-1  | Baud                | 9,600 bps                             | 300 bps                             | Every cycle          | 145<br>(CP1L<br>EM-type<br>CPU Unit)                | 00 to<br>07                           | 01 hex  |  |
|   |      |  |                     |                                       | 600 bps                             |                      |   |                                       | 02 hex  |  |
|   |      |  |                     |                                       | 1,200 bps                           |                      |   |                                       | 03 hex  |  |
|   |      |  |                     |                                       | 2,400 bps                           |                      |   |                                       | 04 hex  |  |
|   |      |  |                     |                                       | 4,800 bps                           |                      |   |                                       | 05 hex  |  |
|   |      |  |                     |                                       | 9,600 bps                           |                      |   |                                       | 00 or<br>06 hex                                   |  |
|   |      |  |                     |                                       | 19,200 bps                          |                      |   |                                       | 07 hex  |  |
|   |      |  |                     |                                       | 38,400 bps                          |                      |   |                                       | 08 hex  |  |
|   |      |  |                     |                                       | 57,600 bps                          |                      |   |                                       | 09 hex  |  |
|   |      |  |                     |                                       | 115,200 bps                         |                      |   |                                       | 0A hex  |  |
|   |      |  |                     |                                       | 2-5-2                               |                      | Format<br>(data<br>length,<br>stop bits,<br>parity) |                                       | 7,2,E: 7-bit<br>data, 2 stop<br>bits, even parity | 7,2,E: 7-bit data, 2 stop<br>bits, even parity |
|   |      | 7,2,O: 7-bit data, 2 stop<br>bits, odd parity  | 1 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 7,2,N: 7-bit data, 2 stop<br>bits, no parity   | 2 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 7,1,E: 7-bit data, 2 stop<br>bits, even parity | 4 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 7,1,O: 7-bit data, 1 stop<br>bit, odd parity   | 5 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 7,1,N: 7-bit data, 1 stop<br>bit, no parity    | 6 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 8,2,E: 8-bit data, 2 stop<br>bits, even parity | 8 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 8,2,O: 8-bit data, 2 stop<br>bits, odd parity  | 9 hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 8,2,N: 8-bit data, 2 stop<br>bits, no parity   | A hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 8,1,E: 8-bit data, 1 stop<br>bit, even parity  | C hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 8,1,O: 8-bit data, 1 stop<br>bit, odd parity   | D hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 8,1,N: 8-bit data, 1 stop<br>bit, no parity    | E hex               |                                       |                                     |                      |   |                                       |   |  |
|   |      | 2-5-3  | Response<br>Timeout | 50:<br>50 × 100 ms =<br>5 s           | 50: 50 × 100 ms = 5 s               | Every cycle          | 151<br>(CP1L<br>EM-type<br>CPU Unit)                | 08 to<br>15                           | 00 hex  |  |
|   |      |  |                     |                                       | 1: 1 × 100 ms                       |                      |   |                                       | 01 hex  |  |
|   |      |  |                     |                                       | :                                   |                      | :   |                                       |   |  |
|   |      |  | 255: 255 × 100 ms   | 167<br>(CP1L EL-<br>type CPU<br>Unit) | FF hex                              |                      |   |                                       |   |  |
|   |      | 2-6  | PC Link (Slave)     |                                       |                                     |                      |   |                                       |   |  |
|   |      |  | 2-6-1               | Baud                                  | 9,600 bps<br>(disabled)             | 38,400 (standard)    | Every cycle   | 145<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>07                                       | 00 hex   |
|   |      |  |                     |                                       |                                     | 115,200 (high speed) |   | 161<br>(CP1L EL-<br>type CPU<br>Unit) |   | 0A hex   |
|   |      |  | 2-6-2               | PC Link<br>Unit No.                   | 0                                   | 0                    | Every cycle   | 151<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>03                                       | 0 hex  |
|   |      |  |                     |                                       |                                     | :                    |   | :                                     |   |  |
|   |      |  |                     |                                       |                                     | 7                    |   | 167<br>(CP1L EL-<br>type CPU<br>Unit) |   | 7 hex  |

|   | Name |                  | Default         | Settings                | When setting is read<br>by CPU Unit | Internal<br>address | Bits                                  | Settings    |                          |
|---|------|------------------|-----------------|-------------------------|-------------------------------------|---------------------|---------------------------------------|-------------|--------------------------|
| 2 | 2-7  | PC Link (Master) |                 |                         |                                     |                     |                                       |             |                          |
|   |      | 2-7-1            | Baud            | 9,600 bps<br>(disabled) | 38,400 (standard)                   | Every cycle         | 145<br>(CP1L<br>EM-type<br>CPU Unit)  | 00 to<br>07 | 00 hex                   |
|   |      |                  |                 |                         | 115,200 (high speed)                |                     | 161<br>(CP1L EL-<br>type CPU<br>Unit) |             | 0A hex                   |
|   |      | 2-7-2            | Link<br>Words   | 10 (default)            | 1<br>:<br>10 (default)              | Every cycle         | 150<br>(CP1L<br>EM-type<br>CPU Unit)  | 04 to<br>07 | 1 hex<br>:<br>0 or A hex |
|   |      |                  |                 |                         |                                     |                     | 166<br>(CP1L EL-<br>type CPU<br>Unit) |             |                          |
|   |      | 2-7-3            | PC Link<br>Mode | ALL                     | ALL                                 | Every cycle         | 150<br>(CP1L<br>EM-type<br>CPU Unit)  | 15          | 0                        |
|   |      |                  |                 |                         | Masters                             |                     | 166<br>(CP1L EL-<br>type CPU<br>Unit) |             | 1                        |



## Serial Port 2 Settings

### Serial Communications Settings

|     | Name                    |   | Default                                     | Settings   | When setting is read by CPU Unit | Internal address            | Bits     | Settings     |   |   |             |                             |          |        |
|-----|-------------------------|---|---|--|----------------------------------|-----------------------------|----------|--------------|---|---|-------------|-----------------------------|----------|--------|
| 1   | Communications Settings |   | Standard (9600 ; 1,7,2,E)                   | Standard (9600; 1,7,2,E)<br>(The standard settings are as follows: 9,600 baud, 1 start bit, 7-bit data, even parity, and 2 stop bits.) | Every cycle                      | 160 (CP1L EM-type CPU Unit) | 15       | 0            |   |   |             |                             |          |        |
|     |                         |   |   | Custom   |                                  |                             |          | 1            |   |   |             |                             |          |        |
| 2   | Mode                    |   | Host Link                                   | Host Link  | Every cycle                      | 160 (CP1L EM-type CPU Unit) | 08 to 11 | 0 hex        |   |   |             |                             |          |        |
|     |                         |   |   | NT Link (1:N): 1:N NT Links  |                                  |                             |          | 5 hex        |   |   |             |                             |          |        |
|     |                         |   |   | RS-232C  |                                  |                             |          | 2 hex        |   |   |             |                             |          |        |
|     |                         |   |   | ToolBus (peripheral bus)   |                                  |                             |          | 3 hex        |   |   |             |                             |          |        |
|     |                         |   |   | Serial Gateway   |                                  |                             |          | 4 hex        |   |   |             |                             |          |        |
|     |                         |   |   | PC Link (Slave)  |                                  |                             |          | 9 hex        |   |   |             |                             |          |        |
|     |                         |   |   | PC Link (Master)   |                                  |                             |          | 7 hex        |   |   |             |                             |          |        |
|     |                         |   |   |  |                                  |                             |          | 8 hex        |   |   |             |                             |          |        |
| 2-1 | Host Link               |   |   |  |                                  |                             |          |              |   |   |             |                             |          |        |
|     | 2-1-1                   | Baud                                    | 9,600 bps                                   | 300 bps  | Every cycle                      | 161 (CP1L EM-type CPU Unit) | 00 to 07 | 01 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 600 bps  |                                  |                             |          | 02 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 1,200 bps  |                                  |                             |          | 03 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 2,400 bps  |                                  |                             |          | 04 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 4,800 bps  |                                  |                             |          | 05 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 9,600 bps  |                                  |                             |          | 00 or 06 hex |   |   |             |                             |          |        |
|     |                         |   |   | 19,200 bps   |                                  |                             |          | 07 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 38,400 bps   |                                  |                             |          | 08 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 57,600 bps   |                                  |                             |          | 09 hex       |   |   |             |                             |          |        |
|     |                         |   |   | 115,200 bps  |                                  |                             |          | 0A hex       |   |   |             |                             |          |        |
|     | 2-1-2                   | Format (data length, stop bits, parity) | 7,2,E: 7-bit data, 2 stop bits, even parity | 7,2,E: 7-bit data, 2 stop bits, even parity  | Every cycle                      | 160 (CP1L EM-type CPU Unit) | 00 to 03 | 0 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 7,2,O: 7-bit data, 2 stop bits, odd parity   |                                  |                             |          | 1 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 7,2,N: 7-bit data, 2 stop bits, no parity  |                                  |                             |          | 2 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 7,1,E: 7-bit data, 2 stop bits, even parity  |                                  |                             |          | 4 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 7,1,O: 7-bit data, 1 stop bit, odd parity  |                                  |                             |          | 5 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 7,1,N: 7-bit data, 1 stop bit, no parity   |                                  |                             |          | 6 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 8,2,E: 8-bit data, 2 stop bits, even parity  |                                  |                             |          | 8 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 8,2,O: 8-bit data, 2 stop bits, odd parity   |                                  |                             |          | 9 hex        |   |   |             |                             |          |        |
|     |                         |   |   | 8,2,N: 8-bit data, 2 stop bits, no parity  |                                  |                             |          | A hex        |   |   |             |                             |          |        |
|     |                         |   |   | 8,1,E: 8-bit data, 1 stop bit, even parity   |                                  |                             |          | C hex        |   |   |             |                             |          |        |
|     |                         |   |   | 8,1,O: 8-bit data, 1 stop bit, odd parity  |                                  |                             |          | D hex        |   |   |             |                             |          |        |
|     |                         |   |   | 8,1,N: 8-bit data, 1 stop bit, no parity   |                                  |                             |          | E hex        |   |   |             |                             |          |        |
|     |                         |   |   | 2-1-3  |                                  |                             |          | Unit Number  | 0 | 0 | Every cycle | 161 (CP1L EM-type CPU Unit) | 00 to 07 | 00 hex |
|     |                         |   |   |  |                                  |                             |          |              |   | : |             |                             |          | :      |
|     | 31                      | 1F hex                                  |   |  |                                  |                             |          |              |   |   |             |                             |          |        |

