



# **SYSMAC CVM1D**

## **Duplex System**

### **Programmable Controllers**

**Installation Guide**

*Produced July 2000*

SYSMAC CVM1/CV/CVM1D Series  
Memory Cards Built into CPU Units  
Models: HMC-ES251/551 (SRAM)

**OMRON**

Applicable Manuals  
W195  
W202  
W350  
W351

## Information on Replacing Discontinued Products

OMRON Corporation

Thank you for your continued support of OMRON and OMRON products.

Production of the HMC-ES251/551 Memory Cards built into CVM1/CV/CVM1D-series CPU Units has been terminated as of February 2004. Please use the HMC-ES252/552 Memory Cards as replacement products.

### Differences in Specifications

The appearance (color) and life expectancy of the replacement products have changed, but the basic specifications as Memory Cards are the same.

Item	Discontinued products		Replacement products	
	HMC-ES251	HMC-ES551	HMC-ES252	HMC-ES552
Memory type	SRAM			
Memory capacity	256 KB	512 KB	256 KB	512 KB
File capacity	112 files			
Battery life	1 year	0.5 years	5 years	
Replacement Battery	HMC-BAT01		HMC-BAT01 or HMC-BAT02 (to be marketed soon)	
Appearance (color)	Orange		Yellow	

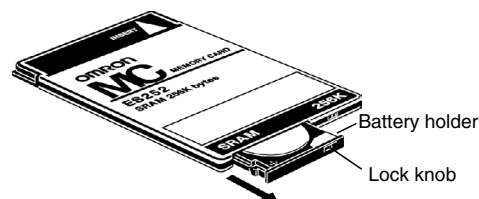
### Replacing the Battery in HMC-ES252/552 Memory Cards

The Battery replacement procedure for the HMC-ES252/552 is basically the same as that for the HMC-ES251/551. The shape of the Battery holder, however, is different, so step 3, below, is different.

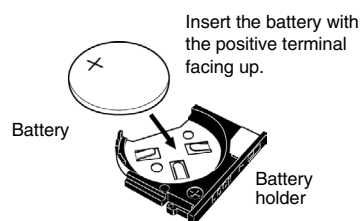
1. If the Memory Card power indicator (M/C ON) is lit, press the Memory Card power switch to turn OFF the indicator. If the indicator is already not lit, press the switch so that the indicator is lit for at least 10 s and then press the switch again to turn OFF the indicator.
2. After confirming that the Memory Card power indicator is not lit, press Memory Card ejection button and remove the Memory Card from the CPU Unit.

Complete Battery replacement (steps 3 to 5, below) within one minute. If more than one minute elapses, memory may be lost.

3. Slide the lock knob on the battery holder to the left to release the lock and remove the holder from the Memory Card.



4. Remove the old Battery from the battery holder and insert a new Battery.



5. Insert the battery holder into the Memory Card. Be sure the battery holder is inserted all the way to the back, press in on the battery holder so that it does not come out, and slide the lock knob to the right to lock the battery holder in place. Be sure that the battery holder cannot be pulled output after completing this step.
6. Insert the Memory Card into the CPU Unit.

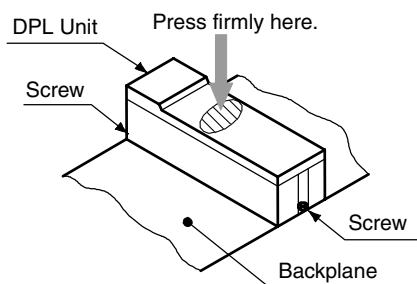
# Supplemental Information

Thank you for your continued support of OMRON and OMRON products.

The following supplemental information applies to SYSMAC CVM1D PLCs. Please use this information in addition to the *SYSMAC CVM1D Duplex System Installation Guide* (Cat. No. W350-E1-02).

Use the following procedure to mount the Duplex Unit to the CPU Backplane.

- (1) Align the CVM1D-DPL01 Duplex Unit properly with the bus connectors on the CPU Backplane, and then firmly press the Duplex Unit onto the Backplane until it clicks into place. The Duplex Unit uses a multi-pole connector with a locking mechanism, and must be pressed more firmly than other SYSMAC Units.
- (2) Confirm that the Duplex Unit is properly mounted by trying to lift it gently off the Backplane. If the Duplex Unit separates from Backplane, then the connection is not proper. Repeat the procedure from step 1.
- (3) Tighten the mounting screws (two) at the top and bottom of the Duplex Unit securely using a Phillips screwdriver to a maximum tightening torque of 0.9 N·m.



## ***Read and Understand this Manual***

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

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

### ***WARRANTY***

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

### ***LIMITATIONS OF LIABILITY***

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

## ***Application Considerations***

### ***SUITABILITY FOR USE***

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

**NEVER USE THE PRODUCTS 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 PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.**

### ***PROGRAMMABLE PRODUCTS***

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

## ***Disclaimers***

### ***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 model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

### ***DIMENSIONS AND WEIGHTS***

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

### ***PERFORMANCE DATA***

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

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


The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.





## 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.

 **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **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 “PC” means Programmable Controller and is not used as an abbreviation for anything else.

## 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.

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No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.





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## About this Manual:

This manual describes the hardware and installation of the CVM1D Duplex System Programmable Controllers and includes the sections described below.

Please read this and all related manuals carefully and be sure you understand the information provided before attempting to operate or program a CVM1D Duplex System Programmable Controller. The main manuals required for operation are listed below. A list of other related manuals is provided at the end of *Section 1 Introduction*.

Manual	Contents	Cat. No.
CVM1D Duplex System PC Installation Guide	Describes the system configuration, specifications, installation, and wiring.	W350
CVM1D Duplex System PC Operation Manual	Describes ladder-diagram programming and programming instructions.	W351
CVM1-PRS21-V1E Programming Console Operation Manual	Describes Programming Console operations.	W222
CVM1/CV-series PCs Operation Manual: Host Link	Describes communications methods with host computers.	W205

**Section 1** provides general information about Programmable Controllers and how they fit into a Control System. It also lists the C-series, CVM1, and CV-series products that can be used with the CVM1D PCs and operation manuals available for various OMRON products. Finally, this section introduces Systems that can be used to create networks and enable remote I/O, and provides a list of manuals for related products

**Section 2** provides information about the types of system configuration in which the CVM1D PCs can be used and the individual Units that make up these configuration. Refer to Appendix A Standard Models for a list of OMRON products that can be used in CVM1D PC Systems.


**Section 3** describes how to assemble, mount, and wire a PC starting with a Backplane and use all the Units discussed in the previous section. Technical specifications and dimensions are provided in Appendix B Specifications.

**Section 4** describes procedures for the starting up the system and performing trial operation.

**Section 5** describes the procedures necessary for periodic inspection and maintenance.

**Section 6** describes the self-diagnostic functions of the PC and provides troubleshooting techniques and error corrections.

The **Appendices** provide a list of standard product model numbers and specifications.

 **WARNING** Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

# PRECAUTIONS

This section provides general precautions for using the Programmable Controller (PC) and related devices.

**The information contained in this section is important for the safe and reliable application of the Programmable Controller. You must read this section and understand the information contained before attempting to set up or operate a PC system.**

- 1 Intended Audience .....
- 2 General Precautions .....
- 3 Safety Precautions .....
- 4 Operating Environment Precautions .....
- 5 Application Precautions .....
- 6 Conformance to EC Directives .....

## 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 PC and all PC 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 PC 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 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** There is a lithium battery built into the SRAM Memory Cards. Do not short the positive and negative terminals of the battery, charge the battery, attempt to take it apart, subject it to pressures that would deform it, incinerate it, or otherwise mistreat it. Doing any of these could cause the battery to erupt, ignite, or leak.
-  **WARNING** Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, in order to ensure safety in the system if an abnormality occurs due to malfunction of the PC or another external factor affecting the PC 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 PC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. As a countermeasure for such errors, external safety measures must be provided to ensure safety in the system.
- The PC outputs may remain ON or OFF due to deposition 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-VDC output (service power supply to the PC) 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.

 **Caution** Tighten the screws on the terminal block of the AC Power Supply Unit to the torque specified in the operation manual. The loose screws may result in burning or malfunction.


## 4 Operating Environment Precautions

 **Caution** Do not operate the control system in the following places:

- 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.


 **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 PC 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 PC System. Be sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.

## 5 Application Precautions

Observe the following precautions when using the PC System.

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

- Always ground the system to 100  $\Omega$  or less when installing the Units to protect against electric shock.

- Always turn OFF the power supply to the PC before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
  - Mounting or dismounting Power Supply Units, I/O Units, CPU Units, Memory Cassettes, or any other Units.
  - Assembling the Units.
  - 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 PC or the system, or could damage the PC or PC Units. Always heed these precautions.

- 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.
- Interlock circuits, limit circuits, and similar safety measures in external circuits (i.e., not in the Programmable Controller) must be provided by the customer.
- 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.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
- Do not mount a CVM1D Power Supply Unit in a CVM1 or CV-series PC. Doing so may result in burning or malfunction.
- Do not mount a CVM1 or CV-series Power Supply Unit on a Duplex CVM1D PC. Doing so may result in unexpected stoppage of the PC.
- Do not apply voltages to the Input Units in excess of the rated input voltage. Excess voltages may result in burning.
- Do not apply voltages or connect loads to the Output Units in excess of the maximum switching capacity. Excess voltage or loads may result in burning.
- Disconnect the functional ground terminal when performing withstand voltage tests. Not disconnecting the functional ground terminal may result in burning.
- Install the Unit properly as specified in the operation manual. Improper installation of the Unit may result in malfunction.
- Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque 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.
- Double-check all the wiring before turning on the power supply. Incorrect wiring may result in burning.
- Mount the Unit only after checking the terminal block completely.
- Be sure that the terminal blocks, EM Units, expansion cables, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.



- Check the user program for proper execution before actually running it on the Unit. Not checking the program 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 PC.
  - 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 built-up. Not doing so may result in malfunction or damage.

## 6 Conformance to EC Directives

The CVM1D PCs conform to EMC and Low Voltage Directives as follows:

### **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 confirmed 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** Applicable EMC (Electromagnetic Compatibility) standards are as follows:

EMS (Electromagnetic Susceptibility): EN61131-2  
EMI (Electromagnetic Interference): EN50081-2  
(Radiated emission: 10-m regulations)

### **Low Voltage Directive**

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

The CVM1D, CVM1, and CV-series PCs that comply with EC Directives must be installed as follows:

- 1, 2, 3...** 1. The CVM1D, CVM1, and CV-series PCs are designed for installation inside control panels. All PCs must be securely grounded within control panels.
2. Use reinforced insulation or double insulation for the DC power supplies used for the communications power supply and I/O power supplies.
3. The CVM1D, CVM1, and CV-series PCs that comply with EC Directives also conform to the Common Emission Standard (EN50081-2). 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.

Precautions Regarding Relay Output Switching:

Noise generated by the switching of relay outputs may exceed the standards of the Common Emission Standard (EN50081-2). In this case, take the necessary countermeasures to reduce the emissions, such as connecting a surge suppressor or shielding the PC. Some methods of reducing emissions are shown below.

Countermeasures are required when the load switching frequency of the overall PC exceeds 5 times/minute. Refer to *3-8 Conformance to EC Directives* for examples of circuits that can be used to reduce noise generated by switching.

# SECTION 1

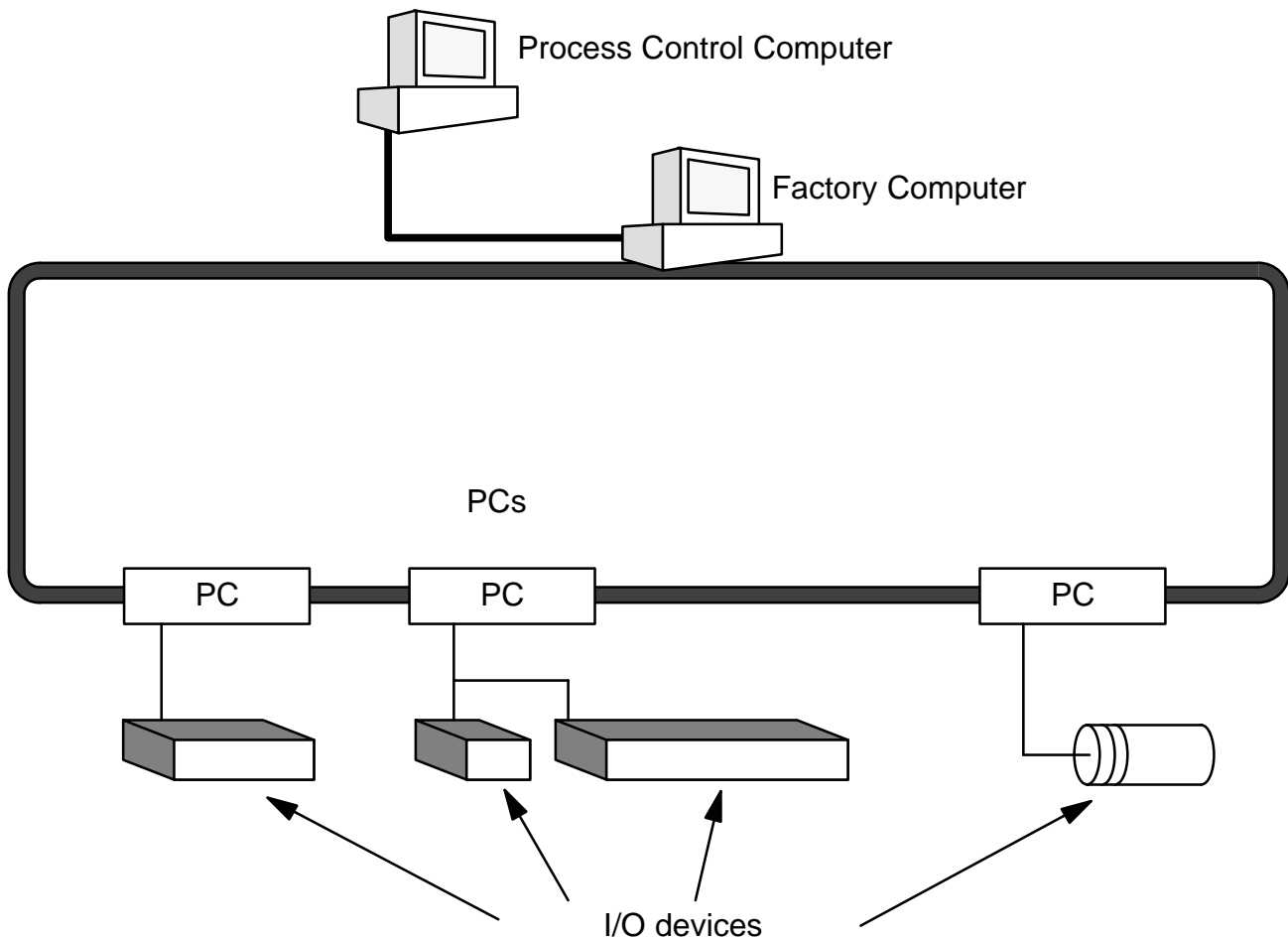
## Introduction

This section provides general information about Programmable Controllers and how they fit into a Control System. It also lists the C-series, CVM1, and CV-series products that can be used with the CVM1D PCs and operation manuals available for various OMRON products. Finally, this section introduces Systems that can be used to create networks and enable remote I/O, and provides a list of manuals for related products.

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1-2-2	Output Devices .....
1-3	PC Operation .....
1-4	CV-series Manuals .....
1-5	Features .....
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1-6	Networks and Remote I/O Systems .....
1-7	Compatibility with CVM1, C-series, and CV-series Units .....
1-8	Related Manuals .....

## 1-1 Control Systems

A Control System is the electronic equipment needed to control a particular process. It may include everything from a process control computer, to the factory computer, down through the PCs, and then on down through the network to the I/O devices: control components like the switches, stepping motors, solenoids, and sensors which monitor and control mechanical operations.



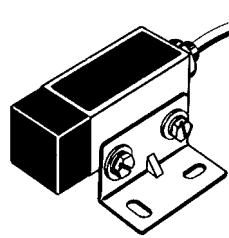
A Control System can involve very large applications where many different models of PC are networked together or it could be an application as small as a single PC controlling a number of output devices.

## 1-2 The Role of the PC

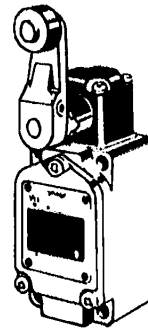
The PC is the part of the Control System that directly controls the manufacturing process. According to the program stored in its memory, the PC accepts data from the input devices connected to it and uses this data to monitor the controlled system. When the program calls for some action to take place, the PC sends data to the output devices connected to it to cause that action to take place. The PC may be used to control a simple, repetitive task, or it may be connected to other PCs or to a host computer in order to integrate the control of a complex process.

### 1-2-1 Input Devices

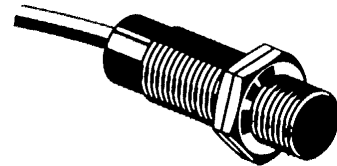
PCs can receive inputs from either automated or manual devices. The PC could receive data from the user via a pushbutton switch, keyboard, or similar device. Automated inputs could come from a variety of devices: micro-switches, timers, encoders, photoelectric sensors, and so on. Some devices, like the limit switch shown below, turn ON or OFF when the equipment actually makes contact with them. Other devices, like the photoelectric sensor and proximity sensor shown below, use other means, such as light or inductance, in order to get information about the equipment being monitored.



Photoelectric Sensor



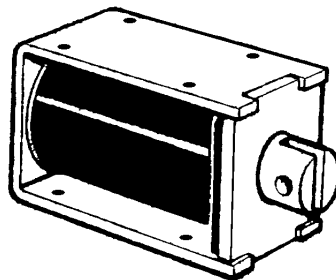
Limit Switch



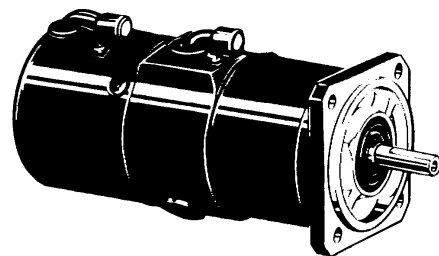
Proximity Sensor

### 1-2-2 Output Devices

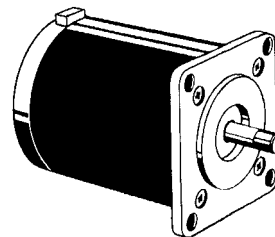
A PC can output to a myriad of devices for use in automated control. Almost anything that you can think of could be controlled by a PC. Some of the most common devices are motors, solenoids, servomotors, stepping motors, valves, switches, indicator lights, buzzers, and alarms. Some of these output devices, such as the motors, solenoids, servomotors, stepping motors, and valves, affect the controlled system directly. Others, such as the indicator lights, buzzers, and alarms, provide outputs to notify personnel operating or monitoring the system.



Solenoid



Servomotor

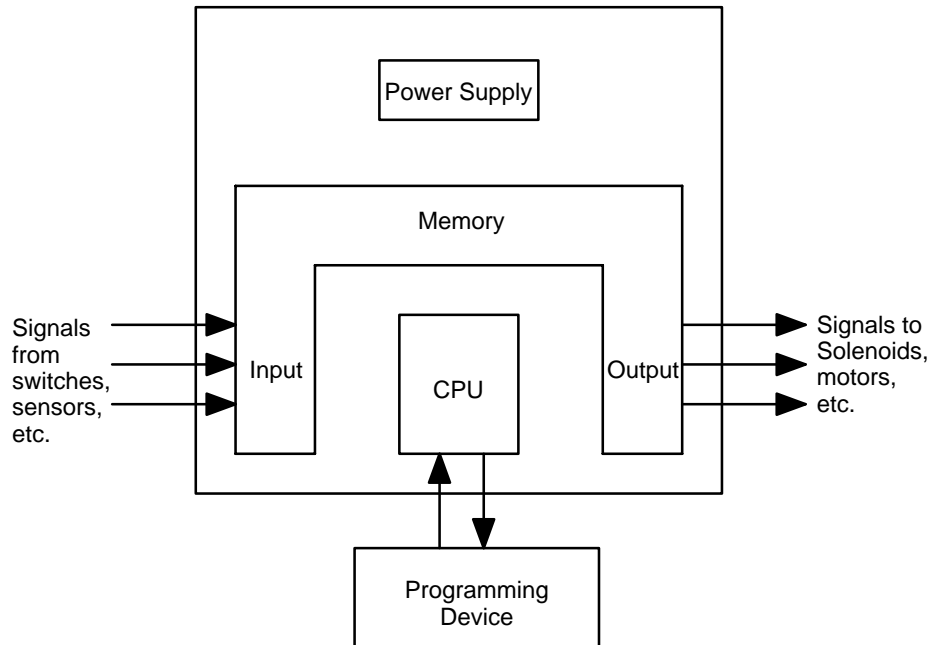


Stepping Motor

## 1-3 PC Operation

PCs operate by monitoring input signals and providing output signals. When changes are detected in input signals, the PC reacts through the user-programmed internal logic to produce output signals. The PC continually executes the program in its memory to achieve this control.

### Block Diagram of PC



A program for your applications must be designed and stored in the PC. This program is then executed as part of the cycle of internal operations of the PC.

### Execution Cycle

When a PC operates, i.e., when it executes its program to control an external system, a series of operations are performed inside the PC. These internal operations can be broadly classified into the following four categories. Refer to the *CVM1D Operation Manual* for details.

- 1, 2, 3...**
1. Common (or overseeing) processes, such as watchdog timer operation and testing the program memory.
  2. Data input and output.
  3. Program execution.
  4. Programming Device servicing.

### Cycle Time

The total time required for a PC to perform all these internal operations is called the cycle time.

Timing is one of the most important factors in designing a Control System. For accurate operations, it is necessary to have answers to such questions as these:

- How long does it take for the PC to execute all the instructions in its memory?
- How long does it take for the PC to produce a control output in response to a given input signal?