|   | Name        |               | Default   | Settings  | When setting is read<br>by CPU Unit                      | Internal<br>address                                 | Bits                                 | Settings                             |                                      |   |
|---|-------------|---------------|---|---|--|---|--------------------------------------|--------------------------------------|--------------------------------------|---|
| 2 | 2-2         | NT Link (1:N) |   |   |  |   |                                      |                                      |                                      |   |
|   |             | 2-2-1         | Baud  | 9,600<br>(disabled)   | 38,400 (standard)  | Every cycle   | 161<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>07                          | 00 hex                               |   |
|   |             |               |   |   | 115,200 (high speed)                                     |   |                                      |                                      | 0A hex                               |   |
|   |             | 2-2-2         | NT/PC<br>Link Max:<br>Highest<br>unit num-<br>ber | 0   | 0  | Every cycle   | 166<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>03                          | 0 hex                                |   |
|   |             |               |   |   | :  |   |                                      |                                      | :                                    |   |
|   |             |               |   |   | 7  |   |                                      |                                      | 7 hex                                |   |
|   |             | 2-3           | RS-232C   |   |  |   |                                      |                                      |                                      |   |
|   |             |               | 2-3-1   | Baud  | 9600 bps   | 300 bps   | Every cycle                          | 161<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>07                          | 01 hex  |
|   |             |               |   |   |  | 600 bps   |                                      |                                      |                                      | 02 hex  |
|   | 1,200 bps   |               |   |   |  | 03 hex  |                                      |                                      |                                      |   |
|   | 2,400 bps   |               |   |   |  | 04 hex  |                                      |                                      |                                      |   |
|   | 4,800 bps   |               |   |   |  | 05 hex  |                                      |                                      |                                      |   |
|   | 9,600 bps   |               |   |   |  | 00 or<br>06 hex                                     |                                      |                                      |                                      |   |
|   | 19,200 bps  |               |   |   |  | 07 hex  |                                      |                                      |                                      |   |
|   | 38,400 bps  |               |   |   |  | 08 hex  |                                      |                                      |                                      |   |
|   | 57,600 bps  |               |   |   |  | 09 hex  |                                      |                                      |                                      |   |
|   | 115,200 bps |               |   |   |  | 0A hex  |                                      |                                      |                                      |   |
|   | 2-3-2       |               |   |   |  | Format<br>(data<br>length,<br>stop bits,<br>parity) |                                      |                                      |                                      | 7,2,E: 7-bit<br>data, 2 stop<br>bits, even parity |
|   |             |               | 7,2,O: 7-bit data, 2 stop<br>bits, odd parity     | 1 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 7,2,N: 7-bit data, 2 stop<br>bits, no parity      | 2 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 7,1,E: 7-bit data, 2 stop<br>bits, even parity    | 4 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 7,1,O: 7-bit data, 1 stop<br>bit, odd parity      | 5 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 7,1,N: 7-bit data, 1 stop<br>bit, no parity       | 6 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 8,2,E: 8-bit data, 2 stop<br>bits, even parity    | 8 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 8,2,O: 8-bit data, 2 stop<br>bits, odd parity     | 9 hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 8,2,N: 8-bit data, 2 stop<br>bits, no parity      | A hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 8,1,E: 8-bit data, 1 stop<br>bit, even parity     | C hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 8,1,O: 8-bit data, 1 stop<br>bit, odd parity      | D hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 8,1,N: 8-bit data, 1 stop<br>bit, no parity       | E hex   |  |   |                                      |                                      |                                      |   |
|   |             |               | 2-3-3   | Start Code  | Disable.   |   | Disable.                             | Every cycle                          | 165<br>(CP1L<br>EM-type<br>CPU Unit) |   |
|   | Set.        |               |   |   |  | 1   |                                      |                                      |                                      |   |
|   | 2-3-4       |               | Start Code  | 00 hex0x0000  | 0x0000   | Every cycle   | 164<br>(CP1L<br>EM-type<br>CPU Unit) | 08 to<br>15                          | 00 hex                               |   |
|   |             |               |   |   | :  |   |                                      |                                      | :                                    |   |
|   |             |               |   |   | 0x00FF   |   |                                      |                                      | FF hex                               |   |
|   | 2-3-5       |               | End Code  | Received<br>Bytes: Receive<br>specified num-<br>ber of bytes. | Received Bytes: Receive<br>specified number of<br>bytes. | Every cycle   | 165<br>(CP1L<br>EM-type<br>CPU Unit) | 08 and<br>09                         | 00                                   |   |
|   |             |               |   |   | CR,LF  |   |                                      |                                      | 10                                   |   |
|   |             |               |   |   | Set End Code   |   |                                      |                                      | 01                                   |   |

|             | Name           |   |   | Default                                     | Settings           | When setting is read by CPU Unit | Internal address            | Bits                        | Settings     |              |
|-------------|----------------|---|---|---|--------------------|----------------------------------|-----------------------------|-----------------------------|--------------|--------------|
| 2           | 2-3            | 2-3-6                                   | Received Bytes                              | 256 bytes                                   | 256 bytes          | Every cycle                      | 165 (CP1L EM-type CPU Unit) | 00 to 07                    | 00 hex       |              |
|             |                |   |   |   | 1 byte             |                                  |                             |                             | 01 hex       |              |
|             |                |   |   |   | :                  |                                  |                             |                             | :            |              |
|             |                |   |   |   | 255 bytes          |                                  |                             |                             | FF hex       |              |
|             |                | 2-3-7                                   | Set End Code                                | 0x0000                                      | 0x0000             | Every cycle                      | 164 (CP1L EM-type CPU Unit) | 00 to 07                    | 00 hex       |              |
|             |                |   |   |   | :                  |                                  |                             |                             | :            |              |
|             |                |   |   |   | 0x00FF             |                                  |                             |                             | FF hex       |              |
|             |                | 2-3-8                                   | Delay                                       | 0: 0 × 10 ms                                | 0: 0 × 10 ms       | Every cycle                      | 162 (CP1L EM-type CPU Unit) | 00 to 15                    | 0000 hex     |              |
|             |                |   |   |   | :                  |                                  |                             |                             | :            |              |
|             |                |   |   |   | 9999: 9999 × 10 ms |                                  |                             |                             | 270F hex     |              |
|             |                | 2-4                                     | ToolBus (peripheral bus)                    |   |                    |                                  |                             |                             |              |              |
|             |                |   | 2-4-1                                       | Baud  | 9,600 bps          | 9,600 bps                        | Every cycle                 | 161 (CP1L EM-type CPU Unit) | 00 to 07     | 00 or 06 hex |
|             | 19,200 bps     |   |   |   |                    | 07 hex                           |                             |                             |              |              |
|             | 38,400 bps     |   |   |   |                    | 08 hex                           |                             |                             |              |              |
|             | 57,600 bps     |   |   |   |                    | 09 hex                           |                             |                             |              |              |
|             | 115,200 bps    |   |   |   |                    | 0A hex                           |                             |                             |              |              |
|             | Serial Gateway |   |   |   |                    |                                  |                             |                             |              |              |
|             | 2-5            | 2-5-1                                   | Baud  | 9,600 bps                                   | 300 bps            | Every cycle                      | 161 (CP1L EM-type CPU Unit) | 00 to 07                    | 01 hex       |              |
|             |                |   |   |   | 600 bps            |                                  |                             |                             | 02 hex       |              |
|             |                |   |   |   | 1,200 bps          |                                  |                             |                             | 03 hex       |              |
|             |                |   |   |   | 2,400 bps          |                                  |                             |                             | 04 hex       |              |
|             |                |   |   |   | 4,800 bps          |                                  |                             |                             | 05 hex       |              |
|             |                |   |   |   | 9,600 bps          |                                  |                             |                             | 00 or 06 hex |              |
| 19,200 bps  |                |   |   |   | 07 hex             |                                  |                             |                             |              |              |
| 38,400 bps  |                |   |   |   | 08 hex             |                                  |                             |                             |              |              |
| 57,600 bps  |                |   |   |   | 09 hex             |                                  |                             |                             |              |              |
| 115,200 bps |                |   |   |   | 0A hex             |                                  |                             |                             |              |              |
| 2-5-2       |                | Format (data length, stop bits, parity) | 7,2,E: 7-bit data, 2 stop bits, even parity | 7,2,E: 7-bit data, 2 stop bits, even parity | Every cycle        | 160 (CP1L EM-type CPU Unit)      | 00 to 03                    | 0 hex                       |              |              |
|             |                |   |   | 7,2,O: 7-bit data, 2 stop bits, odd parity  |                    |                                  |                             | 1 hex                       |              |              |
|             |                |   |   | 7,2,N: 7-bit data, 2 stop bits, no parity   |                    |                                  |                             | 2 hex                       |              |              |
|             |                |   |   | 7,1,E: 7-bit data, 2 stop bits, even parity |                    |                                  |                             | 4 hex                       |              |              |
|             |                |   |   | 7,1,O: 7-bit data, 1 stop bit, odd parity   |                    |                                  |                             | 5 hex                       |              |              |
|             |                |   |   | 7,1,N: 7-bit data, 1 stop bit, no parity    |                    |                                  |                             | 6 hex                       |              |              |
|             |                |   |   | 8,2,E: 8-bit data, 2 stop bits, even parity |                    |                                  |                             | 8 hex                       |              |              |
|             |                |   |   | 8,2,O: 8-bit data, 2 stop bits, odd parity  |                    |                                  |                             | 9 hex                       |              |              |
|             |                |   |   | 8,2,N: 8-bit data, 2 stop bits, no parity   |                    |                                  |                             | A hex                       |              |              |
|             |                |   |   | 8,1,E: 8-bit data, 1 stop bit, even parity  |                    |                                  |                             | C hex                       |              |              |
|             |                |   |   | 8,1,O: 8-bit data, 1 stop bit, odd parity   |                    |                                  |                             | D hex                       |              |              |
|             |                |   |   | 8,1,N: 8-bit data, 1 stop bit, no parity    |                    |                                  |                             | E hex                       |              |              |
| 2-5-3       |                | Response Timeout                        | 50: 50 × 100 ms = 5 s                       | 50: 50 × 100 ms = 5 s                       | Every cycle        | 167 (CP1L EM-type CPU Unit)      | 08 to 15                    | 00 hex                      |              |              |
|             |                |   |   | 1: 1 × 100 ms                               |                    |                                  |                             | 01 hex                      |              |              |
|             |                |   |   | :   |                    |                                  |                             | :                           |              |              |
|             |                |   |   | 255: 255 × 100 ms                           |                    |                                  |                             | FF hex                      |              |              |

|   | Name |                  | Default             | Settings                | When setting is read<br>by CPU Unit | Internal<br>address | Bits                                 | Settings    |                          |
|---|------|------------------|---------------------|-------------------------|-------------------------------------|---------------------|--------------------------------------|-------------|--------------------------|
| 2 | 2-6  | PC Link (Slave)  |                     |                         |                                     |                     |                                      |             |                          |
|   |      | 2-6-1            | Baud                | 9,600 bps<br>(disabled) | 38,400 (standard)                   | Every cycle         | 161<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>07 | 00 hex                   |
|   |      |                  |                     |                         | 115,200 (high speed)                |                     |                                      |             | 0A hex                   |
|   |      | 2-6-2            | PC Link<br>Unit No. | 0                       | 0                                   | Every cycle         | 167<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>03 | 0 hex                    |
|   |      |                  |                     |                         | :                                   |                     |                                      |             | :                        |
|   |      |                  |                     |                         | 7                                   |                     |                                      |             | 7 hex                    |
|   | 2-7  | PC Link (Master) |                     |                         |                                     |                     |                                      |             |                          |
|   |      | 2-7-1            | Baud                | 9,600 bps<br>(disabled) | 38,400 (standard)                   | Every cycle         | 161<br>(CP1L<br>EM-type<br>CPU Unit) | 00 to<br>07 | 00 hex                   |
|   |      |                  |                     |                         | 115,200 (high speed)                |                     |                                      |             | 0A hex                   |
|   |      | 2-7-2            | Link<br>Words       | 10 (default)            | 1<br>:<br>10 (default)              | Every cycle         | 166<br>(CP1L<br>EM-type<br>CPU Unit) | 04 to<br>07 | 1 hex<br>:<br>0 or A hex |
|   |      | 2-7-3            | PC Link<br>Mode     | ALL                     | ALL                                 | Every cycle         | 166<br>(CP1L<br>EM-type<br>CPU Unit) | 15          | 0                        |
|   |      |                  |                     |                         | Masters                             |                     |                                      |             | 1                        |

## Peripheral Service Settings

### Set Time to All Events: Time Setting for Services

|   | Name                   |                            | Default              | Settings                   | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|------------------------|----------------------------|----------------------|----------------------------|----------------------------------|------------------|----------|----------|
| 1 | Set time to all events |                            | Default              | Default (4% of cycle time) | At start of operation            | 218              | 15       | 0        |
|   |                        |                            |                      | Use user setting.          |                                  |                  |          | 1        |
|   | 1-1                    | Time allocated to services | 0: 0 × 0.1 ms = 0 ms | 0: 0 × 0.1 ms = 0 ms       | At start of operation            | 218              | 00 to 07 | 00 hex   |
|   |                        |                            |                      | :                          |                                  |                  |          | :        |
|   |                        |                            |                      | 255: 255 × 0.1 ms          |                                  |                  |          | FF hex   |

## Built-in Input Settings

### High Speed Counter Settings

|   | Name                     |               | Default             | Settings                 | When setting is read by CPU Unit    | Internal address        | Bits      | Settings |          |
|---|--------------------------|---------------|---------------------|--------------------------|-------------------------------------|-------------------------|-----------|----------|----------|
| 1 | Use high speed counter 0 |               | Do not use.         | Do not use.              | When power is turned ON             | 50                      | 12 to 15  | 0 hex    |          |
|   |                          |               |                     | Use.                     |                                     |                         |           | 1 hex    |          |
|   | 1-1                      | Counting mode |                     | Linear mode              | Linear mode                         | At start of operation   | 50        | 08 to 11 | 0 hex    |
|   |                          |               |                     |                          | Circular mode                       |                         |           |          | 1 hex    |
|   |                          | 1-1-1         | Circular Max. Count | 0                        | 0                                   | At start of operation   | 52 and 51 | 00 to 15 | 0000     |
|   |                          |               |                     |                          | :                                   |                         |           |          | 0000 hex |
|   | 4,294,967,295            |               |                     |                          | FFFF                                |                         |           |          |          |
|   |                          |               |                     |                          |                                     |                         |           | FFFF hex |          |
|   | 1-2                      | Reset         |                     | Z phase, software reset  | Z phase, software reset             | When power is turned ON | 50        | 04 to 07 | 0 hex    |
|   |                          |               |                     |                          | Software reset                      |                         |           |          | 1 hex    |
|   |                          |               |                     |                          | Z phase, software reset (comparing) |                         |           |          | 2 hex    |
|   |                          |               |                     |                          | Software reset (comparing)          |                         |           |          | 3 hex    |
|   | 1-3                      | Input Setting |                     | Differential phase input | Differential phase input            | When power is turned ON | 50        | 00 to 03 | 0 hex    |
|   |                          |               |                     |                          | Pulse + direction input             |                         |           |          | 1 hex    |
|   |                          |               |                     |                          | Up/Down input                       |                         |           |          | 2 hex    |
|   |                          |               |                     |                          | Increment pulse input               |                         |           |          | 3 hex    |
| 2 | Use high speed counter 1 |               | Do not use.         | Do not use.              | When power is turned ON             | 53                      | 12 to 15  | 0 hex    |          |
|   |                          |               |                     | Use.                     |                                     |                         |           | 1 hex    |          |
|   | 2-1                      | Counting mode |                     | Linear mode              | Linear mode                         | At start of operation   | 53        | 08 to 11 | 0 hex    |
|   |                          |               |                     |                          | Circular mode                       |                         |           |          | 1 hex    |
|   |                          | 2-1-1         | Circular Max. Count | 0                        | 0                                   | At start of operation   | 55 and 54 | 00 to 15 | 0000     |
|   |                          |               |                     |                          | :                                   |                         |           |          | 0000 hex |
|   | 4,294,967,295            |               |                     |                          | FFFF                                |                         |           |          |          |
|   |                          |               |                     |                          |                                     |                         |           | FFFF hex |          |
|   | 2-2                      | Reset         |                     | Z phase, software reset  | Z phase, software reset             | When power is turned ON | 53        | 04 to 07 | 0 hex    |
|   |                          |               |                     |                          | Software reset                      |                         |           |          | 1 hex    |
|   |                          |               |                     |                          | Z phase, software reset (comparing) |                         |           |          | 2 hex    |
|   |                          |               |                     |                          | Software reset (comparing)          |                         |           |          | 3 hex    |
|   | 2-3                      | Input Setting |                     | Differential phase input | Differential phase input            | When power is turned ON | 53        | 00 to 03 | 0 hex    |
|   |                          |               |                     |                          | Pulse + direction input             |                         |           |          | 1 hex    |
|   |                          |               |                     |                          | Up/Down input                       |                         |           |          | 2 hex    |
|   |                          |               |                     |                          | Increment pulse input               |                         |           |          | 3 hex    |