The cycle time of the PC can be automatically calculated and monitored, but it is necessary to have an understanding of the timing relationships within the PC for effective System design and programming. Refer to the *CVM1D Operation Manual* for details on internal PC processing and to the *SSS Operation Manuals* for details on monitoring the cycle time.

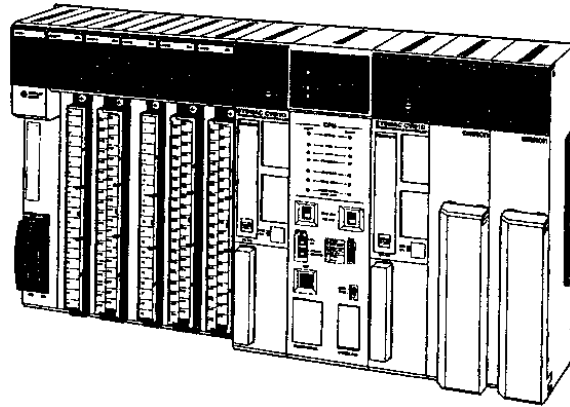
## 1-4 CV-series Manuals

The following manuals are available for the various products that can be used in a CVM1D system. Catalog number suffixes have been omitted; be sure you have the most recent version for your region.

Product	Manual	Cat. No.
CV-series PCs	CV-series PCs Installation Guide	W195
	CV-series PCs Operation Manual: SFC	W194
	CV-series PCs Operation Manual: Ladder Diagrams	W202
	CV-series PCs Operation Manual: Host Link System, CV500-LK201 Host Link Unit	W205
SYSMAC Support Software (SSS)	SYSMAC Support Software Operation Manual: Basics	W247
	SYSMAC Support Software Operation Manual: CVM1 PCs	W249
Programming Console	CVM1-PRS21-E Programming Console Operation Manual	W222
SYSMAC NET Link System	SYSMAC NET Link System Manual	W213
SYSMAC LINK System	SYSMAC LINK System Manual	W212
SYSMAC BUS/2 Remote I/O System	SYSMAC BUS/2 Remote I/O System Manual	W204
CV-series Ethernet Unit	CV-series Ethernet System Manual	W242
BASIC Unit	BASIC Unit Reference Manual	W207
	BASIC Unit Operation Manual	W206
Personal Computer Unit	Personal Computer Unit Operation Manual	W251
	Personal Computer Unit Technical Manual	W252
Motion Control Unit	Motion Control Unit Operation Manual: Introduction	W254
	Motion Control Unit Operation Manual: Details	W255
Temperature Controller Data Link Unit	CV500-TDL21 Temperature Controller Data Link Unit	W244
Memory Card Writer	CV500-MCW01-E Memory Card Writer Operation Manual	W214
Optical Fiber Cable	Optical Fiber Cable Installation Guide	W156

## 1-5 Features

The SYSMAC CVM1D Duplex System is a high-speed, highly reliable ladder-program PC that can operate 24 hours/day.



### Redundant CPU Units

The redundant CPU Units allow continuous, 24-hour/day PC operation. The CVM1D-CPU21 CPU Unit was developed specifically for the duplex system and based on the CVM1-CPU21-V2 CPU Unit, so the duplex CPU Unit inherits the superior performance of the CVM1 and CV-series PCs.

### Both Duplex and Simplex Operation are Supported

The PC can operate in duplex mode or simplex mode depending on the setting of the Duplex/Simplex Mode Switch on the front of the Duplex Unit.

### Redundant Power Supply Units

Redundant Power Supply Units have been added to CPU Racks, Expansion CPU Racks, and Expansion I/O Racks. The two Units supply power to the rack in parallel. Even if one of the Power Supply Units breaks down, the PC can continue operating normally and the faulty Unit can be replaced without interruption.

Backplanes that accommodate two Power Supply Units must be used for the Expansion CPU Racks and Expansion I/O Racks in order to take advantage of the redundant power supply function.

### Online I/O Unit Replacement

When an error occurs in an I/O Unit, the faulty Unit can be replaced without turning off the power to the whole system. Use the duplex system's CVM1-PRS21-EV1 Programming Console to replace an I/O Unit online.

### Compatible with C-series and CV-series Units

C500 I/O Units and Special I/O Units as well as CV-series CPU Bus Units can be used with CVM1D PCs.

## 1-5-1 Duplex System Operation

A CVM1D Duplex System can be assembled with redundant CPU Units and Power Supply Units to allow continuous operation.

### CVM1D Duplex System Configuration

A CVM1D can be configured to run in duplex mode with two CPU Units operating in parallel or in simplex mode with one CPU Unit operating independently.

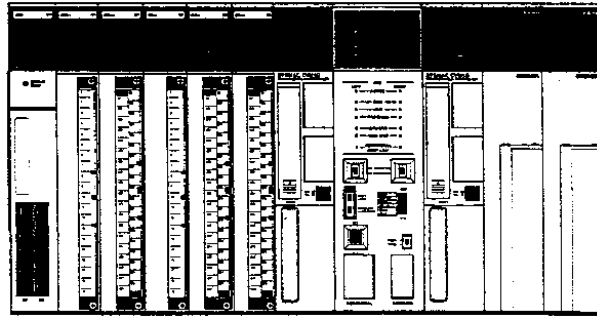
- Duplex (DPL) System:  
Both CPU Units and Power Supply Units are redundant.
- Simplex (SPL) System:  
One CPU Unit is used, but Power Supply Units are redundant.

### Duplex (DPL) System

A CVM1D CPU Backplane is equipped with two CPU Units, a Duplex Unit, and two Power Supply Units.



When the PC is operating in duplex mode, the two CPU Units operate the same program and one CPU Unit (the active CPU Unit) controls the system while the other (the standby CPU Unit) operates in parallel. If an error occurs in the one of the CPU Units, operation continues with the other CPU Unit and the faulty CPU Unit can be replaced without stopping the PC.

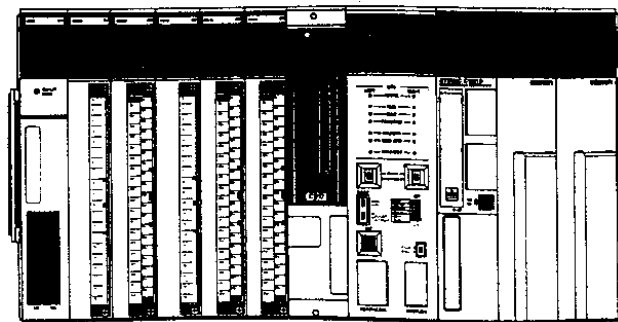


**Simplex (SPL) System**

A CVM1D CPU Backplane is equipped with a CPU Unit, a Duplex Unit, and two Power Supply Units.

The Duplex Unit is primarily needed to operate the duplex system, but it performs other functions such as I/O bus switching so the Duplex Unit is also required in a simplex system.

Two Power Supply Units are used, so the PC can continue operating with one Power Supply Unit if the other breaks down. The faulty Unit can be replaced without stopping operation.



**1-5-2 Duplex Unit**

The Duplex Unit monitors errors in the two CPU Units and switches the CPU bus, I/O bus, and Peripheral bus to the standby CPU Unit if an error occurs in the active CPU Unit.

**Operation of the CVM1D Duplex System**

When the PC is operating as a duplex system, the two CPU Units perform different roles, one is the active CPU Unit and the other is the standby CPU Unit.

CPU Unit	Operation
Active CPU Unit	Executes the program and controls I/O Units, Special I/O Units, and CPU Bus Units.
Standby CPU Unit	Executes the same program as the active CPU Unit but does not control I/O.

- The “active CPU Unit” is determined at the start of duplex mode operation by the setting on the Duplex Unit’s Active CPU Switch.
- If an error occurs in the active CPU Unit during operation, operation is switched automatically to the standby CPU Unit which becomes the active CPU Unit.
- The PC can be returned to duplex mode operation by replacing or repairing the CPU Unit in which the error occurred.

### 1-5-3 Power Supply Redundancy

When two Power Supply Units are mounted, the Backplane's 5-VDC power is supplied simultaneously from the two Power Supply Units.

If one of the Power Supply Units breaks down, its load will be picked up by the other Power Supply Unit. Be sure that the current consumption of all of the Units mounted in the Backplane can be supplied by either one of the Power Supply Units. If one of the Power Supply Units breaks down and the capacity of the other Unit is insufficient, the second Unit will overload and the system will shutdown.

The Power Supply Units' error status is displayed on Rack's I/O Control Unit or I/O Interface Unit (IC□□□/II□□□). The error status is also indicated in the Power Supply Unit OFF/Error Flags in A397 and A398.

### 1-5-4 CVM1D Limitations

The performance of CVM1D CPU Units is comparable to that of the CVM1-CPU-EV1, but as part of the conversion to duplex operation several instructions have been removed and some Units have become incompatible.

#### Incompatible Units

- C2000-ID216 Interrupt Input Unit  
(If the Unit is mounted, it will operate as a normal 8-point Input Unit.)
- C500-ASC03 ASCII Unit

#### Unusable Instructions

Refer to the *CVM1D Operation Manual* for more details on the following instructions.

- Immediate-refresh Variations  
(Immediate-refreshing variations can be used in simplex mode, but they can cause improper operation in duplex mode so they should not be used.)
- Interrupt Control Instructions  
MSKS(153), CLI(154), and MSKR(155)
- Memory Card instructions  
FILR(180), FILW(181), FILP(182), and FLSP(183)

#### Memory Card Functions

Memory Cards can be installed and used in each CPU Unit, although the Card's program and data are not included in duplex synchronization.

#### I/O Refreshing

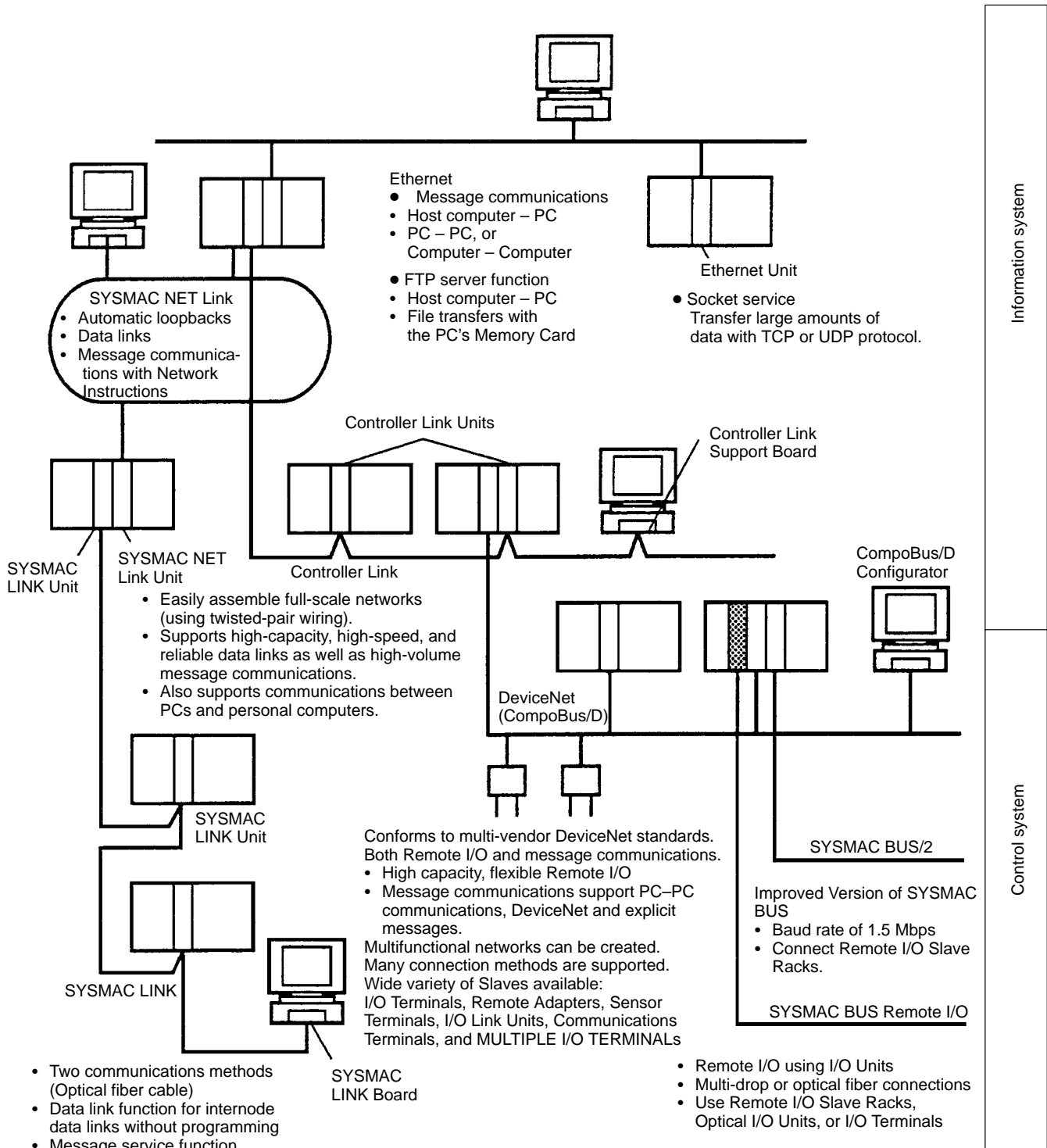
Cyclic refreshing is the only method used to refresh the entire I/O area. The I/O REFRESH instruction (IORF(184)) can be used to refresh specific ranges of I/O words. Immediate refreshing cannot be used in duplex mode.

#### Operation of Timers

The precision of the TIM, TIMH(015), and TTIM(120) timers has decreased slightly because of changes in the refreshing process. Refer to the *CVM1D Operation Manual* for more details on the precision of timers.

# 1-6 Networks and Remote I/O Systems

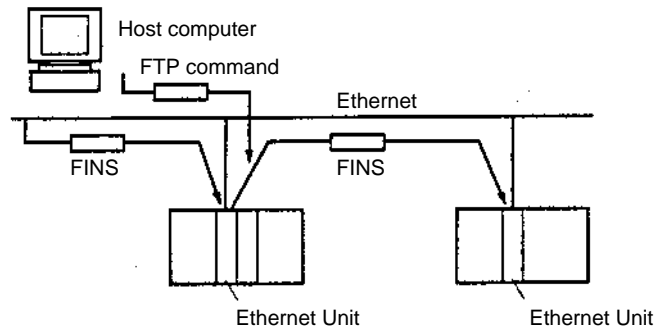
The following diagram shows the communications networks that can be used with the CVM1D PCs.



## Ethernet

Mounting an Ethernet Unit allows message (FINS) communications between the PC and other PCs or host computers on the Ethernet. It is also possible to transfer data to and from the Memory Card installed in the CPU Unit by issuing an FTP command to the PC from a host computer on the Ethernet. In addition, all kinds of data can be transferred by UDP or TCP protocol.

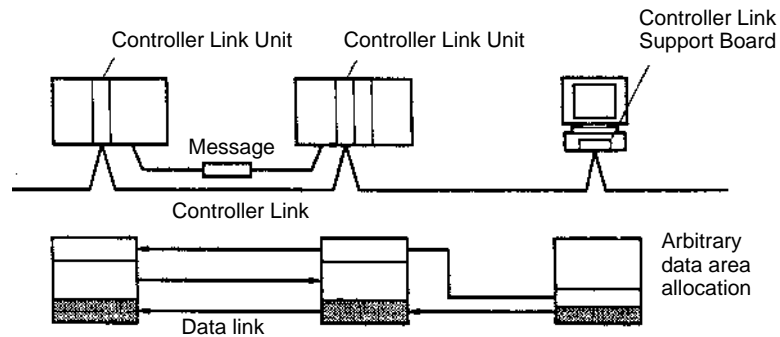
These functions can improve the interconnection with information systems and networks.



**Controller Link**

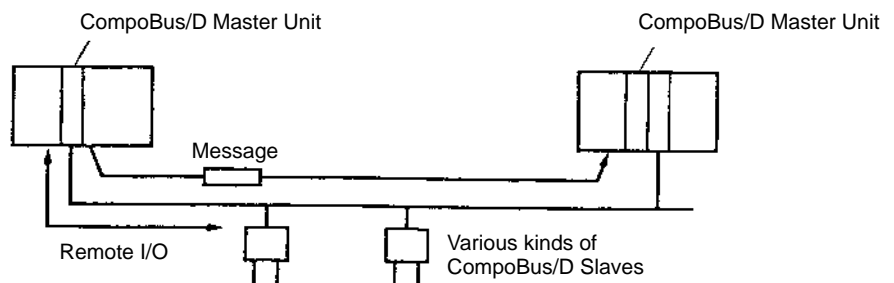
The Controller Link is the main FA network of OMRON PCs; it can provide data links between PCs (automatic data sharing independent of the program) as well as message (FINS) communications between PCs (data transfers and control when required). A Controller Link network can be connected with twisted-pair wiring. Data links and message communications between PCs and computers are also supported.

Data links can share large volumes of data and the shared data areas can be allocated freely. Message (FINS) communications can also transfer large volumes of data.



**DeviceNet (CompoBus/D)**

DeviceNet is a standardized multi-vendor network that can be used simultaneously for control and information transmission. CompoBus/D conforms to the open field network DeviceNet standards. Remote I/O communications between the PC and various CompoBus/D Slaves can be achieved by mounting a CompoBus/D Master Unit. Remote I/O communications can handle a large number of I/O points and provide free allocation. Slaves such as Analog I/O Terminals are available. In addition, DeviceNet supports message communications between PCs and between the PC and other manufacturers' DeviceNet devices.



**Summary of Communications Networks: Information**

Network	Function	Communications	Devices
Ethernet	PC ↔ Host computer	Message (FINS) communications	Ethernet Unit
	PC ↔ PC		
	Memory Card in CPU Unit ↔ Host computer	FTP server function	
	PC ↔ Nodes with socket service (such as Unix-based computers)	Socket service function	
Controller Link	PC ↔ Computer directly connected to the network	Message (FINS) communications	Controller Link Support Board and Unit
		Data link (Offsets and automatic settings can be used.)	
RS-232C to Controller Link	Host computer and PCs in the network	Host link commands and gateway functions	RS-232C cable and Controller Link Unit
SYSMAC NET Link	PC ↔ Computer directly connected to the network	Message (FINS) communications	SYSMAC NET Link Support Board and Unit
		Data link	
SYSMAC LINK	PC ↔ Computer directly connected to the network	Message (FINS) communications	SYSMAC LINK Support Board and Unit
		Data link	

**Summary of Communications Networks: Control**

Network	Function	Communications	Devices
Controller Link	PC ↔ PC	Message (FINS) communications	Controller Link Unit
		Data link (Offsets and automatic settings can be used.)	
		Automatic data link	
PC Link			PC Link Unit
DeviceNet (CompoBus/D)		Open network message (FINS) communications	CompoBus/D Master Unit and Configurator
DeviceNet (CompoBus/D)	PC ↔ Components (Slaves)	Open network high-capacity remote I/O (fixed or arbitrary allocation)	CompoBus/D Master Unit and Configurator
SYSMAC NET Link	PC ↔ PC	Message (FINS) communications	SYSMAC NET Link Unit
		Data link	
SYSMAC LINK		Message (FINS) communications	SYSMAC LINK Unit
		Data link	

**Communications Specifications**

Network	Options	Max. baud rate	Total distance	Number of nodes	Medium	Capacity	Devices
Ethernet	• Message	10 Mbps	2.5 km	---	Coaxial	---	PC ↔ Host computer or PC ↔ PC
Controller Link	• Message • Data link	2 Mbps	500 m	32 max.	Twisted-pair cable	Data link: 32,000 words per network	PC ↔ PC or Computer ↔ PC
PC Link	• Data link	128 Kbps	500 m	32 max.	RS-232C or RS-422	Data link: 64 words per network	---
DeviceNet (CompoBus/D)	• Message • Remote I/O	50 Mbps <sup>1</sup>	100 m	63 max.	Special cable	Remote I/O: 2,048 points	PC ↔ Slave <sup>2</sup>
SYSMAC NET Link	• Message • Data link	2 Mbps	1 km	126 max.	Optical fiber	Data link: 3,584 words per network	PC ↔ Host computer or PC ↔ PC
SYSMAC LINK	• Message • Data link	2 Mbps	1 km	62 max.	Coaxial	Data link: 2,966 words per network	PC ↔ Host computer or PC ↔ PC
SYSMAC BUS/2	• Remote I/O	1.5 Mbps	See note 3.	4 max.	Wired or optical fiber	Remote I/O: 128 points	---

**Note** 1. Communications cycle of approximately 5 ns (128 inputs and 128 outputs).

2. Slaves include I/O Terminals, Remote Adapters, Sensor Terminals, CQM1 I/O Link Units, and Analog Output Terminals.
3. For wired systems, the total communications distance can be up to 500 m; for optical systems it can be up to 10 km and up to 800 m with node connections.