|   | Name                     |               | Default                   | Settings                     | When setting is read<br>by CPU Unit    | Internal<br>address        | Bits          | Settings    |                  |
|---|--------------------------|---------------|---------------------------|------------------------------|--|----------------------------|---------------|-------------|------------------|
| 3 | Use high speed counter 2 |               | Do not use.               | Do not use.                  | When power is turned<br>ON             | 95                         | 12 to<br>15   | 0 hex       |                  |
|   |                          |               |                           | Use.                         |  |                            |               | 1 hex       |                  |
|   | 3-1                      | Counting mode |                           | Linear mode                  | Linear mode                            | At start of operation      | 95            | 08 to<br>11 | 0 hex            |
|   |                          |               |                           |                              | Circular mode                          |                            |               |             | 1 hex            |
|   |                          | 3-1-1         | Circular<br>Max.<br>Count | 0                            | 0                                      | At start of operation      | 97 and 96     | 00 to<br>15 | 0000<br>0000 hex |
|   |                          |               |                           |                              | :                                      |                            |               |             | :                |
|   |                          |               |                           |                              | 4,294,967,295                          |                            |               |             | FFFF<br>FFFF hex |
|   | 3-2                      | Reset         |                           | Z phase, soft-<br>ware reset | Z phase, software reset                | When power is turned<br>ON | 95            | 04 to<br>07 | 0 hex            |
|   |                          |               |                           |                              | Software reset                         |                            |               |             | 1 hex            |
|   |                          |               |                           |                              | Z phase, software reset<br>(comparing) |                            |               |             | 2 hex            |
|   |                          |               |                           |                              | Software reset<br>(comparing)          |                            |               |             | 3 hex            |
|   | 3-3                      | Input Setting |                           | Differential<br>phase input  | Differential phase input               | When power is turned<br>ON | 95            | 00 to<br>03 | 0 hex            |
|   |                          |               |                           |                              | Pulse + direction input                |                            |               |             | 1 hex            |
|   |                          |               |                           |                              | Up/Down input                          |                            |               |             | 2 hex            |
|   |                          |               |                           |                              | Increment pulse input                  |                            |               |             | 3 hex            |
| 4 | Use high speed counter 3 |               | Do not use.               | Do not use.                  | When power is turned<br>ON             | 98                         | 12 to<br>15   | 0 hex       |                  |
|   |                          |               |                           | Use.                         |  |                            |               | 1 hex       |                  |
|   | 4-1                      | Counting mode |                           | Linear mode                  | Linear mode                            | At start of operation      | 98            | 08 to<br>11 | 0 hex            |
|   |                          |               |                           |                              | Circular mode                          |                            |               |             | 1 hex            |
|   |                          | 4-1-1         | Circular<br>Max.<br>Count | 0                            | 0                                      | At start of operation      | 100 and<br>99 | 00 to<br>15 | 0000<br>0000 hex |
|   |                          |               |                           |                              | :                                      |                            |               |             | :                |
|   |                          |               |                           |                              | 4,294,967,295                          |                            |               |             | FFFF<br>FFFF hex |
|   | 4-2                      | Reset         |                           | Z phase, soft-<br>ware reset | Z phase, software reset                | When power is turned<br>ON | 98            | 04 to<br>07 | 0 hex            |
|   |                          |               |                           |                              | Software reset                         |                            |               |             | 1 hex            |
|   |                          |               |                           |                              | Z phase, software reset<br>(comparing) |                            |               |             | 2 hex            |
|   |                          |               |                           |                              | Software reset<br>(comparing)          |                            |               |             | 3 hex            |
|   | 4-3                      | Input Setting |                           | Differential<br>phase input  | Differential phase input               | When power is turned<br>ON | 98            | 00 to<br>03 | 0 hex            |
|   |                          |               |                           |                              | Pulse + direction input                |                            |               |             | 1 hex            |
|   |                          |               |                           |                              | Up/Down input                          |                            |               |             | 2 hex            |
|   |                          |               |                           |                              | Increment pulse input                  |                            |               |             | 3 hex            |

## Interrupt Input Settings

|   | Name              | Default | Settings  | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|-------------------|---------|-----------|----------------------------------|------------------|----------|----------|
| 1 | IN0<br>(CIO 0.04) | Normal  | Normal    | When power is turned ON          | 60               | 00 to 03 | 0 hex    |
|   |                   |         | Interrupt |                                  |                  |          | 1 hex    |
|   |                   |         | Quick     |                                  |                  |          | 2 hex    |
| 2 | IN1<br>(CIO 0.05) | Normal  | Normal    | When power is turned ON          | 60               | 04 to 07 | 0 hex    |
|   |                   |         | Interrupt |                                  |                  |          | 1 hex    |
|   |                   |         | Quick     |                                  |                  |          | 2 hex    |
| 3 | IN2<br>(CIO 0.06) | Normal  | Normal    | When power is turned ON          | 60               | 08 to 11 | 0 hex    |
|   |                   |         | Interrupt |                                  |                  |          | 1 hex    |
|   |                   |         | Quick     |                                  |                  |          | 2 hex    |
| 4 | IN3<br>(CIO 0.07) | Normal  | Normal    | When power is turned ON          | 60               | 12 to 15 | 0 hex    |
|   |                   |         | Interrupt |                                  |                  |          | 1 hex    |
|   |                   |         | Quick     |                                  |                  |          | 2 hex    |
| 5 | IN4<br>(CIO 0.08) | Normal  | Normal    | When power is turned ON          | 59               | 00 to 03 | 0 hex    |
|   |                   |         | Interrupt |                                  |                  |          | 1 hex    |
|   |                   |         | Quick     |                                  |                  |          | 2 hex    |
| 6 | IN5<br>(CIO 0.09) | Normal  | Normal    | When power is turned ON          | 59               | 04 to 07 | 0 hex    |
|   |                   |         | Interrupt |                                  |                  |          | 1 hex    |
|   |                   |         | Quick     |                                  |                  |          | 2 hex    |

## Pulse Output 0 Settings

### Base Settings

|   | Name   | Default     | Settings    | When setting is read by CPU Unit | Internal address | Bits     | Settings                       |
|---|--|-------------|-------------|----------------------------------|------------------|----------|--------------------------------|
| 1 | Undefined Origin (operation for limit signal turning ON) | Hold        | Hold        | At start of operation            | 268              | 12 to 15 | 0 hex                          |
|   |  |             | Undefined   |                                  |                  |          | 1 hex                          |
| 2 | Limited Input Signal Operation                           | Search Only | Search Only | When power is turned ON          | 256              | 04 to 07 | 0 hex                          |
|   |  |             | Always      |                                  |                  |          | 1 hex                          |
| 3 | Limit Input Signal                                       | NC          | NC          | At start of operation            | 268              | 00 to 03 | 0 hex                          |
|   |  |             | NO          |                                  |                  |          | 1 hex                          |
| 4 | Search/Return Initial Speed                              | 0 pps       | 0 pps       | At start of operation            | 259 and 258      | 00 to 15 | 0000 0000 hex                  |
|   |  |             | :           |                                  |                  |          | :                              |
|   |  |             | 100,000 pps |                                  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
| 5 | Speed Curve  | Trapezium   | Trapezium   | When power is turned ON          | 256              | 12 to 15 | 0 hex                          |
|   |  |             | S-shaped    |                                  |                  |          | 1 hex                          |

## Define Origin Operation Settings: Origin Search Settings

|                | Name                        |   | Default              | Settings              | When setting is read by CPU Unit   | Internal address | Bits     | Settings                       |
|----------------|-----------------------------|---|----------------------|-----------------------|--|------------------|----------|--------------------------------|
| 1              | Use define origin operation |   | Do not use.          | Do not use.           | When power is turned ON  | 256              | 00 to 03 | 0 hex                          |
|                |                             |   |                      | Use.                  |  |                  |          | 1 hex                          |
|                | 1-1                         | Search Direction                        | CW                   | CW                    | At start of operation  | 257              | 12 to 15 | 0 hex                          |
|                |                             |   |                      | CCW                   |  |                  |          | 1 hex                          |
|                | 1-2                         | Detection Method                        | Method 0             | Method 0              | At start of operation  | 257              | 08 to 11 | 0 hex                          |
|                |                             |   |                      | Method 1              |  |                  |          | 1 hex                          |
|                |                             |   |                      | Method 2              |  |                  |          | 2 hex                          |
|                | 1-3                         | Search Operation                        | Inverse 1            | Inverse 1             | At start of operation  | 257              | 04 to 07 | 0 hex                          |
|                |                             |   |                      | Inverse 2             |  |                  |          | 1 hex                          |
|                | 1-4                         | Operation Mode                          | Mode 0               | Mode 0                | At start of operation  | 257              | 00 to 03 | 0 hex                          |
|                |                             |   |                      | Mode 1                |  |                  |          | 1 hex                          |
|                |                             |   |                      | Mode 2                |  |                  |          | 2 hex                          |
|                | 1-5                         | Origin Input Signal<br>(X/XA CPU Units) | NC                   | NC                    | Unit version 1.0 and earlier: At start of operation<br>Unit version 1.1 and later: When power is turned ON | 268              | 08 to 11 | 0 hex                          |
|                |                             |   |                      | NO                    |  |                  |          | 1 hex                          |
|                |                             | Origin Input Signal<br>(Y CPU Units)    |                      | NC (line driver)      | At start of operation  |                  |          | 2 hex                          |
|                |                             |   |                      | NO (line driver)      |  |                  |          | 3 hex                          |
|                | 1-6                         | Proximity Input Signal                  | NC                   | NC                    | At start of operation  | 268              | 04 to 07 | 0 hex                          |
|                |                             |   |                      | NO                    |  |                  |          | 1 hex                          |
|                | 1-7                         | Search High Speed                       | 0 pps<br>(disabled)  | 1 pps                 | At start of operation  | 261 and 260      | 00 to 15 | 0000 0001 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
|                |                             |   |                      | 100,000 pps           |  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
|                | 1-8                         | Search Proximity Speed                  | 0 pps<br>(disabled)  | 1 pps                 | At start of operation  | 263 and 262      | 00 to 15 | 0000 0001 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
|                |                             |   |                      | 100,000 pps           |  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
|                | 1-9                         | Search Compensation Value               | 0 pps                | −2,147,483,648        | At start of operation  | 265 and 264      | 00 to 15 | 8000 0000 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
|                |                             |   |                      | 0                     |  |                  |          | 0000 0000 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
| +2,147,483,647 |                             |   |                      | 7FFF FFFF hex         |  |                  |          |                                |
|                |                             |   |                      |                       |  |                  |          |                                |
| 1-10           | Search Acceleration Ratio   | 0 (disabled)                            | 1 (pulses/4 ms)      | At start of operation | 266  | 00 to 15         | 0001 hex |                                |
|                |                             |   | :                    |                       |  |                  | :        |                                |
|                |                             |   | 65,535 (pulses/4 ms) |                       |  |                  | FFFF hex |                                |
| 1-11           | Search Deceleration Ratio   | 0 (disabled)                            | 1 (pulses/4 ms)      | At start of operation | 267  | 00 to 15         | 0001 hex |                                |
|                |                             |   | :                    |                       |  |                  | :        |                                |
|                |                             |   | 65,535 (pulses/4 ms) |                       |  |                  | FFFF hex |                                |
| 1-12           | Positioning Monitor Time    | 0 ms                                    | 0 ms                 | At start of operation | 269  | 00 to 15         | 0000 hex |                                |
|                |                             |   | :                    |                       |  |                  | :        |                                |
|                |                             |   | 9,999 ms             |                       |  |                  | 270F hex |                                |



## Origin Return Settings

|   | Name               | Default          | Settings            | When setting is read by CPU Unit | Internal address | Bits     | Settings                       |
|---|--------------------|------------------|---------------------|----------------------------------|------------------|----------|--------------------------------|
| 1 | Speed              | 0 pps (disabled) | 1 pps               | At start of operation            | 271 and 270      | 00 to 15 | 0000 0001 hex                  |
|   |                    |                  | :                   |                                  |                  |          | :                              |
|   |                    |                  | 100,000 pps         |                                  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
| 2 | Acceleration Ratio | 0 (disabled)     | 1 (pulses/4 ms)     | At start of operation            | 272              | 00 to 15 | 0001Hex                        |
|   |                    |                  | :                   |                                  |                  |          | :                              |
|   |                    |                  | 65535 (pulses/4 ms) |                                  |                  |          | FFFF hex                       |
| 3 | Deceleration Ratio | 0 (disabled)     | 1 (pulses/4 ms)     | At start of operation            | 273              | 00 to 15 | 0001 hex                       |
|   |                    |                  | :                   |                                  |                  |          | :                              |
|   |                    |                  | 65535 (pulses/4 ms) |                                  |                  |          | FFFF hex                       |

## Pulse Output 1 Settings

### Base Settings

|   | Name   | Default     | Settings    | When setting is read by CPU Unit | Internal address | Bits     | Settings                       |
|---|--|-------------|-------------|----------------------------------|------------------|----------|--------------------------------|
| 1 | Undefined Origin (operation for limit signal turning ON) | Hold        | Hold        | At start of operation            | 286              | 12 to 15 | 0 hex                          |
|   |  |             | Undefined   |                                  |                  |          | 1 hex                          |
| 2 | Limited Input Signal Operation                           | Search Only | Search Only | When power is turned ON          | 274              | 04 to 07 | 0 hex                          |
|   |  |             | Always      |                                  |                  |          | 1 hex                          |
| 3 | Limit Input Signal                                       | NC          | NC          | At start of operation            | 286              | 00 to 03 | 0 hex                          |
|   |  |             | NO          |                                  |                  |          | 1 hex                          |
| 4 | Search/Return Initial Speed                              | 0 pps       | 0 pps       | At start of operation            | 277 and 276      | 00 to 15 | 0000 0000 hex                  |
|   |  |             | :           |                                  |                  |          | :                              |
|   |  |             | 100,000 pps |                                  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
| 5 | Speed Curve  | Trapezium   | Trapezium   | When power is turned ON          | 274              | 12 to 15 | 0 hex                          |
|   |  |             | S-shaped    |                                  |                  |          | 1 hex                          |