## 1-7 Compatibility with CVM1, C-series, and CV-series Units

Unit		C Series	CV Series	CVM1 Duplex	Remarks
CPU Rack	CPU Unit	---	---	Yes	CVM1D-CPU21
	Power Supply Unit	---	No <sup>1</sup>	Yes	CVM1D-PA208/PA212
	Power Supply Unit	---	Yes	No <sup>1</sup>	CV500-PS211/221 CVM1-PA208
	CPU Backplane supporting online I/O replacement	---	---	Yes	CVM1D-BC051
	I/O Control Unit	---	Yes	---	CV500-IC101/201/301
	Duplex Unit	---	---	Yes	CVM1D-DPL01
Expansion CPU Backplane	CPU Backplane	---	Yes <sup>2</sup>	---	CV500-BI111
	CPU Backplane supporting online I/O replacement	---	---	Yes	CVM1D-BI101
	I/O Interface Unit	---	Yes	---	CV500-II101
Expansion I/O Backplane	Backplane	---	Yes <sup>2</sup>	---	CV500-BI112
	Backplane supporting online I/O replacement	---	---	Yes	CVM1D-BI102
	Backplane for C2000 duplex system	Yes <sup>2</sup>	---	---	C2000-BI082/083
	Direct-connect Backplane	---	No <sup>3</sup>	---	CVM1-BI114
	Backplane for C-series	Yes <sup>2</sup>	---	---	C500-BI181
	I/O Interface Unit	---	Yes	---	CV500-II201
16-point/32-point/64-point I/O Units		Yes	---	---	---
Special I/O Units		Yes	---	---	---
Motion Control Unit		---	Yes	---	CV500-MC421
BASIC Unit		---	Yes	---	CV500-BSC□1
Personal Computer Unit		---	Yes	---	CV500-VP□□□
Temperature Control Data Link Unit		---	Yes	---	CV500-TDL21
Link Systems	SYSMAC NET	---	Yes	---	CV500-SNT31
	SYSMAC LINK	---	Yes	---	CV500-SLK11/SLK21
	Host Link Unit	---	Yes	---	CV500-LK201
	Ethernet Unit	---	Yes	---	CV500-ETN01
	Controller Link Unit	---	Yes	---	CVM1-CLK21
Remote I/O Systems	SYSMAC BUS/2	---	Yes	---	CV500-RM211/221 CV500-RT211/221
	SYSMAC BUS Units	Yes	---	---	---
	CompoBus/D Master Units	---	Yes	---	CVM1-DRM21-V1

- Note**
1. The 5 VDC output voltage in the CVM1 and CV-series Power Supply Units is different from that in the CVM1D Power Supply Units, so they are not interchangeable.
  2. The Backplanes can be used, but do not support online I/O Unit replacement or redundant Power Supply Units.
  3. These Backplanes cannot be connected directly in a CVM1D system.

## 1-8 Related Manuals

The following manuals are available for the various CVM1D-series and related products. Catalog number suffixes have been omitted; be sure you have the most recent version for your region.

Product	Model number	Manual	Cat. No.
CVM1D Duplex System PCs	---	CVM1D Duplex System PC Installation Guide	W350
	---	CVM1D Duplex System PC Operation Manual	W351
CV-series Host Link Unit	CV500-LK201	CV-series PCs Operation Manual: Host Link System,	W205
SYSMAC Support Software (SSS)	C500-ZL3AT1-E	SYSMAC Support Software Operation Manual: Basics	W247
		SYSMAC Support Software Operation Manual: CVM1 PCs	W249
Programming Console	CVM1-PRS21-V1E	Programming Console Operation Manual	W222
CompoBus/D Master Unit	CVM1-DRM21-V1	CompoBus/D Master Unit Operation Manual	W267
Controller Link Unit	CVM1-CLK21	Controller Link Unit Operation Manual	W309
Controller Link Support Software	C200H-ZW3AT2-E	Controller Link Support Software Operation Manual	W308
SYSMAC NET Link Unit	CVM1-SNT31	SYSMAC NET Link System Manual	W213
SYSMAC LINK Unit	CV500-SLK11/SLK21	SYSMAC LINK System Manual	W212
SYSMAC BUS/2 Remote I/O Units	CV500-RM211/RM221/RT211/RT221	SYSMAC BUS/2 Remote I/O System Manual	W204
SYSMAC BUS Wired Remote I/O Units	3G2A5-RM201/RT201	SYSMAC BUS Wired Remote I/O System Manual	W120
Ethernet Unit	CV500-ETN01	CV-series Ethernet System Manual	W242
BASIC Unit	CV500-BSC11/BSC21/BSC31/BSC41/BSC51/BSC61	BASIC Unit Reference Manual	W207
		BASIC Unit Operation Manual	W206
Temperature Controller Data Link Unit	CV500-TDL21	Temperature Controller Data Link Unit Operation Manual	W244
Personal Computer Unit	CV500-VP213-E/VP223-E/VP217-E/VP227-E	Personal Computer Unit Operation Manual	W251
		Personal Computer Unit Technical Manual	W252
Analog I/O Units	3G2A5-AD001/AD002/AD003/AD004/AD005/AD006/AD007, C500-AD101	Analog I/O Units Operation Manual	W258
	3G2A5-DA001/DA002/DA003/DA004/DA005, C500-DA101/DA103		
High-speed Counter Unit	C500-AD501	Analog I/O Unit Operation Manual	W259
	3G2A5-CT001, C500-CT012	High-speed Counter Unit Operation Manual	W129
	C500-CT021	High-speed Counter Unit Operation Manual	W253
Motion Control Unit	CV500-MC221/MC421	C500-CT041	High-speed Counter Unit Operation Manual
		<td>Motion Control Unit Operation Manual: Introduction</td> <td>W254</td>	Motion Control Unit Operation Manual: Introduction
Position Control Unit	C500-NC113/NC211	Motion Control Unit Operation Manual: Details	W255
		Position Control Unit Operation Manual	W323
		3G2A5-NC111-EV1	Position Control Unit Operation Manual
MC Support Software	C500-NC222-E	Position Control Unit Operation Manual	W231
	CV500-ZN3AT1-E	MC Support Software Operation Manual	W247
Teaching Box	C500-TU002-E	Teaching Box Operation Manual	W145
	CVM1-PRS71	Teaching Box Operation Manual	W257

<b>Product</b>	<b>Model number</b>	<b>Manual</b>	<b>Cat. No.</b>
Cam Positioner Unit	C500-CP131	Cam Positioner Unit Operation Manual	W144
Fuzzy Logic Unit	C500-FZ001	Fuzzy Logic Unit Operation Manual	W209
ASCII Unit	C500-ASC04	ASCII Unit Operation Manual	W186
ID Sensor Unit	C500-IDS01-V2/ IDS02-V1/IDS21/ IDS22	ID Sensor Unit Operation Manual	W126
Memory Card Writer	CV500-MCW01-E	Memory Card Writer Operation Manual	W214



## SECTION 2

# System Configuration and Components

This section provides information about the types of system configuration in which the CVM1D PCs can be used and the individual Units that make up these configuration. Refer to *Appendix A Standard Models* for a list of OMRON products that can be used in CVM1D PC Systems.

2-1	System Configuration .....	
2-1-1	Basic Duplex System with Expansion I/O Racks .....	
2-1-2	Duplex System with an Expansion CPU Rack .....	
2-1-3	Duplex System with CV-series Expansion I/O Racks .....	
2-1-4	Duplex System with C-series Expansion I/O Racks .....	
2-2	Unit Mounting Limitations .....	
2-3	Racks .....	
2-3-1	CPU Racks .....	
2-3-2	Expansion CPU Racks .....	
2-3-3	Expansion I/O Racks .....	
2-4	Rack Components .....	
2-4-1	CPU Unit .....	
2-4-2	Duplex Unit .....	
2-4-3	I/O Control Units .....	
2-4-4	I/O Interface Units .....	
2-4-5	Power Supply Units .....	
2-4-6	Terminating Resistance Units .....	
2-4-7	I/O Units .....	

## 2-1 System Configuration

This section provides examples of the following four duplex systems.

- 1, 2, 3...
1. Basic System with a CVM1D CPU Rack and Expansion I/O Racks
    - Up to 5 CPU Bus Units can be used.
    - Redundant Power Supply Units are used and I/O Units can be replaced online.
  2. System with a CVM1D CPU Rack, Expansion CPU Rack, and Expansion I/O Racks
    - Up to 15 CPU Bus Units can be used.
    - Redundant Power Supply Units are used and I/O Units can be replaced online.
  3. System with a CVM1D CPU Rack, CVM1 or CV-series Expansion CPU Rack, and CVM1 or CV-series Expansion I/O Racks
    - Demonstrates how a CVM1 or CV-series system can be converted to a duplex system.
    - Redundant Power Supply Units are used and I/O Units can be replaced online in the CPU Rack, but not the CVM1 or CV-series Racks.
    - CVM1 or CV-series Expansion I/O Racks without I/O Interface Units cannot be connected.
  4. System with a CVM1D CPU Rack and C-series Expansion I/O Racks
    - Demonstrates how a C2000H duplex system can be upgraded to a CVM1D duplex system.
    - Redundant Power Supply Units are used and I/O Units can be replaced online in the CPU Rack, but not the C-series Racks.
    - C-series Racks cannot be combined with CVM1 or CV-series Expansion I/O Racks.

### 2-1-1 Basic Duplex System with Expansion I/O Racks

The following figure shows a basic duplex system with a CVM1D CPU Rack and seven Expansion I/O Racks. Up to 2,048 I/O points (128 words) can be used in the PC.

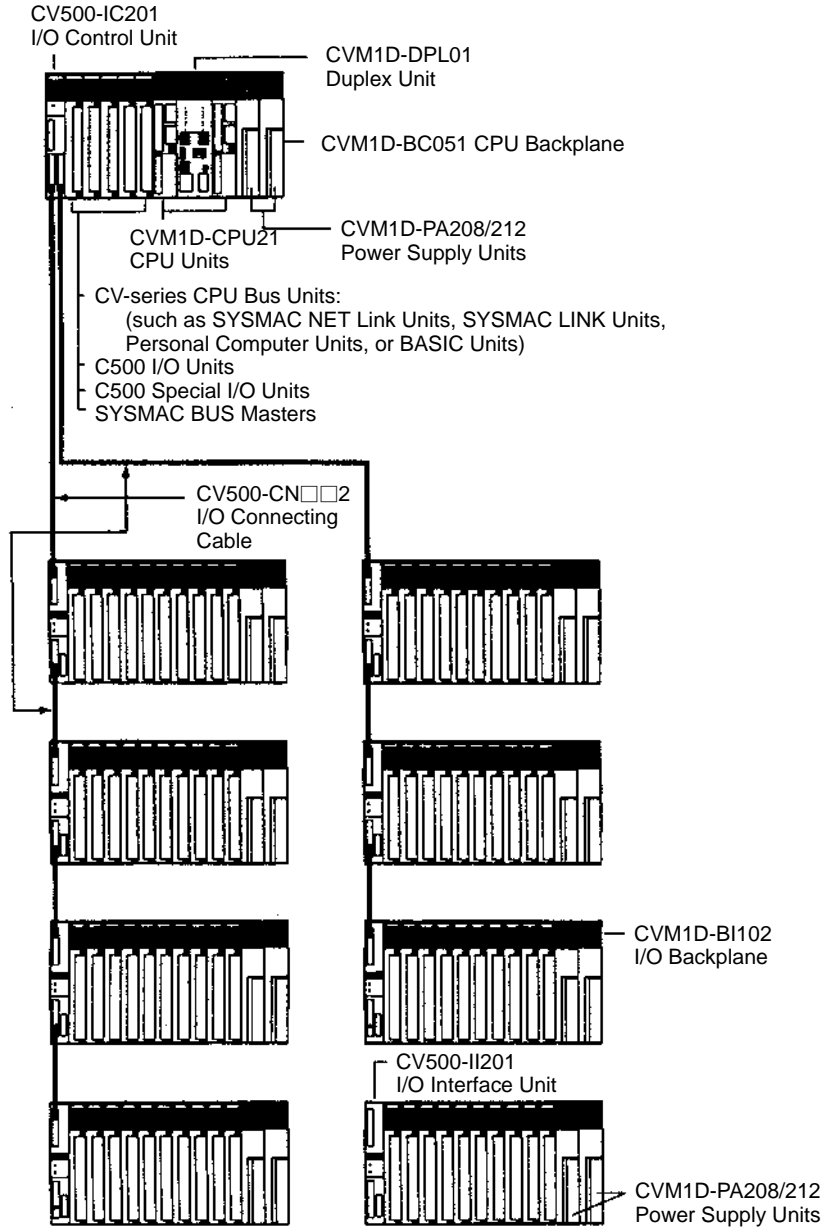
#### **CPU Rack**

Any of the Units listed in the diagram can be connected to the CPU Rack. (Up to 5 CPU Bus Units can be connected.)

#### **Expansion I/O Racks**

- Up to seven Expansion I/O Racks may be connected in two series from the CPU Rack.
- When CVM1D Backplanes that can accommodate two Power Supply Units are used, redundant Power Supply Units can be used and I/O Units can be replaced online.
- CVM1 and CV-series Expansion I/O Racks can be combined with the CVM1D Racks, but not C500 Expansion I/O Racks.
- The total length of I/O Connecting Cable must be 50 m or less for each series.
- A Terminating Resistance Unit must be connected to the last Rack in each series.
- Even when there is only one series of Expansion I/O Racks, be sure to install a Terminating Resistance Unit in the I/O Control Unit's unused connector.

- Up to eight C500 Special I/O Units can be connected to one rack.



## 2-1-2 Duplex System with an Expansion CPU Rack

When six or more CPU Bus Units (up to 15 CPU Bus Units) are required in a System, the CPU Rack may be extended by connecting an Expansion CPU Rack.

The following figure shows a duplex system with a CVM1D CPU Rack, an Expansion CPU Rack, and six Expansion I/O Racks. Up to 2,048 I/O points (128 words) can be used in the PC.

### **CPU Rack**

Any of the Units listed in the diagram can be connected to the CPU Rack. (Up to 5 CPU Bus Units can be connected.)

### **Expansion CPU Rack**

- Any of the Units listed in the diagram can be connected to the Expansion CPU Rack. (Up to 10 CPU Bus Units can be connected.)
- Only one Expansion CPU Rack can be connected to the CPU Rack.
- The following CPU Bus Units can be connected. Together, the CPU Rack and Expansion CPU Rack can accommodate up to 15 CPU Bus Units.

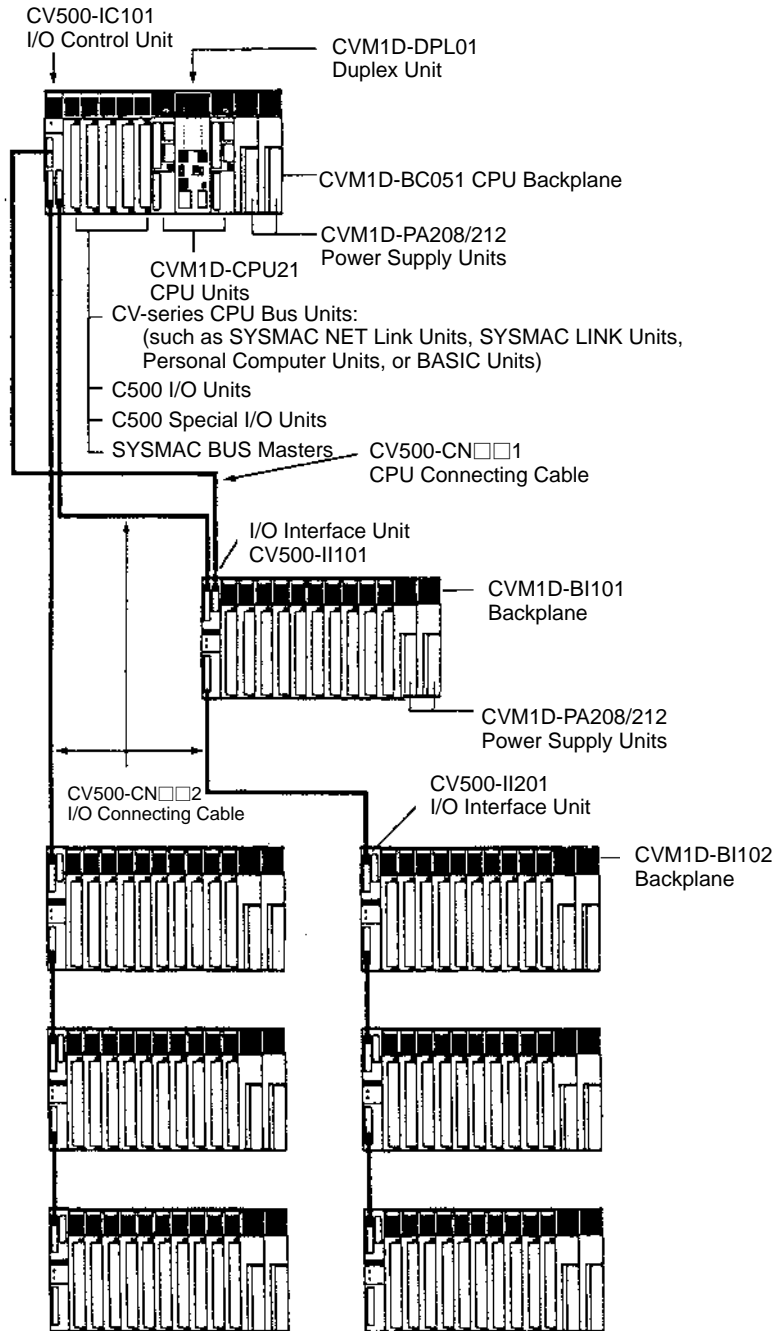
Motion Control Units (MC421), Temperature Controller Data Link Units, Ethernet Units, SYSMAC NET Link Units, SYSMAC LINK Units, SYSMAC BUS/2 Masters, BASIC Units, and Personal Computer Units

- If an Expansion I/O Rack isn't connected, be sure to install a Terminating Resistance Unit in the I/O Control Unit's unused connector.

### **Expansion I/O Racks**

- Up to six Expansion I/O Racks may be connected in two series from the CPU Rack.
- When CVM1D Backplanes that can accommodate two Power Supply Units are used, redundant Power Supply Units can be used and I/O Units can be replaced online.
- CVM1 and CV-series Expansion I/O Racks can be combined with the CVM1D Racks, but not C500 Expansion I/O Racks.
- The total length of I/O Connecting Cable must be 50 m or less for each series.
- A Terminating Resistance Unit must be connected to the last Rack in each series.
- Even when there is only one series of Expansion I/O Racks, be sure to install a Terminating Resistance Unit in the I/O Control Unit's unused connector.

- Up to eight C500 Special I/O Units can be connected to one rack.



### 2-1-3 Duplex System with CV-series Expansion I/O Racks

A CV-series system can be upgraded to a duplex system by connecting a CVM1D CPU Rack to the CV-series Expansion I/O Racks. This example shows only Expansion I/O Racks, but a CV-series Expansion CPU Rack can be connected, too. Up to 2,048 I/O points (128 words) can be used in the PC.

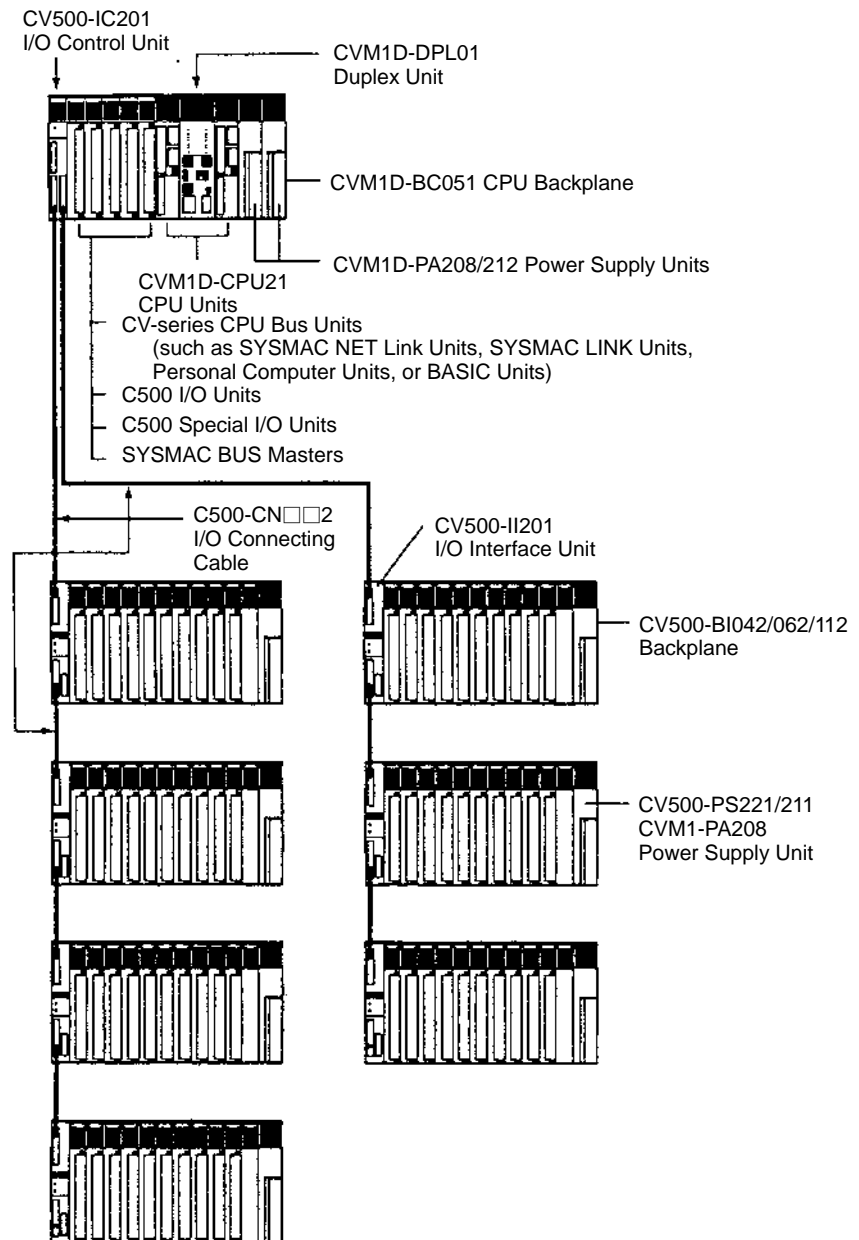
I/O Units connected to CV-series Expansion I/O Racks and Expansion CPU Racks cannot be replaced online.

#### **CPU Rack**

Any of the Units listed in the diagram can be connected to the CPU Rack. (Up to 5 CPU Bus Units can be connected.)

**Expansion I/O Racks**

- Up to seven Expansion I/O Racks may be connected in two series from the CPU Rack.
- The total length of I/O Connecting Cable must be 50 m or less for each series.
- A Terminating Resistance Unit must be connected to the last Rack in each series.
- Even when there is only one series of Expansion I/O Racks, be sure to install a Terminating Resistance Unit in the I/O Control Unit's unused connector.
- Up to eight C500 Special I/O Units can be connected to one rack.