## Define Origin Operation Settings: Origin Search Settings

|                | Name                        |   | Default              | Settings              | When setting is read by CPU Unit   | Internal address | Bits     | Settings                       |
|----------------|-----------------------------|---|----------------------|-----------------------|--|------------------|----------|--------------------------------|
| 1              | Use define origin operation |   | Do not use.          | Do not use.           | When power is turned ON  | 274              | 00 to 03 | 0 hex                          |
|                |                             |   |                      | Use.                  |  |                  |          | 1 hex                          |
|                | 1-1                         | Search Direction                        | CW                   | CW                    | At start of operation  | 275              | 12 to 15 | 0 hex                          |
|                |                             |   |                      | CCW                   |  |                  |          | 1 hex                          |
|                | 1-2                         | Detection Method                        | Method 0             | Method 0              | At start of operation  | 275              | 08 to 11 | 0 hex                          |
|                |                             |   |                      | Method 1              |  |                  |          | 1 hex                          |
|                |                             |   |                      | Method 2              |  |                  |          | 2 hex                          |
|                | 1-3                         | Search Operation                        | Inverse 1            | Inverse 1             | At start of operation  | 275              | 04 to 07 | 0 hex                          |
|                |                             |   |                      | Inverse 2             |  |                  |          | 1 hex                          |
|                | 1-4                         | Operation Mode                          | Mode 0               | Mode 0                | At start of operation  | 275              | 00 to 03 | 0 hex                          |
|                |                             |   |                      | Mode 1                |  |                  |          | 1 hex                          |
|                |                             |   |                      | Mode 2                |  |                  |          | 2 hex                          |
|                | 1-5                         | Origin Input Signal<br>(X/XA CPU Units) | NC                   | NC                    | Unit version 1.0 and earlier: At start of operation<br>Unit version 1.1 and later: When power is turned ON | 286              | 08 to 11 | 0 hex                          |
|                |                             |   |                      | NO                    |  |                  |          | 1 hex                          |
|                |                             | Origin Input Signal<br>(Y CPU Units)    |                      | NC (line driver)      | At start of operation  |                  |          | 2 hex                          |
|                |                             |   |                      | NO (line driver)      |  |                  |          | 3 hex                          |
|                | 1-6                         | Proximity Input Signal                  | NC                   | NC                    | At start of operation  | 286              | 04 to 07 | 0 hex                          |
|                |                             |   |                      | NO                    |  |                  |          | 1 hex                          |
|                | 1-7                         | Search High Speed                       | 0 pps<br>(disabled)  | 1 pps                 | At start of operation  | 279 and 278      | 00 to 15 | 0000 0001 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
|                |                             |   |                      | 100,000 pps           |  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
|                | 1-8                         | Search Proximity Speed                  | 0 pps<br>(disabled)  | 1 pps                 | At start of operation  | 281 and 280      | 00 to 15 | 0000 0001 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
|                |                             |   |                      | 100,000 pps           |  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
|                | 1-9                         | Search Compensation Value               | 0 pps                | -2,147,483,648        | At start of operation  | 283 and 282      | 00 to 15 | 8000 0000 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
|                |                             |   |                      | 0                     |  |                  |          | 0000 0000 hex                  |
|                |                             |   |                      | :                     |  |                  |          | :                              |
| +2,147,483,647 |                             |   |                      | 7FFF FFFF hex         |  |                  |          |                                |
| 1-10           | Search Acceleration Ratio   | 0 (disabled)                            | 1 (pulses/4 ms)      | At start of operation | 284  | 00 to 15         | 0001 hex |                                |
|                |                             |   | :                    |                       |  |                  | :        |                                |
|                |                             |   | 65,535 (pulses/4 ms) |                       |  |                  | FFFF hex |                                |
| 1-11           | Search Deceleration Ratio   | 0 (disabled)                            | 1 (pulses/4 ms)      | At start of operation | 285  | 00 to 15         | 0001 hex |                                |
|                |                             |   | :                    |                       |  |                  | :        |                                |
|                |                             |   | 65,535 (pulses/4 ms) |                       |  |                  | FFFF hex |                                |
| 1-12           | Positioning Monitor Time    | 0 ms                                    | 0 ms                 | At start of operation | 287  | 00 to 15         | 0000 hex |                                |
|                |                             |   | :                    |                       |  |                  | :        |                                |
|                |                             |   | 9,999 ms             |                       |  |                  | 270F hex |                                |

## Origin Return Settings

|   | Name               | Default          | Settings            | When setting is read by CPU Unit | Internal address | Bits     | Settings                       |
|---|--------------------|------------------|---------------------|----------------------------------|------------------|----------|--------------------------------|
| 1 | Speed              | 0 pps (disabled) | 1 pps               | At start of operation            | 289 and 288      | 00 to 15 | 0000 0001 hex                  |
|   |                    |                  | :                   |                                  |                  |          | :                              |
|   |                    |                  | 100,000 pps         |                                  |                  |          | 0001 86A0 hex<br>000F 4240 hex |
| 2 | Acceleration Ratio | 0 (disabled)     | 1 (pulses/4 ms)     | At start of operation            | 290              | 00 to 15 | 0001Hex                        |
|   |                    |                  | :                   |                                  |                  |          | :                              |
|   |                    |                  | 65535 (pulses/4 ms) |                                  |                  |          | FFFF hex                       |
| 3 | Deceleration Ratio | 0 (disabled)     | 1 (pulses/4 ms)     | At start of operation            | 291              | 00 to 15 | 0001 hex                       |
|   |                    |                  | :                   |                                  |                  |          | :                              |
|   |                    |                  | 65535 (pulses/4 ms) |                                  |                  |          | FFFF hex                       |

## Inverter Positioning 0

### Basic Settings

|   | Name                                   | Default                | Settings                | When setting is read by CPU Unit | Internal address | Bits     | Settings     |
|---|--|------------------------|-------------------------|----------------------------------|------------------|----------|--------------|
| 1 | Use inverter positioning               | Do not use             | Use                     | When power is turned ON          | 416              | 00 to 03 | 0 hex        |
|   |  |                        | Do not use              |                                  |                  |          | 1 hex        |
| 2 | Gain                                   | 0: 10 (0.1 increments) | 0: 10 (0.1 increments)  | When power is turned ON          | 418              | 00 to 15 | 0000 hex     |
|   |  |                        | 1 (0.1 increments)      |                                  |                  |          | 0001 hex     |
|   |  |                        | :                       |                                  |                  |          | :            |
|   |  |                        | 65,535 (0.1 increments) |                                  |                  |          | FFFF hex     |
| 3 | In-position range                      | 0: 1                   | 0: 1                    | When power is turned ON          | 419              | 00 to 15 | 0000 hex     |
|   |  |                        | 1                       |                                  |                  |          | 0001 hex     |
|   |  |                        | :                       |                                  |                  |          | :            |
|   |  |                        | 65,535                  |                                  |                  |          | FFFF hex     |
| 4 | Min. output value                      | 0: 1                   | 0: 1                    | When power is turned ON          | 420              | 00 to 15 | 0000 hex     |
|   |  |                        | 1                       |                                  |                  |          | 0001 hex     |
|   |  |                        | :                       |                                  |                  |          | :            |
|   |  |                        | 65,535                  |                                  |                  |          | FFFF hex     |
| 5 | Max. output value                      | 0: 2,000,000           | 0: 2,000,000            | When power is turned ON          | 421, 422         | 00 to 15 | 00000000 hex |
|   |  |                        | 1                       |                                  |                  |          | 00000001 hex |
|   |  |                        | :                       |                                  |                  |          | :            |
|   |  |                        | 4,294,967,295           |                                  |                  |          | FFFFFFFF hex |
| 6 | Error counter overflow detection value | 0: 10,000              | 0: 10,000               | When power is turned ON          | 423              | 00 to 15 | 0000 hex     |
|   |  |                        | 1                       |                                  |                  |          | 0001 hex     |
|   |  |                        | :                       |                                  |                  |          | :            |
|   |  |                        | 32,767                  |                                  |                  |          | 7FFF hex     |
| 7 | Error counter alarm detection value    | 0: 10,000              | 0: 10,000               | When power is turned ON          | 424              | 00 to 15 | 0000 hex     |
|   |  |                        | 1                       |                                  |                  |          | 0001 hex     |
|   |  |                        | :                       |                                  |                  |          | :            |
|   |  |                        | 32,767                  |                                  |                  |          | 7FFF hex     |

|    | Name   | Default                | Settings                      | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|----|--|------------------------|-------------------------------|----------------------------------|------------------|----------|----------|
| 8  | Error counter cycle                                  | 0: 3 (4-ms increments) | 0: 3 (4-ms increments)        | When power is turned ON          | 417              | 00 to 07 | 00 hex   |
|    |  |                        | 1 (4-ms increments)           |                                  |                  |          | 01 hex   |
|    |  |                        | :                             |                                  |                  |          | :        |
|    |  |                        | 255 (4-ms increments)         |                                  |                  |          | FF hex   |
| 9  | Power Supply Freq. for One Motor Revolution per Sec. | 0 (0.1-Hz increments)  | 0 (0.1-Hz increments)         | When power is turned ON          | 436              | 00 to 15 | 0000 hex |
|    |  |                        | :                             |                                  |                  |          | :        |
|    |  |                        | 65,535 Hz (0.1-Hz increments) |                                  |                  |          | FFFF hex |
| 10 | Number of Encoder Pulses for One Motor Revolution    | 0                      | 0                             | When power is turned ON          | 437              | 00 to 15 | 0000 hex |
|    |  |                        | :                             |                                  |                  |          | :        |
|    |  |                        | 65,535                        |                                  |                  |          | FFFF hex |

## Operation Adjustment Settings

|   | Name  | Default                 | Settings                | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|---|-------------------------|-------------------------|----------------------------------|------------------|----------|----------|
| 1 | Limit output during acceleration and constant speed       | Do not use              | Use                     | When power is turned ON          | 432              | 00 to 03 | 0 hex    |
|   |   |                         | Do not use              |                                  |                  |          | 1 hex    |
| 2 | Limit output during deceleration and when stopped         | Do not use              | Use                     | When power is turned ON          | 432              | 04 to 07 | 0 hex    |
|   |   |                         | Do not use              |                                  |                  |          | 1 hex    |
| 3 | Output coefficient during acceleration and constant speed | 0: 6 (0.01 increments)  | 0: 6 (0.01 increments)  | When power is turned ON          | 433              | 00 to 07 | 0 hex    |
|   |   |                         | 1 (0.01 increments)     |                                  |                  |          | 1 hex    |
|   |   |                         | :                       |                                  |                  |          | :        |
|   |   |                         | 255 (0.01 increments)   |                                  |                  |          | FF hex   |
| 4 | Output coefficient during deceleration                    | 0: 96 (0.01 increments) | 0: 96 (0.01 increments) | When power is turned ON          | 434              | 00 to 07 | 0 hex    |
|   |   |                         | 1 (0.01 increments)     |                                  |                  |          | 1 hex    |
|   |   |                         | :                       |                                  |                  |          | :        |
|   |   |                         | 255 (0.01 increments)   |                                  |                  |          | FF hex   |
| 5 | Output coefficient after pulse output                     | 0: 50 (0.01 increments) | 0: 50 (0.01 increments) | When power is turned ON          | 435              | 00 to 07 | 0 hex    |
|   |   |                         | 1 (0.01 increments)     |                                  |                  |          | 1 hex    |
|   |   |                         | :                       |                                  |                  |          | :        |
|   |   |                         | 255 (0.01 increments)   |                                  |                  |          | FF hex   |

# Inverter Positioning 1

## Basic Settings

|    | Name   | Default                | Settings                      | When setting is read by CPU Unit | Internal address | Bits     | Settings     |
|----|--|------------------------|-------------------------------|----------------------------------|------------------|----------|--------------|
| 1  | Use inverter positioning                             | Do not use             | Use                           | When power is turned ON          | 416              | 08 to 11 | 0 hex        |
|    |  |                        | Do not use                    |                                  |                  |          | 1 hex        |
| 2  | Gain   | 0: 10 (0.1 increments) | 0: 10 (0.1 increments)        | When power is turned ON          | 425              | 00 to 15 | 0000 hex     |
|    |  |                        | 1 (0.1 increments)            |                                  |                  |          | 0001 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 65,535 (0.1 increments)       |                                  |                  |          | FFFF hex     |
| 3  | In-position range                                    | 0: 1                   | 0: 1                          | When power is turned ON          | 426              | 00 to 15 | 0000 hex     |
|    |  |                        | 1                             |                                  |                  |          | 0001 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 65,535                        |                                  |                  |          | FFFF hex     |
| 4  | Min. output value                                    | 0: 1                   | 0: 1                          | When power is turned ON          | 427              | 00 to 15 | 0000 hex     |
|    |  |                        | 1                             |                                  |                  |          | 0001 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 65,535                        |                                  |                  |          | FFFF hex     |
| 5  | Max. output value                                    | 0: 2,000,000           | 0: 2,000,000                  | When power is turned ON          | 429, 428         | 00 to 15 | 00000000 hex |
|    |  |                        | 1                             |                                  |                  |          | 00000001 hex |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 4,294,967,295                 |                                  |                  |          | FFFFFFFF hex |
| 6  | Error counter overflow detection value               | 0: 10,000              | 0: 10,000                     | When power is turned ON          | 430              | 00 to 15 | 0000 hex     |
|    |  |                        | 1                             |                                  |                  |          | 0001 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 32,767                        |                                  |                  |          | 7FFF hex     |
| 7  | Error counter alarm detection value                  | 0: 10,000              | 0: 10,000                     | When power is turned ON          | 431              | 00 to 15 | 0000 hex     |
|    |  |                        | 1                             |                                  |                  |          | 0001 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 32,767                        |                                  |                  |          | 7FFF hex     |
| 8  | Error counter cycle                                  | 0: 3 (4-ms increments) | 0: 3 (4-ms increments)        | When power is turned ON          | 417              | 00 to 07 | 00 hex       |
|    |  |                        | 1 (4-ms increments)           |                                  |                  |          | 01 hex       |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 255 (4-ms increments)         |                                  |                  |          | FF hex       |
| 9  | Power Supply Freq. for One Motor Revolution per Sec. | 0 (0.1-Hz increments)  | 0 (0.1-Hz increments)         | When power is turned ON          | 438              | 00 to 15 | 0000 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 65,535 Hz (0.1-Hz increments) |                                  |                  |          | FFFF hex     |
| 10 | Number of Encoder Pulses for One Motor Revolution    | 0                      | 0                             | When power is turned ON          | 439              | 00 to 15 | 0000 hex     |
|    |  |                        | :                             |                                  |                  |          | :            |
|    |  |                        | 65,535                        |                                  |                  |          | FFFF hex     |

## Operation Adjustment Settings

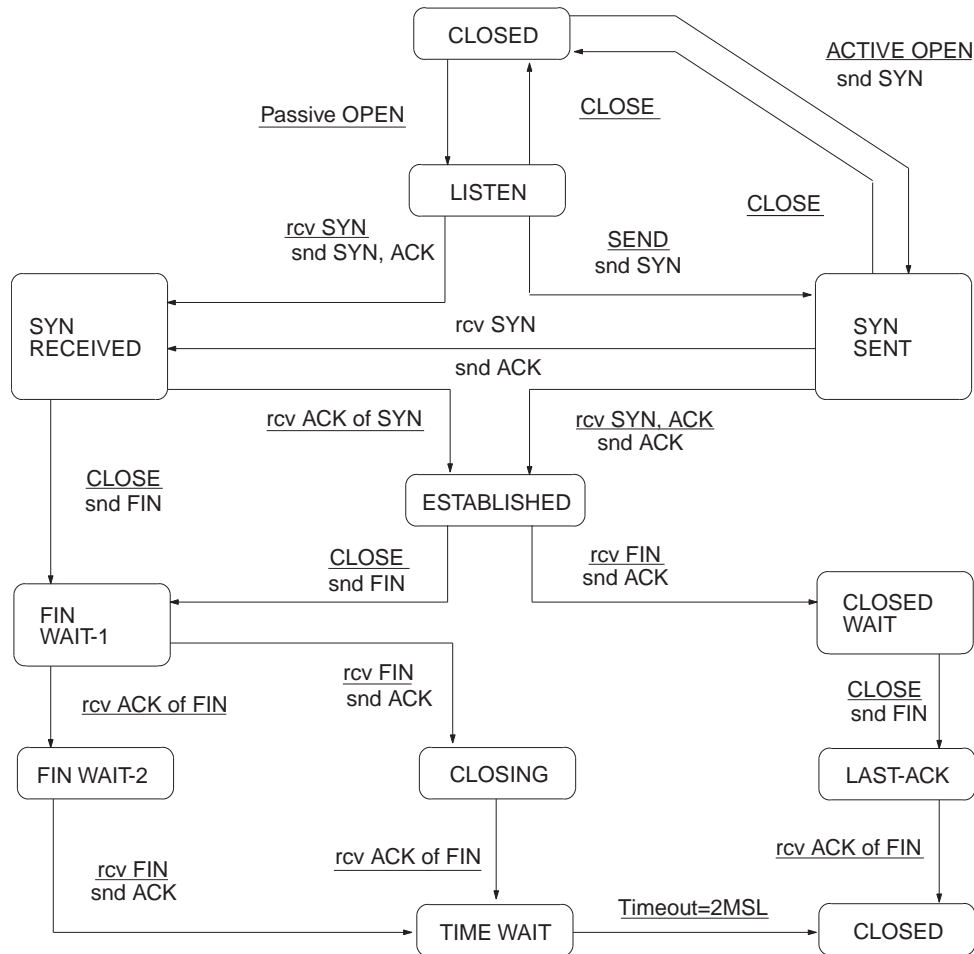
|   | Name  | Default                 | Settings                | When setting is read by CPU Unit | Internal address | Bits     | Settings |
|---|---|-------------------------|-------------------------|----------------------------------|------------------|----------|----------|
| 1 | Limit output during acceleration and constant speed       | Do not use              | Use                     | When power is turned ON          | 432              | 08 to 11 | 0 hex    |
|   |   |                         | Do not use              |                                  |                  |          | 1 hex    |
| 2 | Limit output during deceleration and when stopped         | Do not use              | Use                     | When power is turned ON          | 432              | 12 to 15 | 0 hex    |
|   |   |                         | Do not use              |                                  |                  |          | 1 hex    |
| 3 | Output coefficient during acceleration and constant speed | 0: 6 (0.01 increments)  | 0: 6 (0.01 increments)  | When power is turned ON          | 433              | 08 to 15 | 0 hex    |
|   |   |                         | 1 (0.01 increments)     |                                  |                  |          | 1 hex    |
|   |   |                         | :                       |                                  |                  |          | :        |
|   |   |                         | 255 (0.01 increments)   |                                  |                  |          | FF hex   |
| 4 | Output coefficient during deceleration                    | 0: 96 (0.01 increments) | 0: 96 (0.01 increments) | When power is turned ON          | 434              | 08 to 15 | 0 hex    |
|   |   |                         | 1 (0.01 increments)     |                                  |                  |          | 1 hex    |
|   |   |                         | :                       |                                  |                  |          | :        |
|   |   |                         | 255 (0.01 increments)   |                                  |                  |          | FF hex   |
| 5 | Output coefficient after pulse output                     | 0: 50 (0.01 increments) | 0: 50 (0.01 increments) | When power is turned ON          | 435              | 08 to 15 | 0 hex    |
|   |   |                         | 1 (0.01 increments)     |                                  |                  |          | 1 hex    |
|   |   |                         | :                       |                                  |                  |          | :        |
|   |   |                         | 255 (0.01 increments)   |                                  |                  |          | FF hex   |