## 2-1-4 Duplex System with C-series Expansion I/O Racks

A C-series system (C500, C1000H, C2000H, or C2000H duplex system) can be upgraded to a CVM1D duplex system by connecting a CVM1D CPU Rack to the C-series Expansion I/O Racks. Up to 2,048 I/O points (128 words) can be used in the PC.

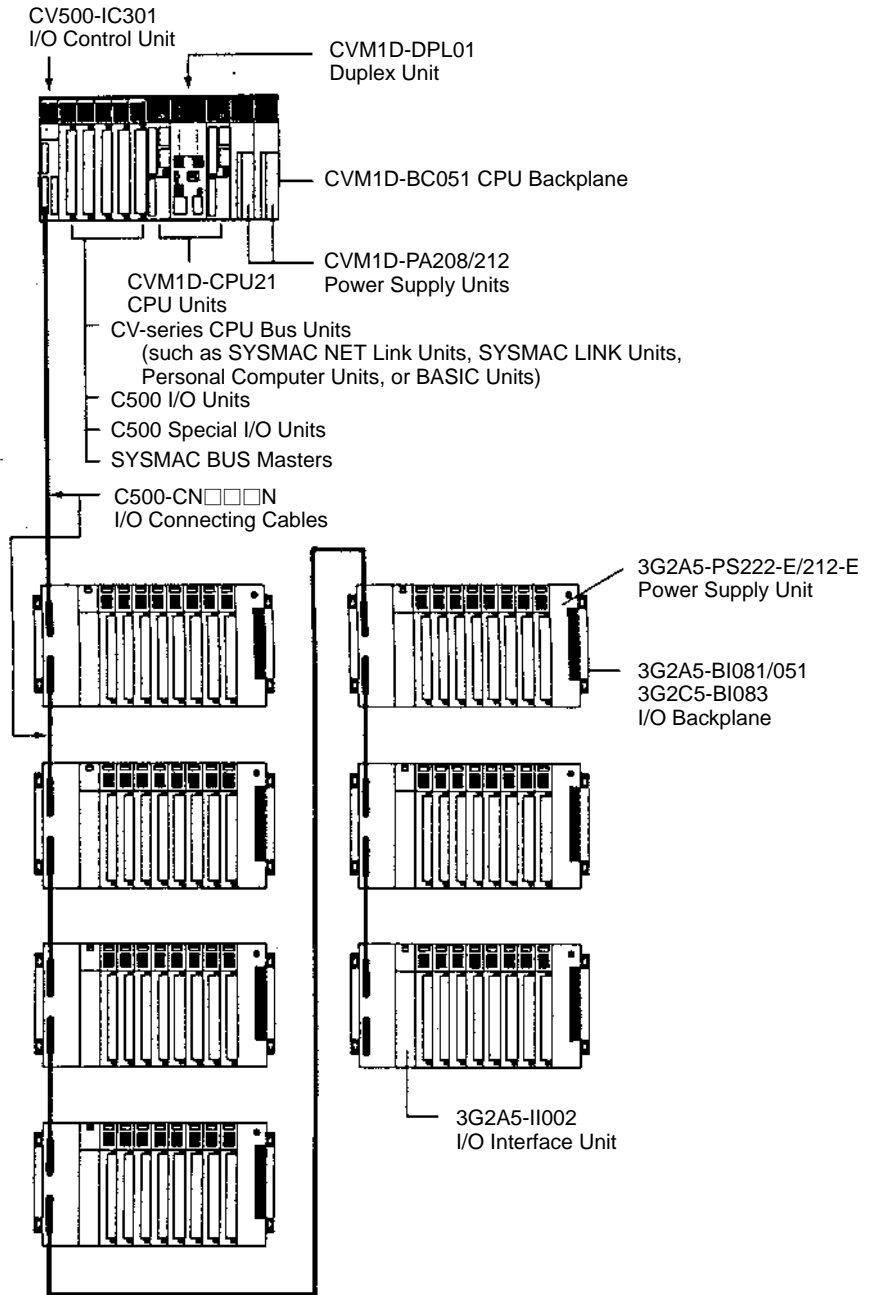
### **CPU Rack**

Any of the Units listed in the diagram can be connected to the CPU Rack. (Up to 5 CPU Bus Units can be connected.)

### **Expansion I/O Racks**

- I/O Units connected to C-series Expansion I/O Racks cannot be replaced on-line.
- C-series Expansion I/O Racks cannot be combined with CV-series or CVM1D Expansion I/O Racks.
- Up to seven Expansion I/O Racks may be connected in one series.
- The total length of I/O Connecting Cable must be 5 m or less.
- Terminating Resistance Units are not required.
- With the 3G2A5-II002 I/O Interface Unit, use Units with lot number 0574 or later.

- Up to eight C500 Special I/O Units can be connected to one rack.





## 2-2 Unit Mounting Limitations

The following tables show the Racks in which the various C-series and CV-series I/O Units, Special Units, Special I/O Units, and CPU Bus Units can be mounted.

### I/O Units

A "Yes" indicates that the Unit can be mounted in the Rack.

Unit	CPU Rack	Expansion CPU Rack		Expansion I/O Racks			Remote I/O Slave Racks	
		CVM1D Backplane	CV-series Backplane	CVM1D Backplane	CV-series Backplane	C500 Backplane	SYSMAC BUS/2	SYSMAC BUS
C500-I□□□□ Input Units	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes	Yes <sup>1</sup>	Yes	Yes	Yes	Yes
C500-OI□□□□ Output Units	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes	Yes <sup>1</sup>	Yes	Yes	Yes	Yes
C500-MD□□□□ DC Input/Transistor Output Unit	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes	Yes <sup>1</sup>	Yes	Yes	Yes	Yes
C2000-ID216 Interrupt Input Unit <sup>2</sup>	No	No						

- Note**
1. The Unit can be mounted in the Rack and can be replaced online with the CVM1-PRS21-EV1 Programming Console.
  2. Interrupt Input Units cannot be used in a CVM1D duplex system. If an Interrupt Input Unit is mounted, it will operate as a normal 8-point Input Unit.

### Other Units

A "Yes" indicates that the Unit can be mounted in the Rack.

Unit	CPU Rack	Expansion CPU Rack		Expansion I/O Racks			Remote I/O Slave Racks	
		CVM1D Backplane	CV-series Backplane	CVM1D Backplane	CV-series Backplane	C500 Backplane	SYSMAC BUS/2	SYSMAC BUS
C500-IPS01 I/O Power Supply Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-DUM01 Dummy I/O Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CV500-PS221/211 Power Supply Unit	No	No	Yes	No	Yes	No	Yes	No
CVM1-PA208 Power Supply Unit	No	No	Yes	No	Yes	No	Yes	No
CVM1D-PA208/212 Power Supply Unit	Yes	Yes	No	Yes	No	No	No	No
3G2A5-PS221-E/222 -E/223-E Power Supply Unit	No	No	No	No	No	Yes	No	Yes

## Special I/O Units

A "Yes" indicates that the Unit can be mounted in the Rack.

Unit	CPU Rack	Expansion CPU Rack		Expansion I/O Racks			Remote I/O Slave Racks	
		CVM1D Backplane	CV-series Backplane	CVM1D Backplane	CV-series Backplane	C500 Backplane	SYSMAC BUS/2	SYSMAC BUS
C500-AD□□□ Analog Input Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-DA□□□ Analog Output Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-PID□□	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-TS501/502	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-CT021 High-speed Counter Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-CT041 High-speed Counter Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
C500-CT001/012 High-speed Counter Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-NC□□□ Position Control Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-NC103/121 Position Control Unit	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
C500-NC221/222 Position Control Unit	Yes	Yes	Yes	Yes	Yes	Yes	No	No
C500-CP131 Cam Positioner Unit	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
C500-ASC04 ASCII Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-ASC03 ASCII Unit	No							
C500-FZ001 Fuzzy Logic Unit	Yes	Yes	Yes	Yes	Yes	Yes	No	No
C500-MGC01 Magnetic Card Reader Unit	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
C500-LDP01 Ladder Program I/O Unit	Yes	Yes	Yes	Yes	Yes	Yes	No	No
C500-IDS□□ ID Sensor Unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C500-GDI11/12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

CPU Bus Units and  
Special Units

A "Yes" indicates that the Unit can be mounted in the Rack.

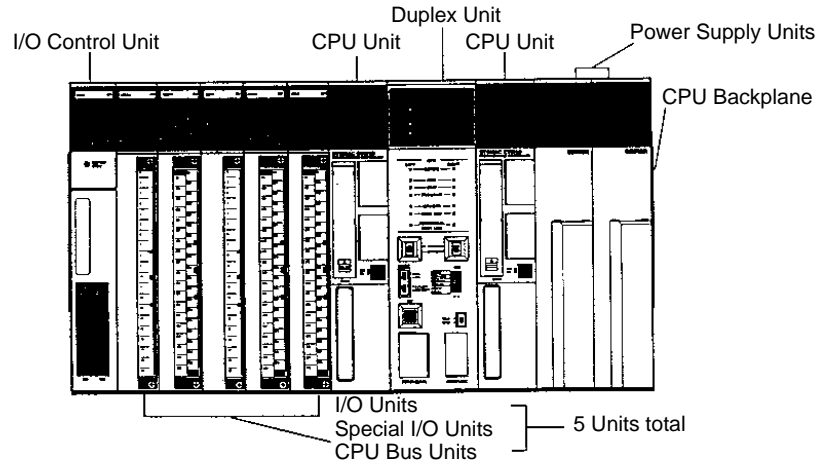
Unit	CPU Rack		Expansion CPU Rack		Expansion I/O Racks			Remote I/O Slave Racks	
			CVM1D Backplane	CV-series Backplane	CVM1D Backplane	CV-series Backplane	C500 Backplane	SYSMAC BUS/2	SYSMAC BUS
CV500-ETN01 Ethernet Unit	4 Units total		Yes		No	No	No	No	No
CV500-SNT31 SYSMAC NET Link Unit	4 Units total		Yes		No	No	No	No	No
CV500-SLK11/21 SYSMAC LINK Unit	4 Units total		Yes		No	No	No	No	No
C1000H-APS01 Power Feeder Unit	Yes	Yes	Yes		No	No	No	No	No
CV500-LK201 Host Link Unit	4 Units total		Yes		No	No	No	No	No
C500-RM□□□ SYSMAC BUS Remote I/O Master	4 Units total		Yes		Yes	Yes	Yes	No	No
CVM1-DRM21-V1 CompoBus/D Master	15 Units with Con- figurator, 1 without		Yes		No	No	No	No	No
CV500-RM211/221 SYSMAC BUS/2 Remote I/O Master	Yes	Yes	Yes		No	No	No	No	No
CV500-RT211/221 SYSMAC BUS/2 Remote I/O Slave	No	No	No		No	Yes	No	No	No
CV500-BSC□1 Basic Unit	Yes	Yes	Yes		No	No	No	No	No
CV500-VP□□□ Personal Computer Unit	Yes	Yes	Yes		No	No	No	No	No
CV500-TDL21 Temperature Controller Data Link Unit	Yes	Yes	Yes		No	No	No	No	No
CV500-MC221/421 Motion Control Unit	Yes	Yes	Yes		No	No	No	No	No
CV500-CLK21 Controller Link Unit	Yes	Yes	Yes		No	No	No	No	No

## 2-3 Racks

### 2-3-1 CPU Racks

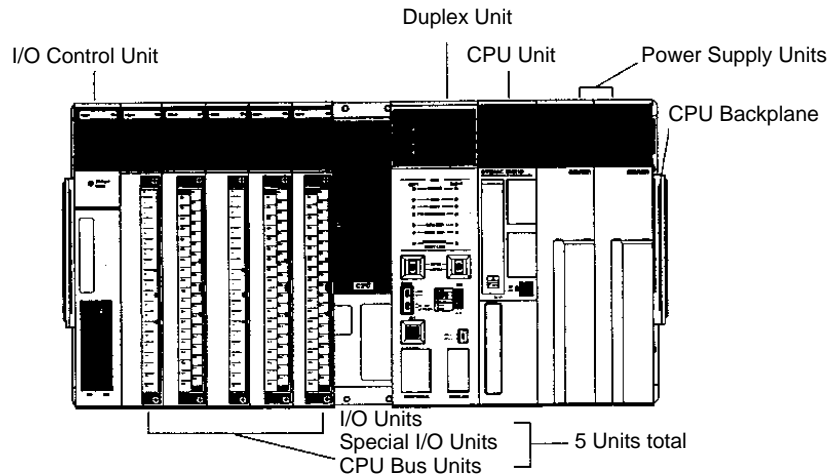
The CPU Rack is made up of the Units shown in the following diagrams.

#### Duplex System Configuration



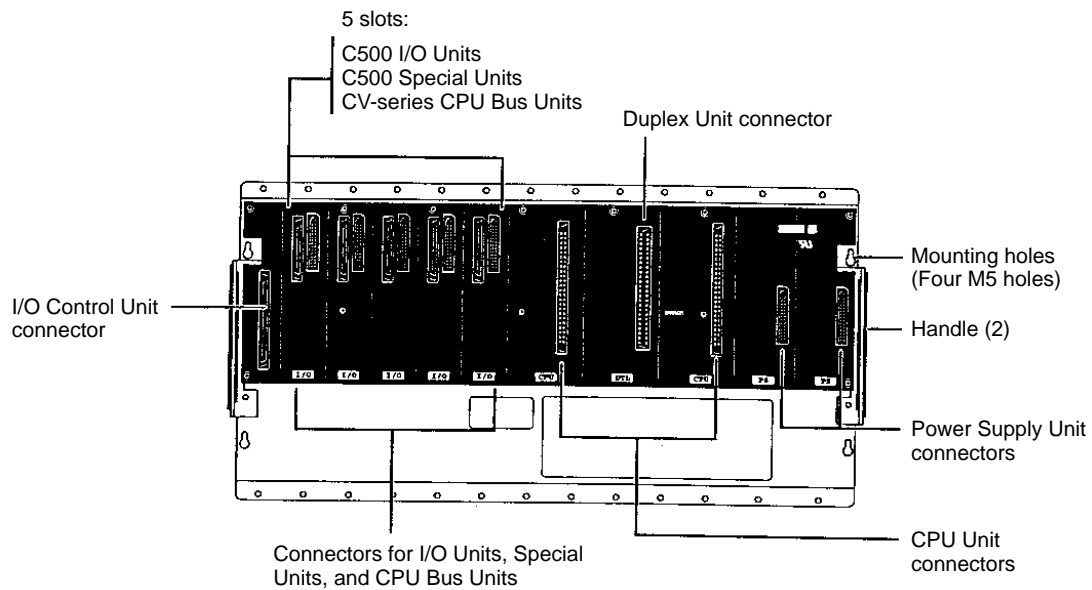
#### Simplex System Configuration

A CVM1D PC can be operated in simplex mode with just one CPU Unit, but a Duplex Unit is still required. The CPU Unit may be mounted in either the left or right slot.



**CPU Backplane**

Use the CVM1D-BC051 CPU Backplane in the CPU Rack. Other CPU Backplanes cannot be used in the CVM1D system.

**Required Units**

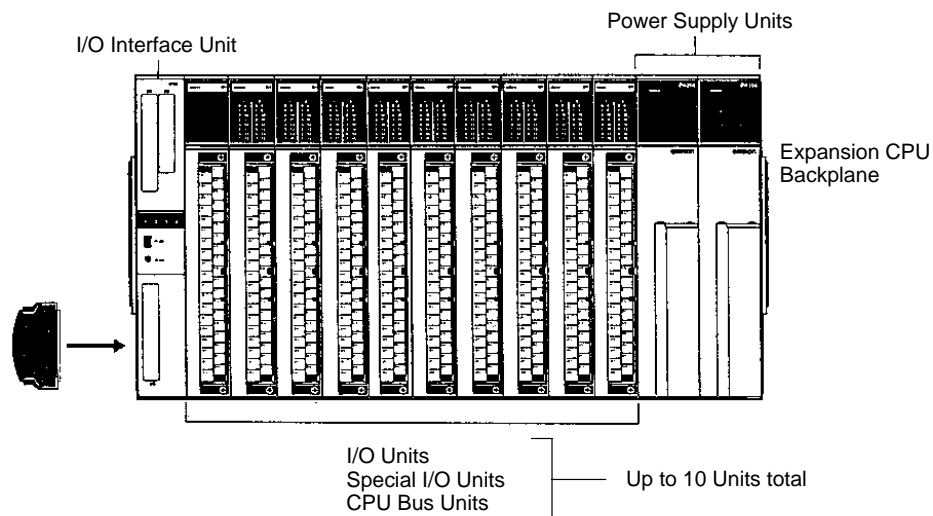
The EM Unit and Memory Card aren't required, but can be installed in the CPU Unit to provide additional memory when necessary.

Unit	Model number	Number of Units	Comments	Page
CPU Backplane	CVM1D-BC051	1	For the CPU Rack only	27
CPU Unit	CVM1D-CPU21	2	---	31
EM Unit	CV1000-DM□51	(2)	Optional.	33
Memory Card	HMC-E□□□1	(2)	Optional.	33
Duplex Unit	CVM1D-DPL01	1	For the CPU Rack only	36
Power Supply Unit	CVM1D-PA208 CVM1D-PA212	2	Use Power Supply Units with the same specifications when two Units are used.	43
CPU Bus Units, Special I/O Units, and I/O Units	---	---	5 Units can be mounted.	---
I/O Control Unit	CV500-IC101	1	Required when connecting an Expansion CPU Rack.	39
	CV500-IC201		Connects to an Expansion I/O Rack.	
	CV500-IC301		Required when connecting a C500 Expansion I/O Rack.	

## 2-3-2 Expansion CPU Racks

An Expansion CPU Rack can be connected when 6 or more CPU Bus Units (up to 15) are required. Like the CPU Rack, a CVM1D Expansion CPU Rack accommodates two Power Supply Units and supports online I/O Unit replacement.

- Just one Expansion CPU Rack can be connected to the CPU Rack and up to 6 Expansion I/O Racks can be connected to the Expansion CPU Rack.
- Use a CV500-IC101 I/O Control Unit in the CPU Rack.
- Two cables are required to connect the Expansion CPU Rack to the CPU Rack, a CPU Bus Cable and an I/O Connecting Cable.
- If no Expansion I/O Racks are being connected, the Expansion CPU Rack is the terminator Rack, so a CV500-TER01 Terminating Resistance Unit must be connected to the I/O Control Unit. Two Terminating Resistance Units are included with each I/O Control Unit.

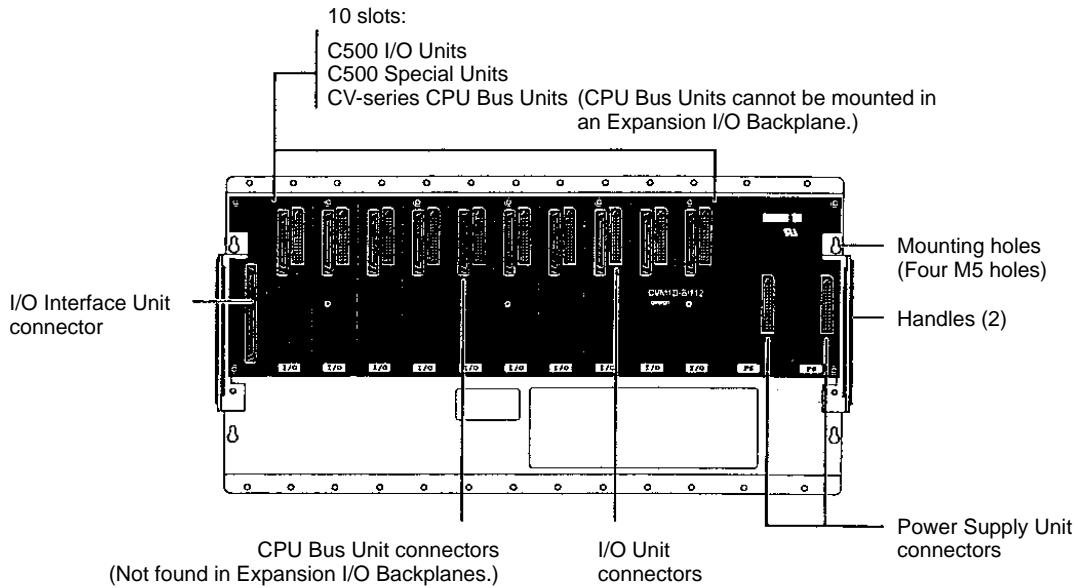


Unit	Model number	Comments
Expansion CPU Backplane	CVM1D-BI101	Accommodates two Power Supply Units and supports online I/O Unit replacement.
Power Supply Unit	CVM1D-PA208 CVM1D-PA212	Use Power Supply Units with the same specifications when two Units are used.
CPU Bus Units, Special I/O Units, and I/O Units	---	A total of 10 Units can be mounted. Refer to <i>2-2 Unit Mounting Limitations</i> for tables showing which Units can be mounted in an Expansion CPU Rack.
I/O Interface Unit	CV500-II101	Also used in CVM1 and CV-series PCs.

There are limitations on the number of Units that can be mounted and the total current consumption of the mounted Units. Refer to *2-2 Unit Mounting Limitations* for details on the limitations on the number of Units and *Appendix B Specifications* for details on current consumption.

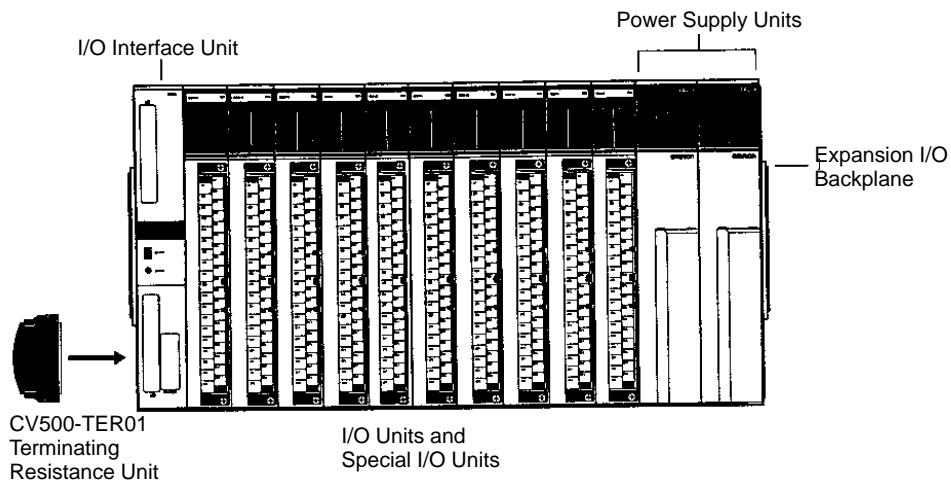
**Note** A CVM1/CV-series Expansion CPU Rack can be used in a CVM1D system, although it will not accommodate two Power Supply Units or support online I/O Unit replacement. Refer to the *CV-series PC Installation Guide* for details on the configuration of CVM1 and CV-series Expansion CPU Racks.

**Expansion CPU Backplane (CVM1D-BI101)**



**2-3-3 Expansion I/O Racks**

CVM1D Expansion I/O Racks accommodate two Power Supply Units and support online I/O Unit replacement.



Unit	Model number	Comments
Expansion I/O Backplane	CVM1D-BI102	Accommodates two Power Supply Units and supports online I/O Unit replacement.
Power Supply Unit	CVM1D-PA208 CVM1D-PA212	Use Power Supply Units with the same specifications when two Units are used.
Special I/O Units and I/O Units	---	A total of 10 Units can be mounted. CPU Bus Units cannot be mounted.
I/O Interface Unit	CV500-II201	Also used in CVM1 and CV-series PCs.

Use the CVM1D-BI102 Expansion I/O Backplane when you want redundant Power Supply Units or want to replace I/O Units online.

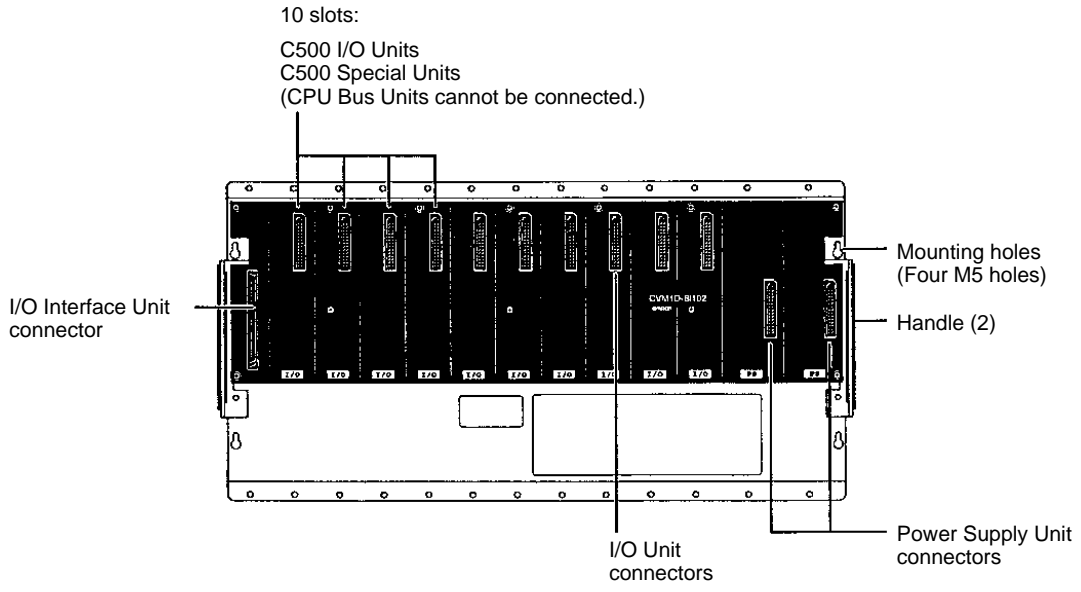
**Using CVM1 and CV-series Expansion I/O Racks**

CVM1 and CV-series Expansion I/O Racks can be connected and combined with CVM1D Expansion I/O Racks, although the CVM1/CV-series Racks will not accommodate two Power Supply Units or support online I/O Unit replacement. Refer to the *CV-series PC Installation Guide* for details on the configuration of CVM1 and CV-series Expansion I/O Racks.

**Using C-series  
Expansion I/O Racks**

C500 Expansion I/O Racks can be connected, but cannot be combined with CVM1D, CVM1, or CV-series Expansion I/O Racks. The C-series Racks will not accommodate two Power Supply Units or support online I/O Unit replacement. Refer to the *C1000H/C2000H PC Installation Guide* for details on the configuration of C500 Expansion I/O Racks.

**Expansion I/O Backplane (CVM1D-BI102)**





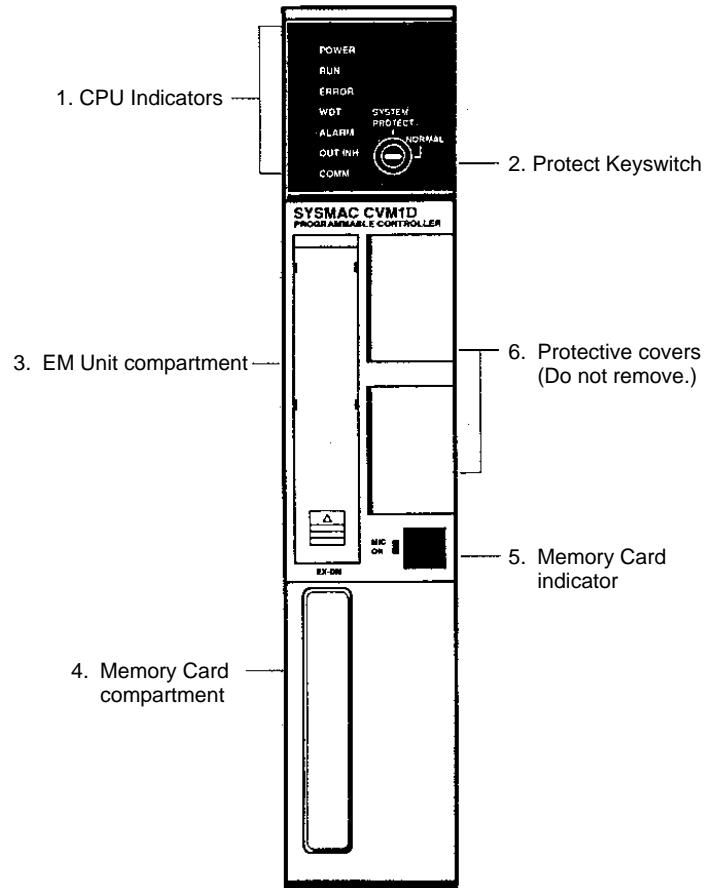
## 2-4 Rack Components

This section describes the main components that are used to construct CPU, Expansion CPU, and Expansion I/O Racks.

**Note** See *Appendix B Specifications* for Unit dimensions and weight.

### 2-4-1 CPU Unit

One or two CVM1D-CPU21 CPU Units must be used in the CPU Rack in CVM1D PCs. Two CPU Units are required for a duplex system. Only one CPU Unit is required for simplex operation.



1, 2, 3... 1. CPU Indicators

POWER	Lights when power (5 VDC) is supplied to the CPU.
RUN	Lights when the CPU Unit is executing the program in RUN or MONITOR mode.
ERROR	Lights when the CPU Unit has detected a fatal error (such as a memory error). When a fatal error is detected, operation will be stopped and all outputs on Output Units will be turned OFF.
WDT	Lights when a watchdog timer error is detected. When the error is detected, operation will be stopped and all outputs on Output Units will be turned OFF.
ALARM	Lights when non-fatal error is detected. CPU Unit operation will continue.
OUTINH	Lights when the Output OFF Bit (A00015) is turned ON. All outputs on Output Units will be turned OFF.
COMM	Lights when data is being exchanged with a host computer.

## 2. Protect Keyswitch

The Protect Keyswitch can be set to write-protect the user program, PC Setup, and CPU Bus Unit settings.

The UM PROTECT operation can also be executed from a Programming Device such as SYSMAC Support Software (SSS) to prevent access (read/write access) to the program. When both protect functions are applied, the Protect Keyswitch setting overrides the UM PROTECT operation.

In duplex mode, the Protect Keyswitch's write-protection is temporarily suspended during duplex synchronization or program transfer. Write-protection is enabled again after the duplex synchronization or program transfer is completed.

## 3. EM Unit Compartment

An EM Unit (sold separately) can be installed in this compartment. See *Expansion Data Memory* on page 33 or more details.

## 4. This compartment contains the Memory Card slot, CPU DIP Switch, Memory Card power switch, and backup battery.

## a) Memory Card slot

When using file memory, insert a Memory Card in the Memory Card slot.

## b) CPU DIP Switch

Pin(s)	Position	Function
1, 2	---	Pins 1 and 2 determine which files will be transferred from the CPU Unit to the Memory Card. (UM is an abbreviation of user program memory.) Start the data transfer by pressing the Memory Card power switch for 3 seconds.
	OFF, OFF	Back up UM, PC Setup, I/O memory, and DM.
	ON, OFF	Back up PC Setup.
	OFF, ON	Back up UM.
	ON, ON	Back up I/O memory and DM.
3	OFF	Not used. (Leave this pin set to OFF.)
4	OFF	Not used. (Leave this pin set to OFF.)
5	OFF	Files are not transferred from the Memory Card automatically at start-up.
	ON	The program file, PC Setup file, and CPU Bus Unit settings file will be transferred from the Memory Card to the CPU Unit automatically at start-up. (In a duplex system, the files are transferred in the active CPU Unit only. The files aren't transferred in the standby CPU Unit. The automatic transfer at start-up setting can be made in the PC Setup as well, but the setting on pin 5 supercedes the PC Setup setting. The files will not be transferred if the Protect Keyswitch is set to PROTECT.)
6	OFF	Not used. (Leave this pin set to OFF.)

## c) Memory Card power switch

Press and release to turn the power to the Memory Card off and on. Press and hold the switch for 3 seconds to start the backup. Refer to *2-4-3 Simplified Backup Function* in the *CVM1D Operation Manual* for more details.

## d) Memory Card eject button

Press to eject the Memory Card. Never eject the Memory Card while the Memory Card ON indicator is lit.

## e) Backup battery compartment

Contains the battery which backs up the CPU Unit's program and data.

5. Memory Card indicator (M/C ON)

The Memory Card indicator will be lit when the power is on. The indicator will go off and on each time that the Memory Card power switch is pressed. Be sure to verify that the indicator is not lit before removing the Memory Card.

6. Protective covers

Do not remove the protective covers.

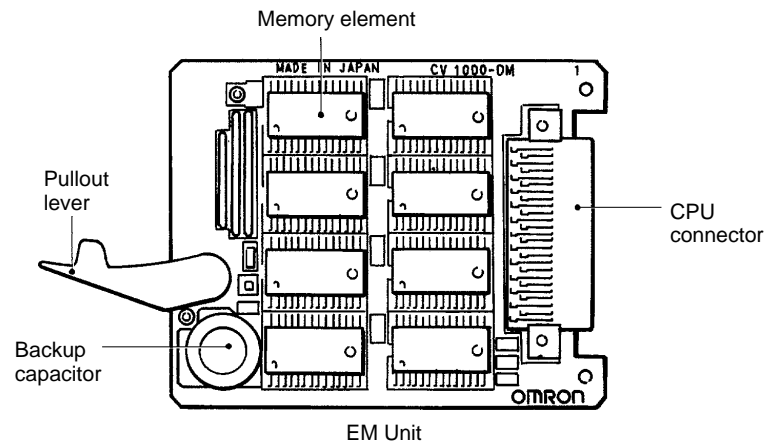
**Expansion Data Memory Units (EM Units)**

An EM Unit may be installed in the CPU Unit when the EM Area is needed to supplement the capacity of the DM Area. The addition of an EM Unit increases the data memory capacity of the CVM1D from 24K words (D00000 to D24575) to up to 256K words. This EM Area memory is divided into 32K-word banks.

When EM Units are used in a duplex system, the same model of EM Unit must be installed in both CPU Units.

EM Units are sold separately, order one of the following EM Units when required.

Model	Memory capacity	EM Area words
CV1000-DM641	64K words	E00000 to E32765 x 2 banks
CV1000-DM151	128K words	E00000 to E32765 x 4 banks
CV1000-DM251	256K words	E00000 to E32765 x 8 banks



When mounted to the CPU, the EM Unit is backed up by the battery mounted in the CPU. When the EM Unit is removed from the CPU Unit, a built-in capacitor will back up the Unit's memory for up to 10 minutes without memory loss. It takes about 1 minute in the CPU Unit for the built-in capacitor to become fully charged.

**Note** See 3-1-2 *Memory Cards* and 3-1-3 *EM Units* for details on installing and removing the EM Unit.

**Memory Cards**

Memory Cards can be used to store data or programs as files to expand the memory storage capacity of the PC. CVM1D PCs cannot use the FILR(180), FILW(181), FILP(182), and FLSP(183) instructions, so Memory Card files cannot be accessed (read or written) from the program.

Files stored in the Memory Card can be read to the CPU automatically at startup. Also, data can be backed up from the CPU to the Memory Card when the power is turned off. These functions are controlled by settings on the CPU DIP Switch. (See page 32 for details on DIP Switch settings.)

When Memory Cards have been installed in the two CPU Units in a duplex system, the files are not transferred or verified between the two Units. Be sure to verify the Memory Card contents when necessary.


Memory	Model	Capacity	Remarks
RAM	HMC-ES641	64K bytes	Data can be written from a Programming Device.
	HMC-ES151	128K bytes	
	HMC-ES251	256K bytes	
	HMC-ES551	512K bytes	
EEPROM	HMC-EE641	64K bytes	Data can be written from a Programming Device when the PC is in PROGRAM mode.
	HMC-EE151	128K bytes	
EPROM	HMC-EP551	512K bytes	CV500-MCW□□ Memory Card Writer or Programming Device required
	HMC-EP161	1M bytes	

The SSS can be used to write data to RAM and EEPROM Cards, but a CV500-MCW□□ Memory Card Writer must be used to write data to EPROM Memory Cards.

The following commercially available memory cards can be used. The procedures and applications for using these memory cards is exactly the same as for the Memory Cards provided by OMRON.

- RAM Memory Cards conforming to JEIDA4.0 and of the following sizes: 64 Kbytes, 128 Kbytes, 256 Kbytes, 512 Kbytes, 1 Mbyte, and 2 Mbytes.

**Note** The 2-Mbyte Memory Cards cannot be used in the CV500-MCW01 Memory Card Writer.

 **Caution** Memory Cards can be damaged by twisting, shock, or exposure to high temperature, humidity, or direct sunlight. Handle them with care.

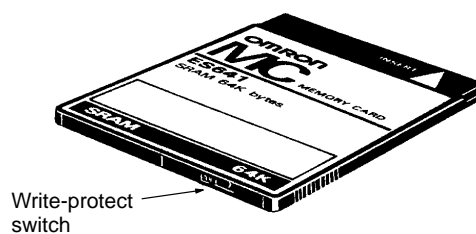
**Simplified Backup Function**

The user program, Extended PC Setup, and IOM/DM data can be backed up from the CPU Unit to a Memory Card very simply without using a Programming Device. The backup data in the Memory Card can be transferred back to the CPU Unit later. Refer to 2-4-3 *Simplified Backup Function* in the *CVM1D Operation Manual* for more details.

**RAM and EEPROM Cards**

Data can be randomly written to and read from RAM or EEPROM Cards, making it possible to easily store programs. Data can be written to RAM Cards while they are mounted in the CPU using the SSS. Refer to the *SSS Operation Manuals* for details.

Both the RAM and EEPROM Memory Cards are equipped with write-protect switches. Setting the write-protect switch to ON prevents data from being written to or erased from the Card. Setting the write-protect switch to OFF allows data to be written to or erased from the Card.



**RAM Card Backup Battery**

Insert a battery into a RAM Memory Card before mounting the Card into the CPU. Leave the battery in its holder. Battery life expectancies at 20°C are given below. Replace the battery within the time listed. Refer to *Section 5 Inspection and Maintenance* for the battery replacement procedure.

Card	Capacity	Life
HMC-ES641	64K bytes	5 years
HMC-ES151	128K bytes	2 years
HMC-ES251	256K bytes	1 year
HMC-ES551	512K bytes	6 months

**Caution** The lithium battery in RAM Cards can burn or explode if it is shorted, crushed, or heated to more than 100°C. Dispose of the Memory Card properly.

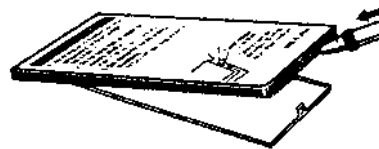
**EPROM Cards**

Data contained in the ROM Card is stored on EPROM chips and cannot be altered or erased during the CPU's operation. The EPROM chip is mounted to the Memory Card and the entire pack is installed in the CPU. Once data is written to the chip, the data will not be lost when the power to the PC is OFF.

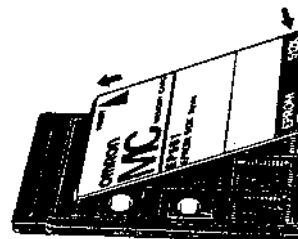
ROM Cards are shipped unprogrammed. The ROM Card can be programmed using a CV500-MCW□□ Memory Card Writer.

The procedure for erasing EPROM Memory Card data is as follows:

- 1, 2, 3... 1. Open the memory card cover by pressing at an angle on the catch at the bottom edge of the card using a pointed object, such as a pen.



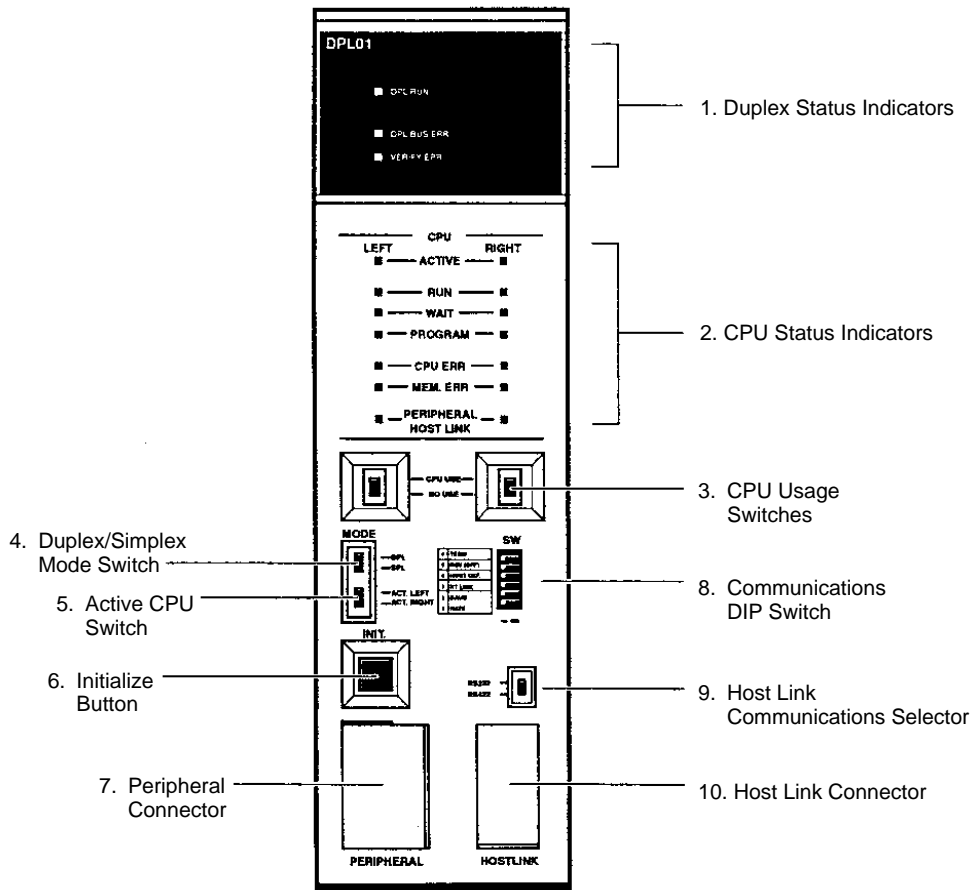
2. Erase the data from the EPROM chips by exposing the window of the EPROM chips to ultraviolet light. Any of a number of commercially available EPROM erasers may be used. To ensure complete erasure, the Memory Card should be subject to a minimum exposure as specified by the eraser manufacturer.
3. Close the cover and slide the catch back into place.



**Note** See 3-1-2 *Memory Cards* and 3-1-3 *EM Units* for details on installing and removing the Memory Card.

### 2-4-2 Duplex Unit

A CVM1D-DPL01 Duplex Unit must be used in the CPU Rack in CVM1D PCs, even if only one CPU Unit is being used for simplex operation.



**1, 2, 3...** 1. Duplex Indicators

DPL RUN	Lights when the active (ACT) and standby (STB) CPU Units are synchronizing and operating normally.
DPL BUS ERR	Lights when the a bus error has occurred in the duplex system. When the error occurs, just the active CPU Unit will operate in simplex mode. If the error has occurred and the power is turned on, the CPU will go into wait status.
VERIFY ERR	Lights when the program memory or added memory (EEPROM or EM Unit capacity) do not match in the left and right CPU Units. When the error occurs, just the active CPU Unit will operate in simplex mode. If the error has occurred and the power is turned on, the CPU will go into wait status.