# Appendix H

## TCP Status Transitions



| Number   | Status       | Meaning  |
|----------|--------------|--|
| 00000000 | CLOSED       | Connection closed.   |
| 00000001 | LISTEN       | Waiting for connection.                                      |
| 00000002 | SYN SENT     | SYN sent in active status.                                   |
| 00000003 | SYN RECEIVED | SYN received and sent.                                       |
| 00000004 | ESTABLISHED  | Already established.   |
| 00000005 | CLOSE WAIT   | FIN received and waiting for completion.                     |
| 00000006 | FIN WAIT 1   | Completed and FIN sent.                                      |
| 00000007 | CLOSING      | Completed and exchanged FIN. Awaiting ACK.                   |
| 00000008 | LAST ACK     | FIN sent and completed. Awaiting ACK.                        |
| 00000009 | FIN WAIT 2   | Completed and ACK received. Awaiting FIN.                    |
| 0000000A | TIME WAIT    | After closing, pauses twice the maximum segment life (2MSL). |



# Appendix I

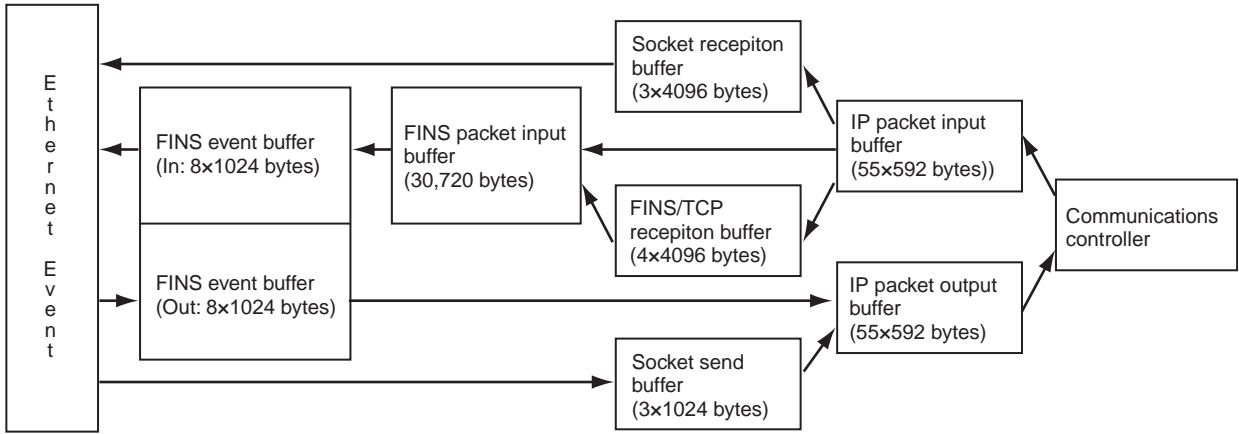
## Ethernet Network Parameters

| Parameter          | Value       | Description  |
|--------------------|-------------|--|
| Hold timer         | 18 s        | The hold timer is used for active open processing of TCP sockets. An ETIMEDOUT error will occur if connection is not completed within 18 s.  |
| Resend timer       | 3 s         | The resend timer is used to monitor completion of reception of arrival confirmations when transferring data via socket services. If the timer setting is exceeded before arrival confirmation is received, data is resent. Resends are performed through the 12th timeout (3 s). An ETIMEDOUT error will occur after the 12th timeout.     |
| 2MSL timer         | 120 s       | The 2MSL timer starts at the TCP socket that first closes the socket and will run for 120 s in the TIME_WAIT status.   |
| ARP timer          | 20 min/5 s  | If a complete ARP table entry (with an Ethernet address) is not referred to for 20 minutes, it is removed from the table.<br>An incomplete ARP table entry (no response yet returned to the ARP request) is removed from the table after 5 seconds.  |
| Window size        | 2,144 bytes | The initial value of the maximum capacity used to control the convergence of TCP sockets. Actually, the node negotiates with the remote node and uses the smaller of the values for the two nodes. The window size will fluctuate with the available space in the TCP reception buffers of the remote node when processing communications. |
| Segment size (MSS) | 536 bytes   | TCP data is separated into 536-byte units  |
| TTL (Time to Live) | 30          | 30   |



# Appendix J

## Buffer Configuration (CP1L-EL/EM)





# Appendix K

## Ethernet Specifications

| Item                              | Specification                                 | Description   |
|-----------------------------------|---|---|
| Data length of FINS message       | 1004 bytes (max)                              | The max data length of FINS message can be dealt with by PLC's FINS service.<br>This data length does not include FINS header whose length is 12 bytes, so the max length of FINS message is 1016 bytes.  |
| FINS buffer size                  | 16K bytes                                     | The FINS buffers combine with 8 groups, and each group includes 1K bytes receive buffer and 1K bytes send buffer.<br>When FINS message wants to be dealt with by PLC's FINS service, it should be saved into FINS buffer.<br>So in one PLC's cycle, there are max 8 FINS message can be dealt. The FINS message is sent from Ethernet host, or CMND/SEND/RECV instructions.   |
| Driver buffer number              | Input: 55×592 bytes<br>Output: 55×592 bytes   | When PLC receives an Ethernet packet, it is saved into input buffer.<br>The packet whose length is not larger than 592 bytes uses one input buffer, and the packet whose length is from 593 bytes to 1184 bytes uses two input buffers.<br>So input buffer can save 55 Ethernet packets whose lengths are all not larger than 592 bytes at one time, and can save 27 max length FINS message which uses two input buffers at one time.<br>Output buffers are used at Ethernet send process. |
| Process of driver buffer overflow | The last packet will be dropped.              | When PLC's driver input buffer is overflow, only the last packet will be dropped and other packets will be dealt with.<br>So the communication can recover to normal state quickly.   |
| Connection number (FINS/TCP)      | 3 for user1 for CX-Programmer auto connection | There are 3 FINS/TCP connections applied to customer, and all of them can be set to FINS/TCP client or FINS/TCP server.<br>Except the above 3 FINS/TCP connections, there is a FINS/TCP connection reserved for auto connection with CX-Programmer, so customer cannot change its setup and only can use it for auto connection with CX-Programmer.   |

## Usage Note

| Item                 | Usage Note   |
|----------------------|--|
| FINS buffer size     | Because there are 8 FINS message be dealt with at the same time, it is better not to send more than 8 FINS commands not only from Ethernet host bus also from CMND/SEND/RECV instructions at one time.<br>For example, if there are 16 FINS commands to be sent, it is better to send these commands by twice and each time to send 8 FINS commands. After the first 8 commands finish, to send the second 8 commands.<br>It is possible to send 16 FINS commands at one time, but only 8 FINS commands can be dealt with at once and others are saved in driver input buffer. |
| Driver buffer number | If PLC receives many Ethernet packets that arouses driver input buffer overflow, the last packet will be dropped. If the dropped packet is FINS message, the FINS communication will be pause.<br>It can be used to calculate the Ethernet storm which can be endured by PLC. How many duty packets, such as broadcast packets, can be included in one Ethernet storm.   |





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## Revision History

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

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The following table outlines the changes made to the manual during each revision.

| Revision code | Date         | Revised content  |
|---------------|--------------|--|
| 01            | March 2012   | Original production  |
| 02            | October 2014 | <ul style="list-style-type: none"><li>• CP1W-AD042 Analog Input Units, CP1W-DA042 Analog Output Units, CP1W-MAD42/MAD44 Analog I/O Units and CP1W-TS003/TS004 Temperature Sensor Units added for CP-series Expansion Units.</li><li>• Errors were corrected.</li></ul> |
| 03            | October 2015 | <ul style="list-style-type: none"><li>• Added CP1L-EL/EM CPU Units with unit version 1.1.</li><li>• Errors were corrected.</li></ul>   |
| 04            | July 2017    | CP1W-CIF12-V1 added for Serial Communication Option Board.   |

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