2. CPU Status Indicators

ACTIVE	The left or right indicator lights when the corresponding CPU Unit is the active CPU Unit (the one controlling the system).
RUN	Lights when the corresponding CPU Unit is operating in RUN or MONITOR mode. Both indicators will light when the PC is operating normally in duplex mode.
WAIT	Lights when the following condition exists in corresponding CPU Unit in duplex mode: <ul style="list-style-type: none"> <li>• Data in UM (program memory), EEPROM, EM Area, or I/O memory is being transferred.</li> <li>• Data in UM , EEPROM, or the EM Area is being compared.</li> <li>• The START INPUT is open or a Remote I/O Slave Rack's power supply is off.</li> <li>• An initialization error (duplex bus error or duplex verification error) has occurred.</li> </ul>
PROGRAM	Lights when the CPU Unit is in PROGRAM mode. Both indicators will light when the PC is in duplex mode.
CPU ERR	Lights when an error has occurred in the CPU Unit. See 6-3 <i>Error Messages and Alarm Outputs</i> for details.
MEM. ERR	Lights when an error has occurred in internal memory, the Memory Card, or the EM Area. See 6-3 <i>Error Messages and Alarm Outputs</i> for details.
PERIPHERAL HOST LINK	Indicates whether the peripheral and host link ports are enabled on the left or right CPU Unit.

3. CPU Usage Switches

These switches control the power supply to the left and right CPU Units.

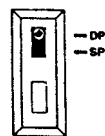


Power will be supplied to a CPU Unit when its CPU Usage Switch is set to "CPU USE." Set the switch to "NO USE" when the CPU Unit isn't being used or the CPU Unit is being replaced with the PC power on.

4. Duplex/Simplex Mode Switch

Set this switch to DPL to operate the PC as a duplex system; set it to SPL to operate the PC as a simplex system.

MODE

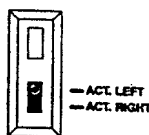


DPL: Set to DPL for duplex operation.  
SPL: Set to SPL for duplex operation.

This switch setting becomes effective when the power is turned on, a CPU Usage Switch is switched from NO USE to CPU USE, or the Initialize Button is pressed. Setting changes during operation are ignored.

5. Active CPU Switch

In a duplex system, this switch determines whether the left or right CPU Unit is the active CPU Unit. Select which CPU Unit is the active CPU when operating the PC in duplex mode.

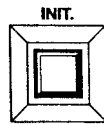


ACT. LEFT: Sets the left CPU Unit as the active CPU Unit.  
ACT. RIGHT: Sets the right CPU Unit as the active CPU Unit.

This switch setting becomes effective when the power is turned on or a CPU Usage Switch is switched from NO USE to CPU USE. Setting changes during operation are ignored.

6. Initialize Button

Initializes changes in duplex system operation. For example, press this button when you want to switch from simplex mode to duplex mode after replacing a CPU Unit in which an error occurred.



7. Peripheral Connector

This connector is used to connect a Programming Device such as a computer running SSS or a Programming Console. The baud rate is set on the Communications DIP Switch. (See below.)

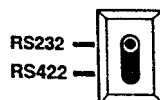
8. Communications DIP Switch

Sets the CPU Unit's communications specifications.

Pin(s)	Position	Function
1, 2	---	Pins 1 and 2 set the baud rate for the peripheral connector.
	OFF, OFF	Programming Device communications: 50,000 bps
	ON, OFF	Programming Device communications: 19,200 bps
	OFF, ON	Programming Device communications: 9,600 bps
	ON, ON	Programming Device communications: 4,800 bps
3	OFF	Communicate via Host Link communications.
	ON	Communicate with PT (Programmable Terminal) via NT Link communications.
4	OFF	Host link communications governed by PC Setup. (Effective only when pin 3 is OFF.)
	ON	Initializes host link communications specifications to the following settings when connecting a personal computer. (Effective only when pin 3 is OFF.) Baud rate: 9,600 bps Unit number 00 Even parity 7-bit data 2 stop bits
5	OFF	Not used. (Leave this pin set to OFF.)
6	---	Sets the terminating resistance for RS-422 communications. (This setting is not used for RS-232 communications. Leave OFF when using RS-232 communications.)
	OFF	Terminating resistance OFF.
	ON	Terminating resistance ON.

9. Host Link Communications Selector

Set the switch to the communications specification desired for the host link connector.



10. Host Link Connector

This connector is used for RS-232 or RS-422 communications. Select RS-232 or RS-422 communications with the host link communications selector (9.). The PERIPHERAL/HOST LINK indicators indicate whether the left or right CPU Unit is connected.

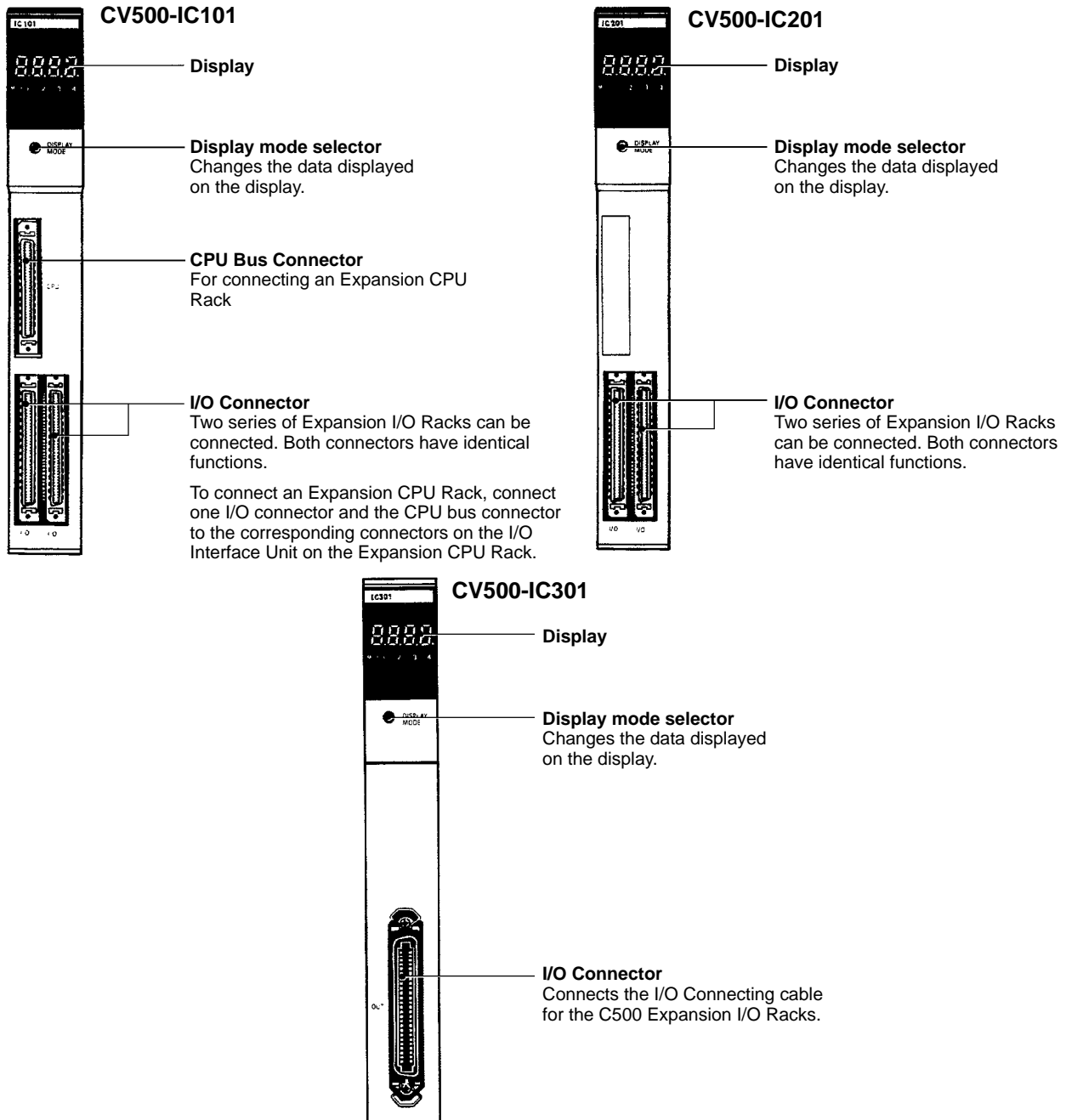


### 2-4-3 I/O Control Units

An I/O Control Unit must be mounted to the leftmost slot of the CPU Rack in order to connect an Expansion CPU Rack or Expansion I/O Rack. The following table shows which Racks can be connected to the three available I/O Control Units.

I/O Control Unit	Connecting Rack
CV500-IC101	Expansion CPU Rack and Expansion I/O Racks
CV500-IC201	Expansion I/O Racks
CV500-IC301 (see note)	C500 Expansion I/O Racks

**Note** For CV500-IC301, use a Unit with a lot number in which the last two digits are 57 or higher (□□57). For the C500-II002, use a Unit with a lot number in which the last two digits are 74 or higher (□□74).



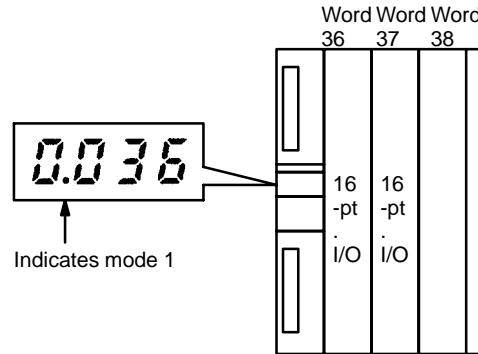
**Note** Refer to *Appendix B Specifications* for the weight and dimensions of each Unit.

**Display Modes**

The following diagrams illustrate the four possible modes. The current mode is indicated by the location of the point on the display.

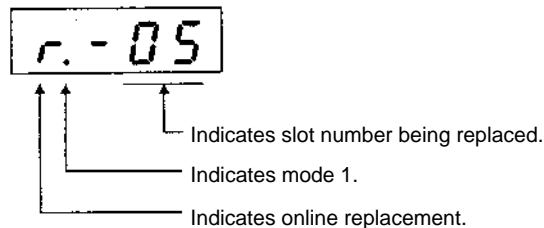
**Mode 1**

Mode 1 normally displays the address of the first word on each Rack. The following example illustrates the mode 1 display for a given Rack. (In this case, the first word allocated is CIO 0036.)



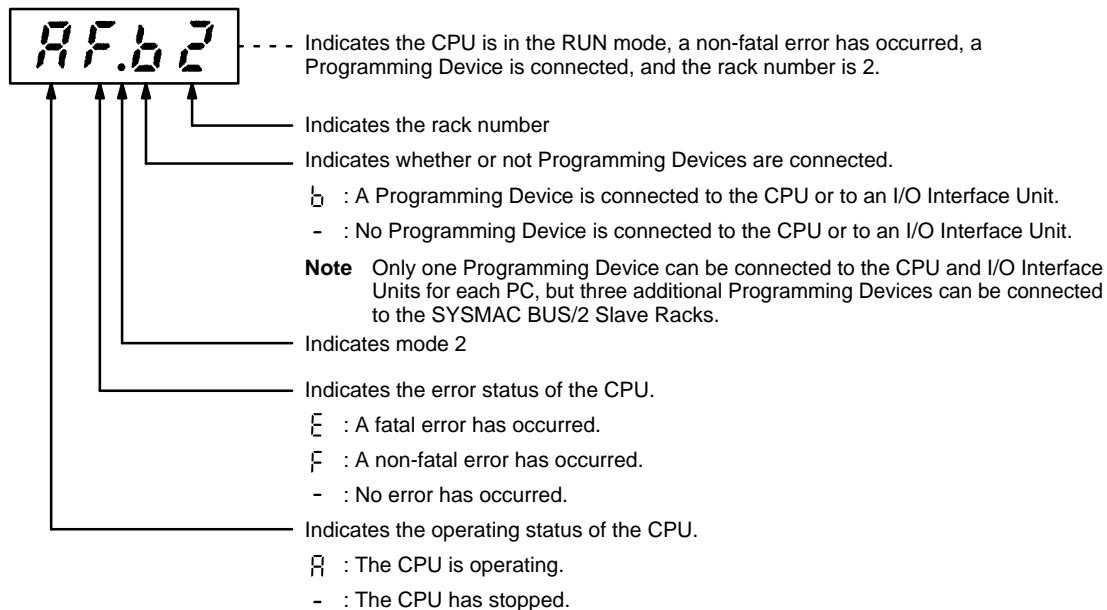
**Note** This display will read "0000" if the I/O table hasn't been registered or an error occurred during I/O table registration.

During online I/O Unit replacement, the slot number of the Unit that can be replaced is displayed. (In this case, the Unit in slot number 5 can be replaced.)



**Mode 2**

Mode 2 indicates the operating status of the CPU as well as the rack number.

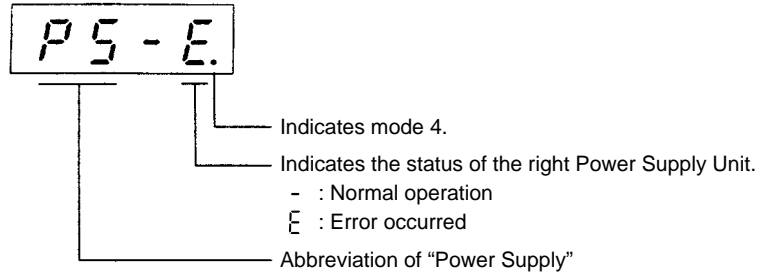


**Mode 3**

In mode 3, data can be output to the display by the I/O DISPLAY instruction (IODP(189)). The binary information can be display in hexadecimal format (0 to F) or as segments of a 7-segment display. For details on the I/O DISPLAY instruction, refer to the *CVM1D Operation Manual*.

**Mode 4**

In mode 4, the display shows the status of the duplex power supplies. When an error has occurred, that information takes priority.



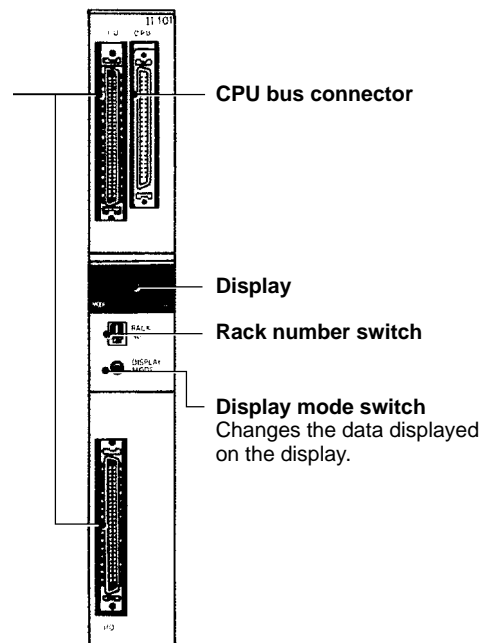
**Note** The status of duplex power supplies is not displayed on SYSMAC BUS/2 Remote I/O Slave Units.

**2-4-4 I/O Interface Units**

One I/O Interface Unit is needed on the Expansion CPU Rack and on each Expansion I/O Rack. Two models of I/O Interface Unit are available, the CV500-II101 for the Expansion CPU Rack and the CV500-II201 for Expansion I/O Racks. The I/O Interface Unit must be mounted to the leftmost slot on the Expansion CPU or Expansion I/O Backplane.

**CV500-II101**

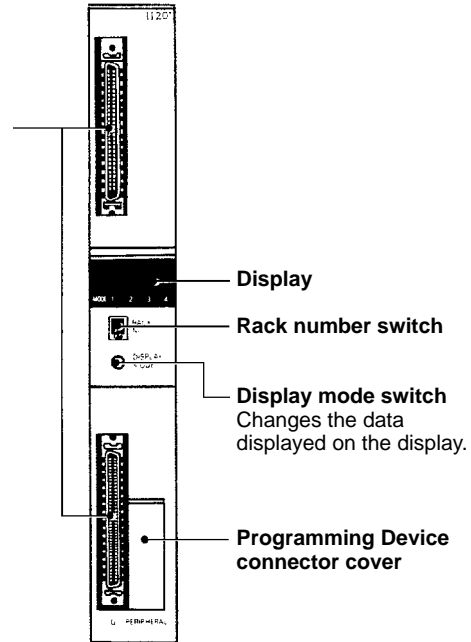
**I/O connectors**  
The connectors are functionally identical and either can be used to connect to the preceding or succeeding Rack.



CV500-II201

**I/O Connectors**

Both connectors are functionally identical and either can be used to connect to the preceding or succeeding Rack.



Attach a Terminating Resistance Unit to the unused I/O Connecting Cable Connector of the last Rack in a each series leading from the CPU Rack.

**Rack Number Switch**

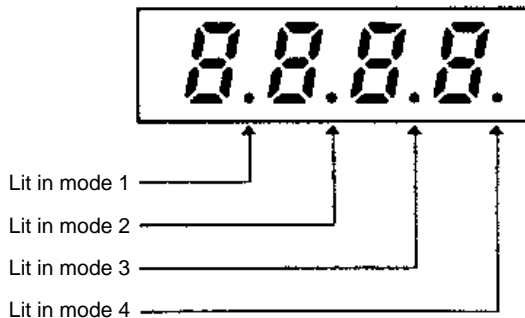
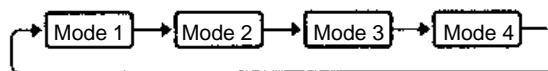
Each Expansion I/O and Expansion CPU Rack is assigned a rack number from 1 through 7. Set the rack number on the rack number switch. Words are allocated to Racks in order according to rack numbers, starting from the CPU Rack, which is always rack number 0.

Set the rack number switch using a standard screwdriver. If a number other than 1 through 7 is assigned, or the same rack number is set to more than one Rack, the PC will not operate

**Note** Turn OFF the power to the PC before setting the rack number switches.

**Display**

The display on the I/O Interface Unit is identical to that on the I/O Control Unit on the CPU Rack. For details on the data displayed in each mode, refer to 2-4-3 I/O Control Units.



**Programming Device Connector**

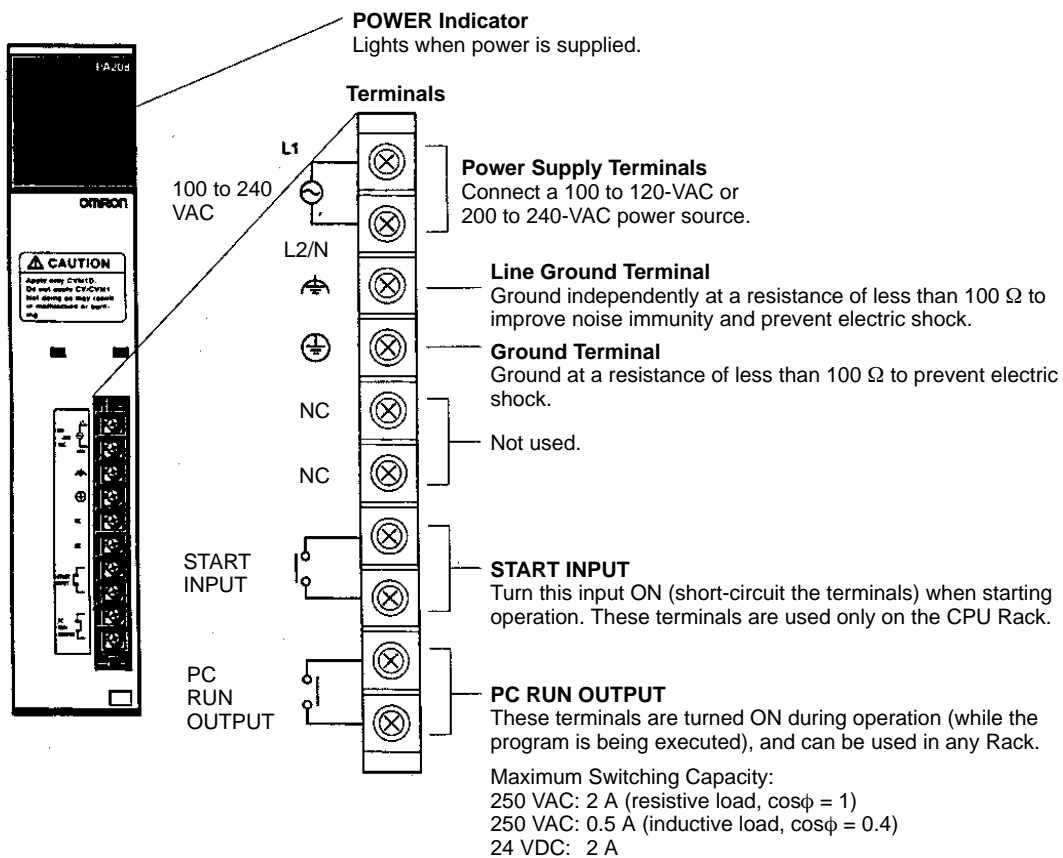
The CV500-II201 I/O Interface Unit for Expansion I/O Racks provides a connector for connecting a Programming Device. One Programming Device (SSS or Programming Console) can be connected to the CPU or an I/O Interface Unit for each PC, although additional Programming Devices can be connected to Slave Racks if a SYSMAC BUS/2 System is used. The operation of the Programming Device is the same whether it is mounted to the CPU or an I/O Interface Unit.

**Note** When connecting a Programming Device to the CPU or an I/O Interface Unit, set the baud rate of the CPU to 50k bps with the CPU DIP Switch.

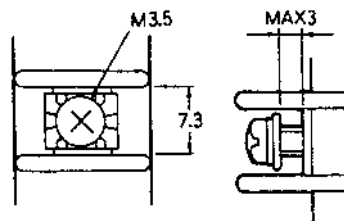
**2-4-5 Power Supply Units**

**Power Supply Units for CVM1D Backplanes**

A CVM1D Power Supply Unit (CVM1D-PA208 or CVM1D-PA212) must be used when Rack is assembled with a CVM1D Backplane. Two of these Power Supply Units can be mounted in a Rack (power supply redundancy) to provide greater reliability. (The same model Power Supply Unit must be used for both Units.)



The following diagram shows the dimensions of the Power Supply Unit's terminals.



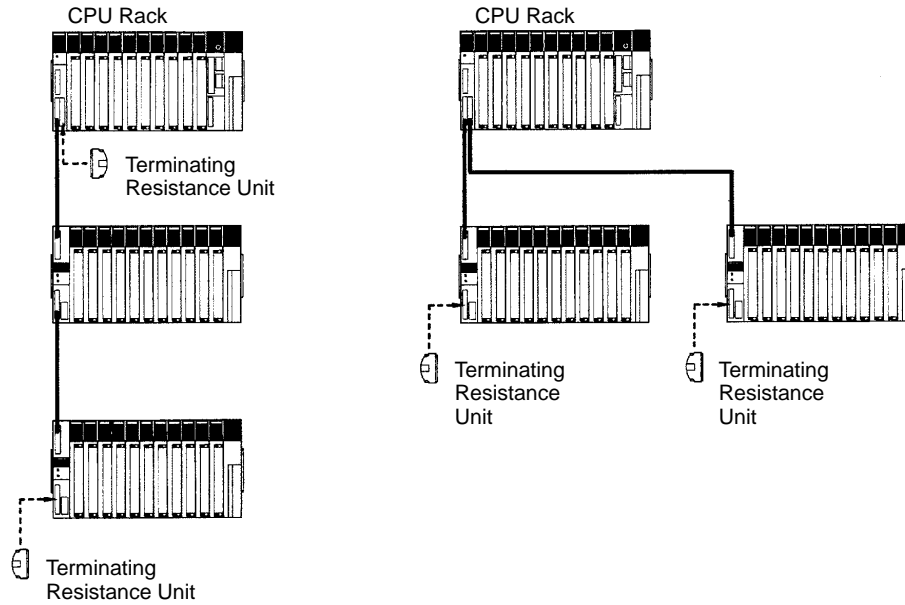
**Note** See Appendix B Specifications for Unit dimensions and weight.

**Power Supply Units for Other Backplanes**

The CVM1D-PA208 and CVM1D-PA212 cannot be used in C500, CVM1, or CV-series Backplanes. See 2-2 *Unit Mounting Limitations* for a table showing which Power Supply Units can be mounted in these Racks.

**2-4-6 Terminating Resistance Units**

A Terminating Resistance Unit (CV500-TER01) must be attached to all unused I/O connectors of I/O Control and I/O Interface Units in the system. Failure to attach Terminating Resistance Units to the unused I/O connectors will result in an error and the incorrect operation of the PC. The following example illustrates the locations where Terminating Resistance Units are required. Two Terminating Resistance Units are provided with each CV500-IC101/201 I/O Control Unit.

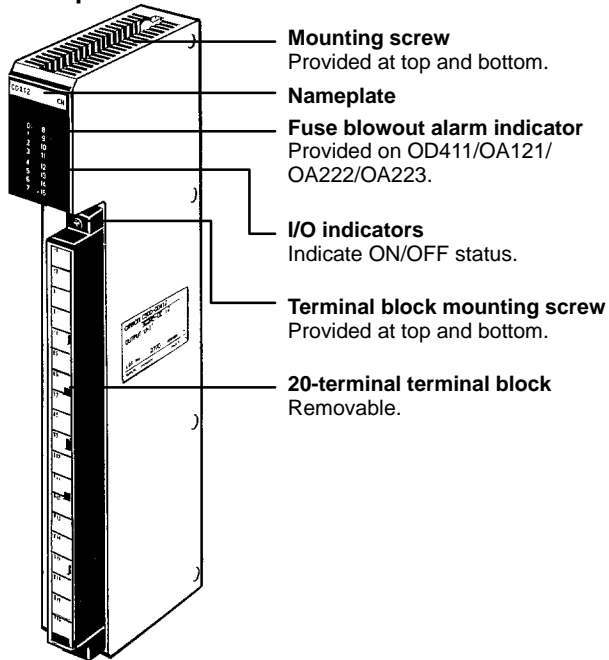


**Note** Attach and remove Terminating Resistance Units only when PC power is OFF.

### 2-4-7 I/O Units

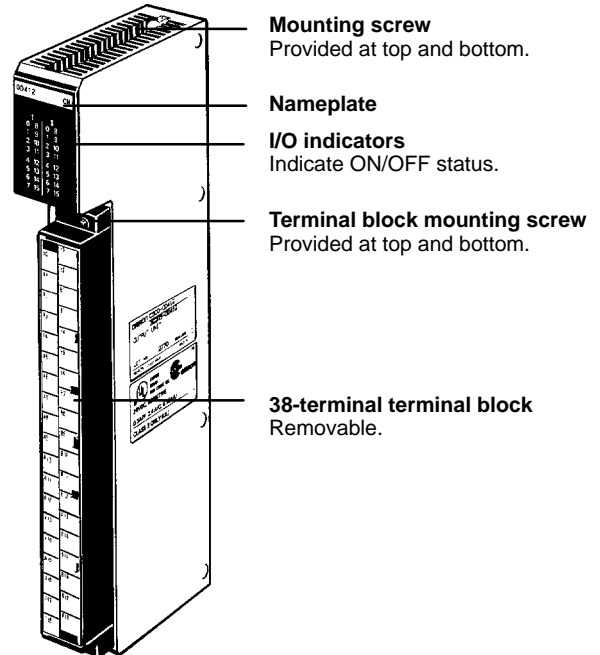
I/O Units come in 5 shapes; A-shape, B-shape, C-shape, D-shape, and E-shape. Refer to *Appendix B Specifications* for the dimensions of each I/O Unit.

#### A-shape



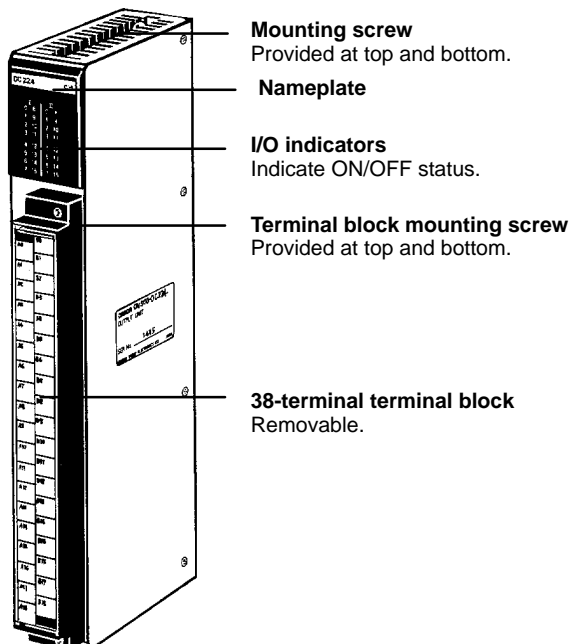
- Mounting screw**  
Provided at top and bottom.
- Nameplate**
- Fuse blowout alarm indicator**  
Provided on OD411/OA121/  
OA222/OA223.
- I/O indicators**  
Indicate ON/OFF status.
- Terminal block mounting screw**  
Provided at top and bottom.
- 20-terminal terminal block**  
Removable.

#### B-shape



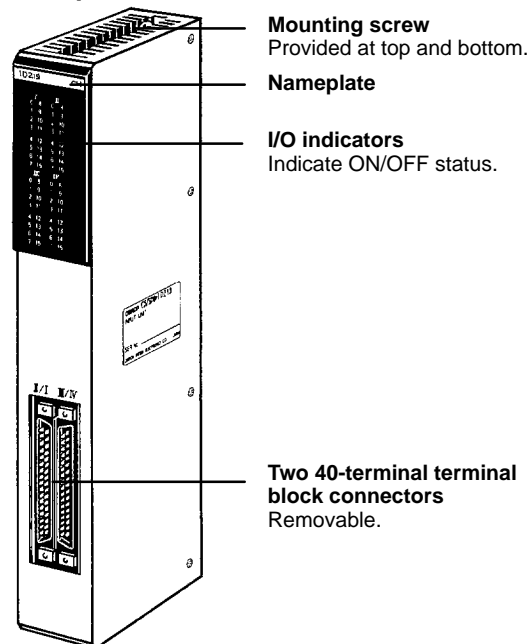
- Mounting screw**  
Provided at top and bottom.
- Nameplate**
- I/O indicators**  
Indicate ON/OFF status.
- Terminal block mounting screw**  
Provided at top and bottom.
- 38-terminal terminal block**  
Removable.

#### C-shape

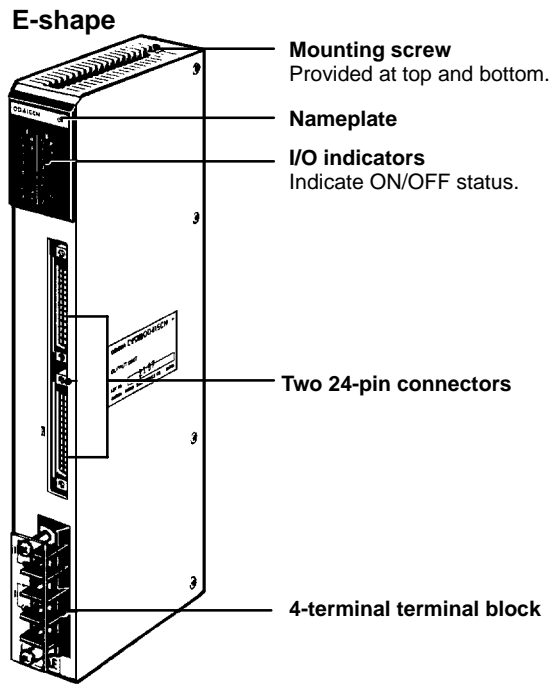


- Mounting screw**  
Provided at top and bottom.
- Nameplate**
- I/O indicators**  
Indicate ON/OFF status.
- Terminal block mounting screw**  
Provided at top and bottom.
- 38-terminal terminal block**  
Removable.

#### D-shape



- Mounting screw**  
Provided at top and bottom.
- Nameplate**
- I/O indicators**  
Indicate ON/OFF status.
- Two 40-terminal terminal block connectors**  
Removable.





# SECTION 3

## Installation

This section describes how to assemble, mount, and wire a PC including the Backplane and the various Units. Technical specifications and dimensions are provided in *Appendix B Specifications*. Refer to *Section 2 System Configuration and Components* for more information on overall system configuration.

3-1	Assembly .....
3-1-1	Extra Memory .....
3-1-2	Memory Cards .....
3-1-3	EM Units .....
3-2	Installation Environment .....
3-3	Installation .....
3-3-1	Racks .....
3-3-2	Control Panel .....
3-3-3	Backplane Installation .....
3-4	Rack Connections .....
3-5	CPU and I/O Connecting Cables .....
3-6	Power Supply Unit Wiring .....
3-6-1	Emergency Stop Circuit .....
3-6-2	Wiring Backplanes to Power Supply Units .....
3-6-3	Expansion CPU Rack Wiring Example .....
3-6-4	Expansion I/O Rack Wiring Examples .....
3-6-5	Power Supply Wiring .....
3-6-6	Grounding .....
3-6-7	Power Interruptions .....
3-6-8	Wiring START Input and RUN Output .....
3-6-9	Using the Noise-preventing Spacers .....
3-6-10	Current Consumption .....
3-7	Wiring I/O Units .....
3-7-1	I/O Unit Wiring Precautions .....
3-7-2	Input Units .....
3-7-3	Output Units .....
3-7-4	Wiring Examples .....
3-7-5	I/O Signal Noise Prevention .....
3-7-6	External Wiring .....
3-8	Compliance with EC Directives .....

## 3-1 Assembly

### 3-1-1 Extra Memory

Extra memory is available in two forms, via the use of Memory Cards or by using an EM Unit. This section outlines the procedure for mounting and removing these optional memory devices.

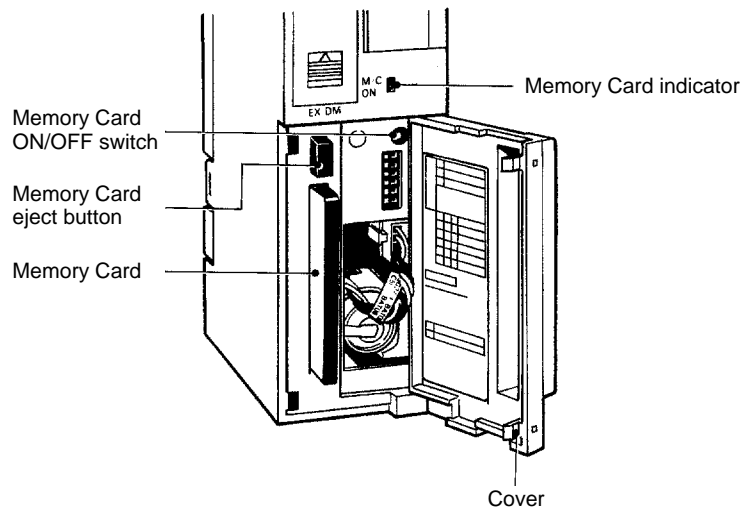
### 3-1-2 Memory Cards

The Memory Card can be used to store data and programs as files. Memory Cards are optional and are not supplied with the CPU Unit. They must be ordered separately and installed by the user

#### Installing a Memory Card

Use the following procedure to install a Memory Card in the CPU Unit.

- 1, 2, 3...
  1. Open the cover of the Memory Card compartment.
  2. If the Memory Card is RAM or EEPROM, set the write-protect switch to OFF so that data can be written to the Card.
  3. Insert the Memory Card into its compartment. In doing so, a slight resistance will be felt as the connector on the Memory Card mates with the connector on the CPU Unit. Continue pushing until the Memory Card is inserted completely into the CPU Unit. If the Memory Card ON/OFF switch is ON, the Memory Card indicator will light.
  4. Close the cover.



#### Removing a Memory Card

- 1, 2, 3...
  1. Open the cover of the Memory Card compartment.
  2. Press the Memory Card ON/OFF switch once if the Memory Card indicator is lit. The Memory Card indicator will turn OFF.
  3. Press the Memory Card eject button. The Memory Card will be released allowing it to be removed.
  4. Pull out the Memory Card.
  5. Close the cover.

- Note**
1. Do not expose the Memory Card to high temperature, humidity, or direct sunlight.
  2. Do not bend the Card or subject it to shock.
  3. Do not apply excess force to the Card when inserting or removing it.
  4. Do not remove the Card while the Memory Card indicator is lit; doing so may result in data errors in the memory.

### 3-1-3 EM Units

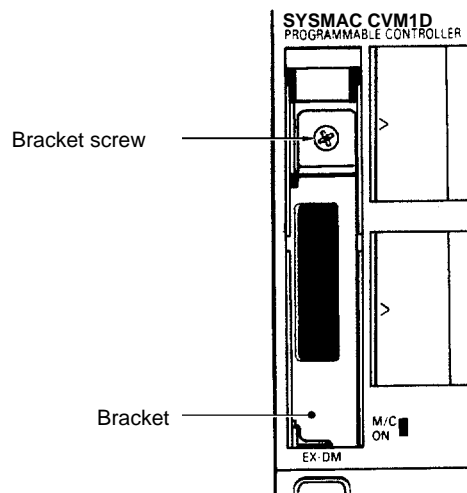
#### Mounting an EM Unit

Mount an EM Unit to the CPU Unit using the following procedure.

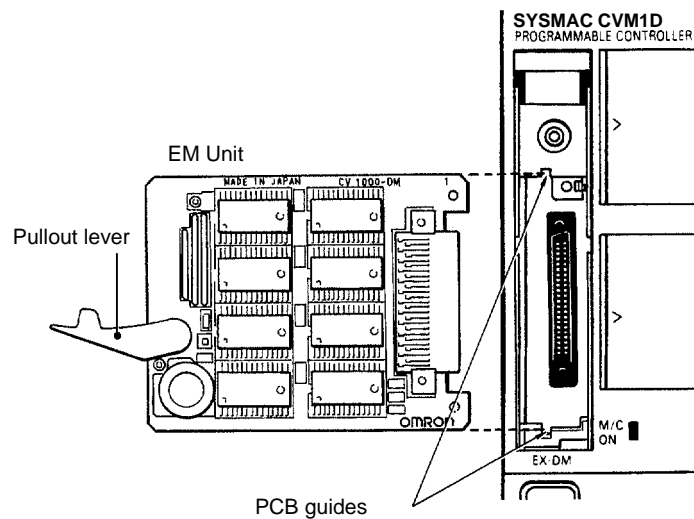
- 1, 2, 3... 1. Turn OFF the power to the PC.

**Caution** Do not attempt to mount or remove the EM Unit while the power to the PC is ON. During mounting or removal, exercise care that you do not directly touch the memory elements or connector pins of the Unit. Hold the Unit by the lever.

2. Remove the EM Unit cover on the front panel of the CPU Unit by pushing the lever on the cover upwards, as indicated by the arrow on the cover.



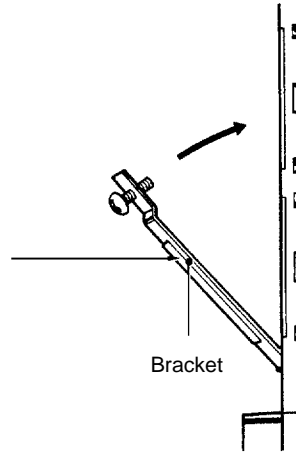
3. Loosen the bracket screw and remove the bracket.



4. Hold the EM Unit with the component side to the right, and insert the Unit into the PCB guides. In doing so, a slight resistance will be felt as the connector on the EM Unit mates with the connector on the CPU Unit. Continue pushing until the EM Unit is inserted completely into the CPU Unit.

5. Re-attach the bracket

Insert the bottom part of the bracket into the groove of the case and then press the bracket into place and tighten the bracket screw.



6. Attach the cover to the compartment.

When the EM Unit is mounted to the CPU Unit, the EM Unit is backed up by the battery in the CPU Unit.

When the Unit has been removed from the CPU Unit, the memory contents will be retained for about 10 minutes by a backup capacitor built-in to the Unit, provided that CPU Unit power was ON and that the Unit was mounted in the CPU Unit for at least 1 minute.

When removing the EM Unit, be sure to turn ON the power to the PC for more than one minute and then turn it OFF. At that time the capacitor will be fully charged allowing it to be backed up for 10 minutes. The retention period will be shorter if EM Unit has been mounted (to the CPU Unit) for less than one minute.

## 3-2 Installation Environment

This section details the necessary environmental conditions for installing the PC.

### Ambient Conditions

Do not install the PC in any of the following locations. Doing so will affect PC life and may affect operating performance.

- Locations subject to temperatures or humidities outside the range specified in the specifications.
- Locations subject to rapid changes in temperature or condensation.
- Locations subject to corrosive or flammable gases.
- Locations subject to excessive dust (especially iron dust) or salts.
- Locations subject to shock or vibration.
- Locations subject to direct sunlight.
- Locations subject to water, oil, or chemicals.

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 or magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supply lines.

### Cooling

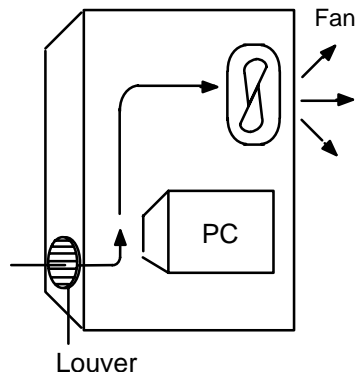
Make sure that sufficient clearance is provided between the Racks and consider installing a cooling fan as measures to prevent the PC from overheating.

### Clearance between Racks

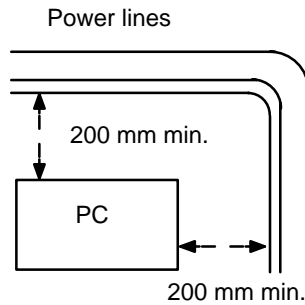
The Racks need to have sufficient room between each other to allow for I/O wiring, and additional room so that the I/O wiring does not prevent adequate cooling. The Racks must also be mounted so that the total length of the Connecting Cable between all Racks in a given series does not exceed 50 m. As a general rule, about 70 to 120 mm should be left between any two Racks. Consider factors such as the width of the wiring duct, wiring length, ventilation, and ease of access to Units, when determining the spacing between Racks. Greater space is required between Racks when using certain CPU Bus Units and Special I/O Units. Refer to the operation manuals for the Units being used for details.

### Cooling Fan

A cooling fan is not always necessary, but may be required in some installation locations. Try to avoid mounting the PC in a warm area or over a source of heat or radiation. A cooling fan is needed if the ambient temperature may exceed 55°C. If the PC is mounted in an enclosure, install a cooling fan, as shown in the following diagram, to maintain the ambient temperature within the range of 0 to 55°C.



Do not mount the PC in a control panel in which high-power equipment is installed and make sure the point of installation is at least 200 mm away from power lines as shown in the following diagram. Ensure the plate to which the PC is mounted is grounded.



When using more than 10 meters of I/O connecting cable, use connecting power lines of at least 2 mm<sup>2</sup> between control panels mounted to Racks.

## 3-3 Installation

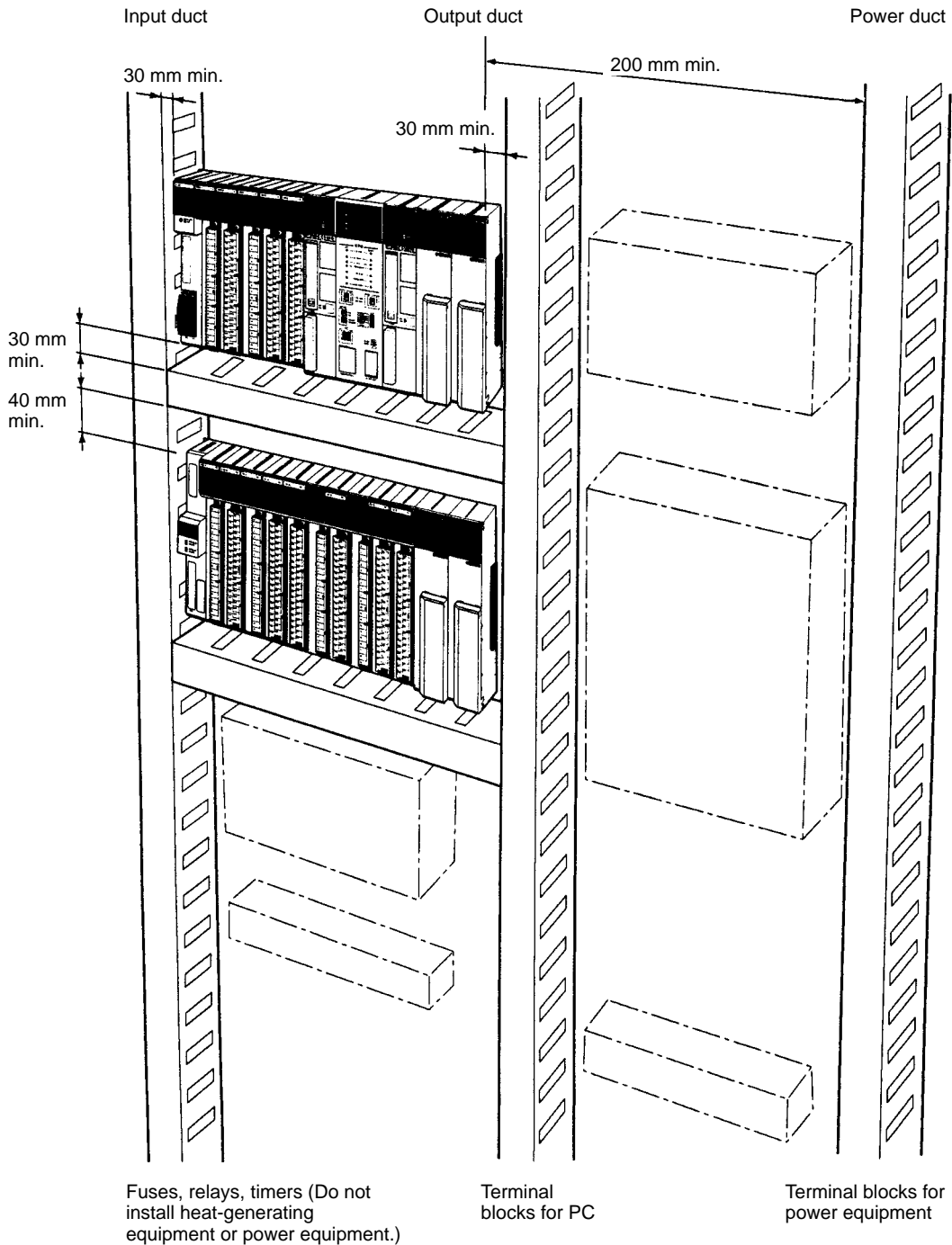
### 3-3-1 Racks

Every Rack must be mounted vertically, that is, with the printing on the front panels oriented as it would normally read. Racks may be directly mounted to any sturdy support meeting the environmental specifications.

Whenever possible, use wiring conduits to hold the I/O wiring. Standard wiring conduit should be used, and it should be long enough to completely contain the I/O wiring and keep it separated from other cables.

The duct work shown in the following diagrams is not used for mounting the Racks. Although optional, this duct work can be used to house the wires from the I/O Units that run along the sides of the Racks, keeping the wires from becoming entangled. The following diagram illustrate the correct way to mount the Racks.

Allow at least 40 mm of clear space at the top of every Rack and 30 mm at the bottom of every Rack.

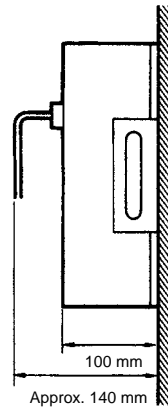


### 3-3-2 Control Panel

When mounting the PC in a control panel, mount the Racks to an intermediate plate. Holes for mounting the Racks to the intermediate plate should be drilled at intervals shown in the following diagram. Completely ground the intermediate mounting plates. Use conductor-plated plates to improve noise immunity.

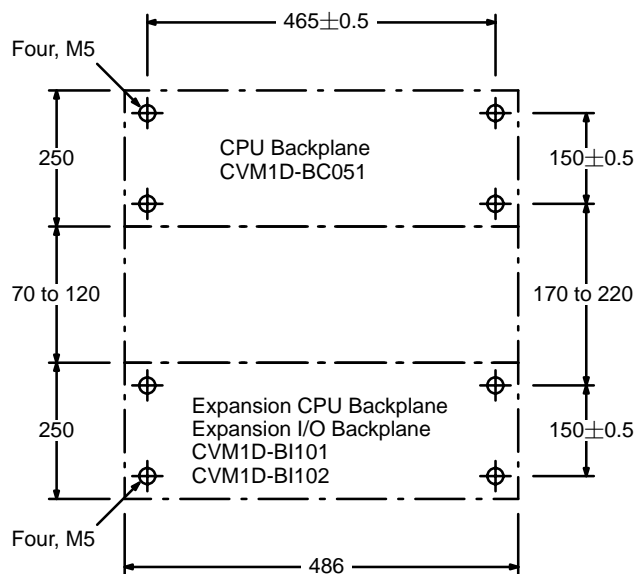
**Mounting Height**

The mounting height of CPU Racks, Expansion I/O Racks, or Slave Racks is 123 mm. If peripheral devices or Connecting Cables are used, however, the additional dimensions must be considered. Allow sufficient clearance in the control panel in which the PC is mounted, as shown in the following diagram.



**3-3-3 Backplane Installation**

**Mounting Dimensions**



Wiring ducts should be situated so as to allow ventilation and easy replacement of Units. Leave a space of at least 40 mm above each Rack and at least 30 mm on all other sides.

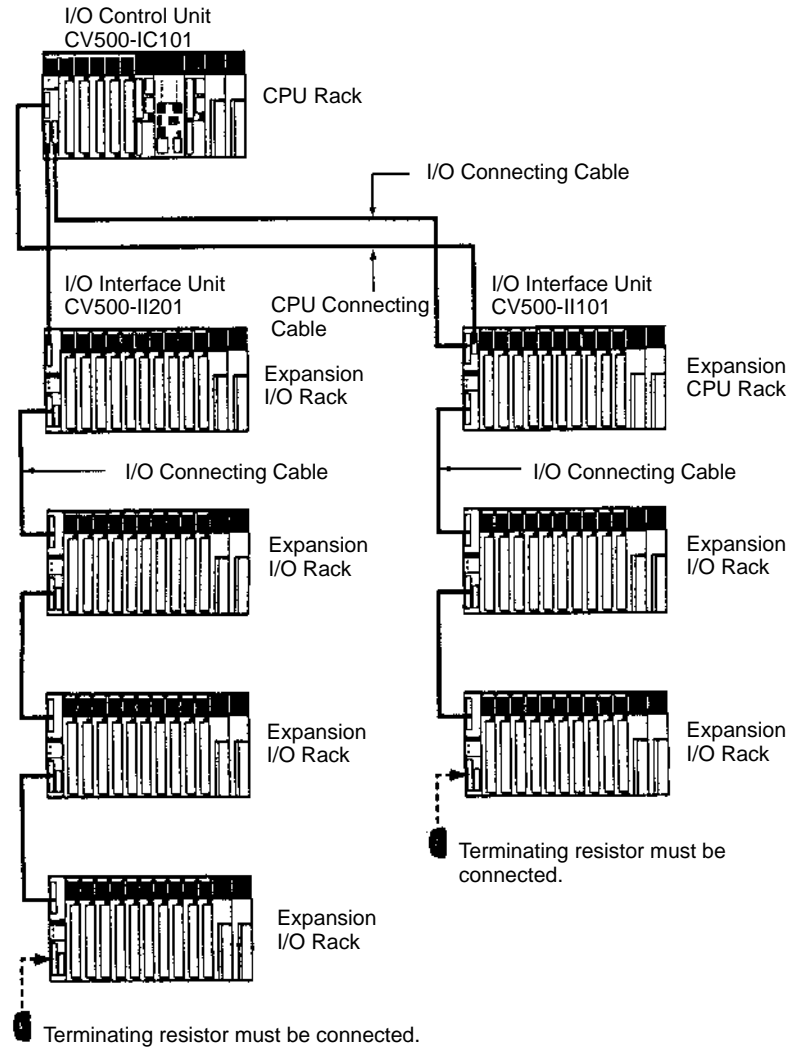
To avoid adverse effects from noise and heat when wiring Racks, be sure to provide at least the spaces shown in the following table between Racks and various other devices (relays and connectors).

In front of each Rack.	100 mm min.
Left and right sides of each Rack.	50 mm min.



### 3-4 Rack Connections

Use the specified cables to connect Racks. A Terminating Resistance Unit must be connected to the I/O Control Unit on the last Rack.

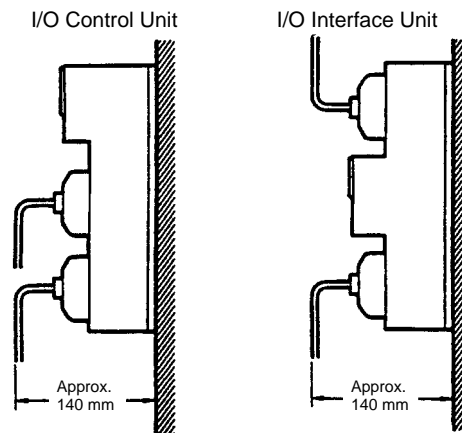


#### Connecting Cables

Rack	Cable	Model (length)
CPU Rack-to-Expansion CPU Rack	CPU Connecting Cable	CV500-CN311 (0.3 m) CV500-CN611 (0.6 m)
CPU Rack-to-Expansion CPU Rack	I/O Connecting Cable	CV500-CN312 (0.3 m) CV500-CN612 (0.6 m) CV500-CN122 (1 m) CV500-CN222 (2 m)
CPU Rack-to-Expansion I/O Rack		CV500-CN322 (3 m) CV500-CN522 (5 m) CV500-CN132 (10 m) CV500-CN232 (20 m)
I/O Rack-to-Expansion I/O Rack		CV500-CN332 (30 m) CV500-CN432 (40 m) CV500-CN532 (50 m)

### 3-5 CPU and I/O Connecting Cables

The dimensions shown in the following diagram are required for the CPU and I/O Connecting Cables when they are connected to the I/O Control Units and I/O Interface Units. Be sure to allow sufficient space for the cables.



The total Connecting Cable length for any one series of Racks must be 50 m or less. Plan installation locations and choose the Connecting Cables accordingly. Do not place CPU or I/O Connecting Cables in the same duct as I/O power or high-voltage lines.

Press in firmly on the connectors and be sure that the connectors on the CPU and I/O Connecting Cables are locked into place on the I/O Control Unit and I/O Interface Units. Bus errors, I/O setting errors, and other errors will occur if the cables are not connected properly.

The connector lock and cable pull strength for the CPU Connecting Cables, I/O Connecting Cables and Programming Device Cables are 5 kg.f.

Always press in on the locks at the top and bottom of the connectors before removing a cable connector.

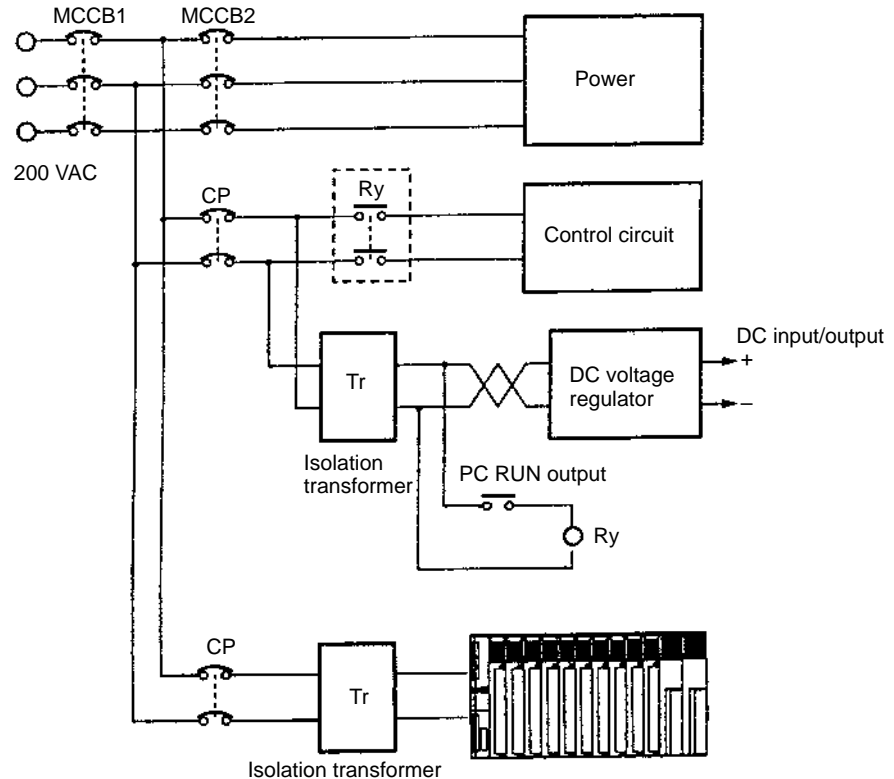
Connect the CV500-TER01 Terminating Resistor Unit to the unused connectors on the last I/O Interface Unit and to any unused connectors on the I/O Control Unit. Two Terminating Resistor Units are provided with the CV500-IC101/IC201 I/O Control Unit.

- Note**
1. The total Connecting Cable length for any one series of Racks must be 50 m or less.
  2. Press in firmly on the connectors until they lock into place.
  3. Always press in on the locks at the top and bottom of the connectors before removing a cable connector.

## 3-6 Power Supply Unit Wiring

### 3-6-1 Emergency Stop Circuit

Be sure to wire power lines, control lines, PC cables, and DC I/O cables separately. Supply power separately when using a second power supply in a duplex system. Use an output terminal (built into Power Supply Unit) for an external relay to form an emergency stop circuit that will turn OFF the system when the PC operation stops, to prevent a malfunction in the PC from affecting the whole system.



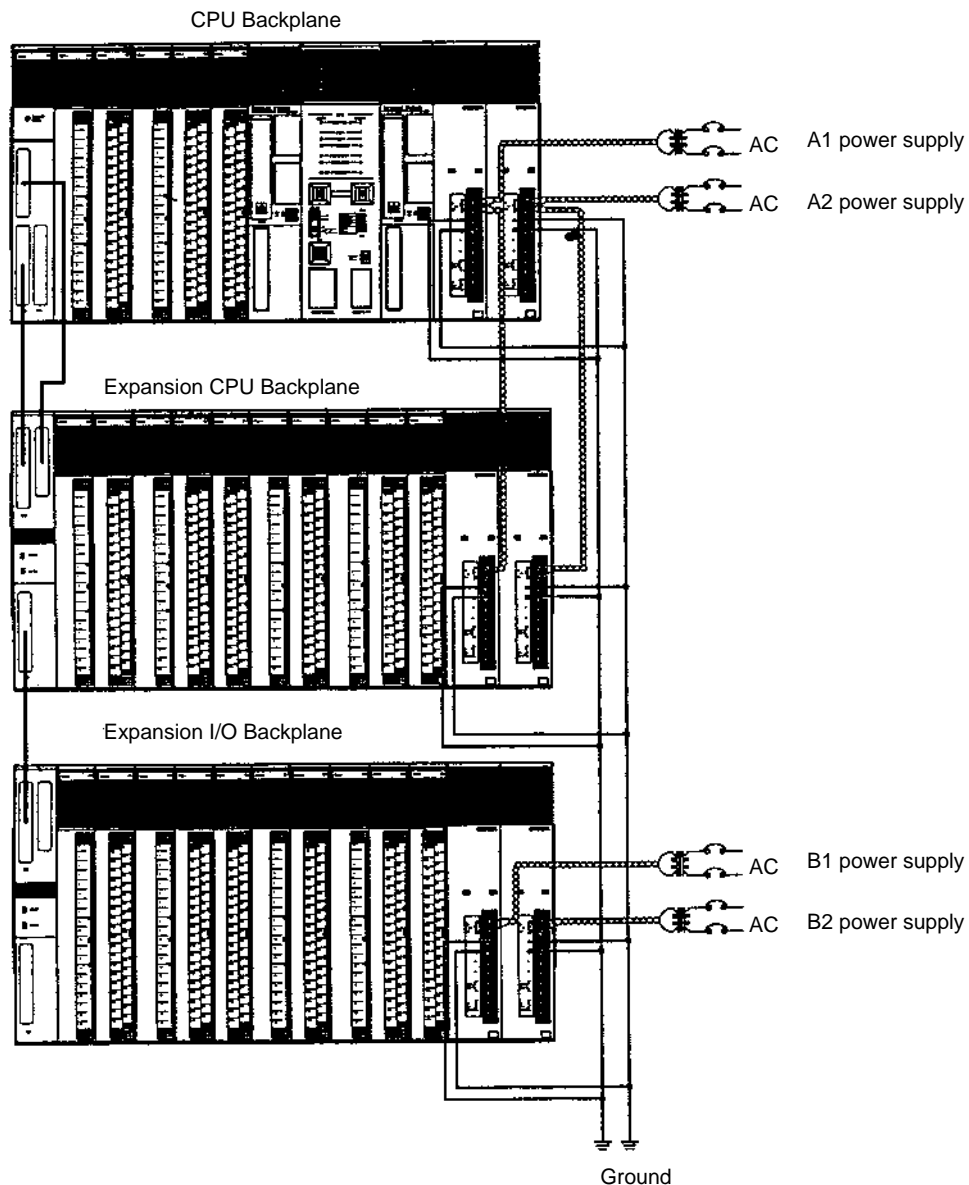
### 3-6-2 Wiring Backplanes to Power Supply Units

The Backplanes of CVM1D CPU Racks, Expansion CPU Racks, and Expansion I/O Racks can be used in a duplex system, and 5-VDC power can be supplied simultaneously to the Units mounted to these Racks from two Power Supply Units. If one of the Power Supply Units malfunctions in a duplex system, power will automatically be supplied to the Units mounted on the Rack from the other Power Supply Unit.

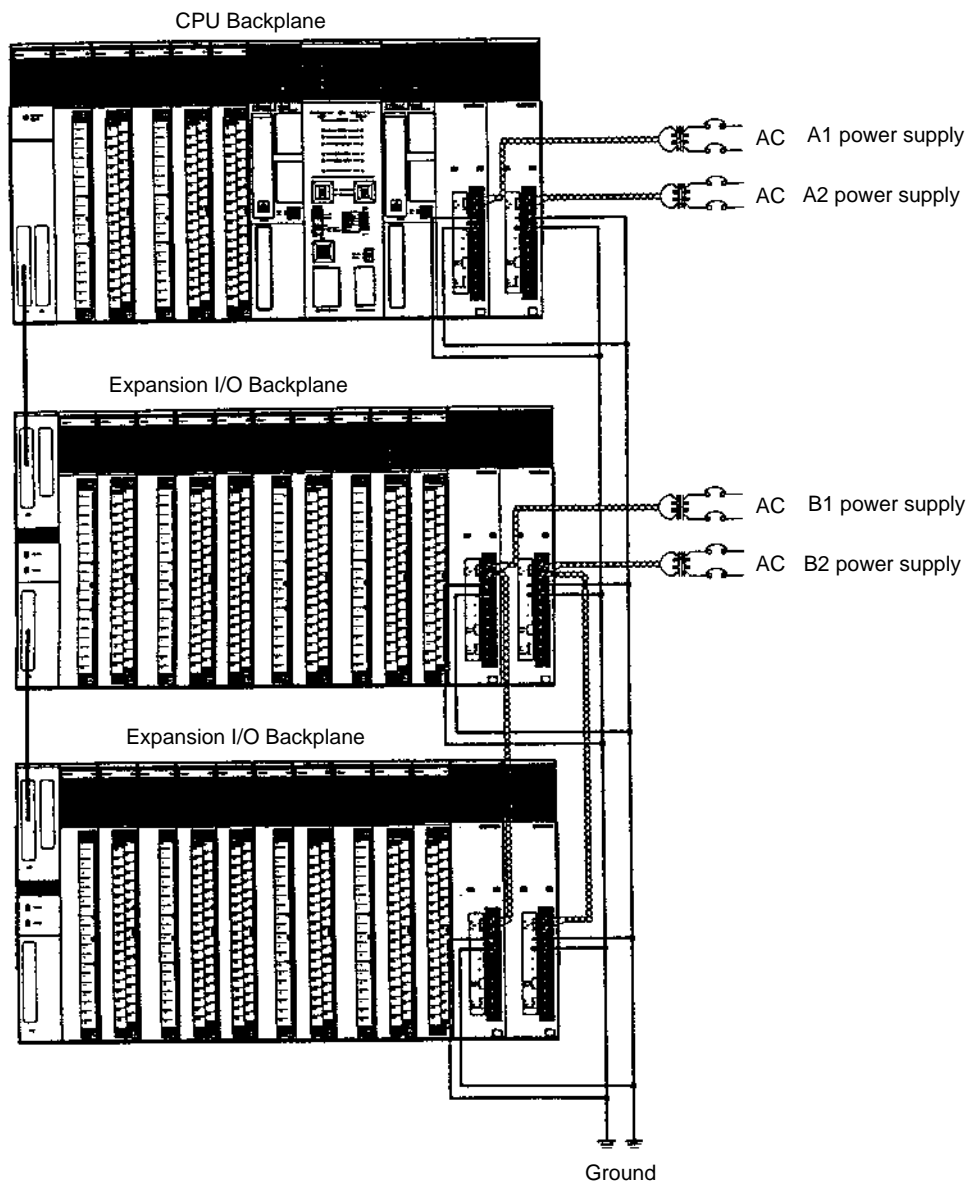
Wire the two Power Supply Units separately, so that the system can continue to operate if there is a power failure in one of the Power Supply Units.

- Wire the power supply for the CPU Rack, the Expansion CPU Rack, and the Expansion I/O Rack separately (indicated by A□ and B□ in the following diagrams).
- Supply two separate power supplies to the two Power Supply Units for the CPU Rack and Expansion CPU Rack (A1 and A2).
- Supply separate power supplies to the two Power Supply Units for each Expansion I/O Rack (B1 and B2).

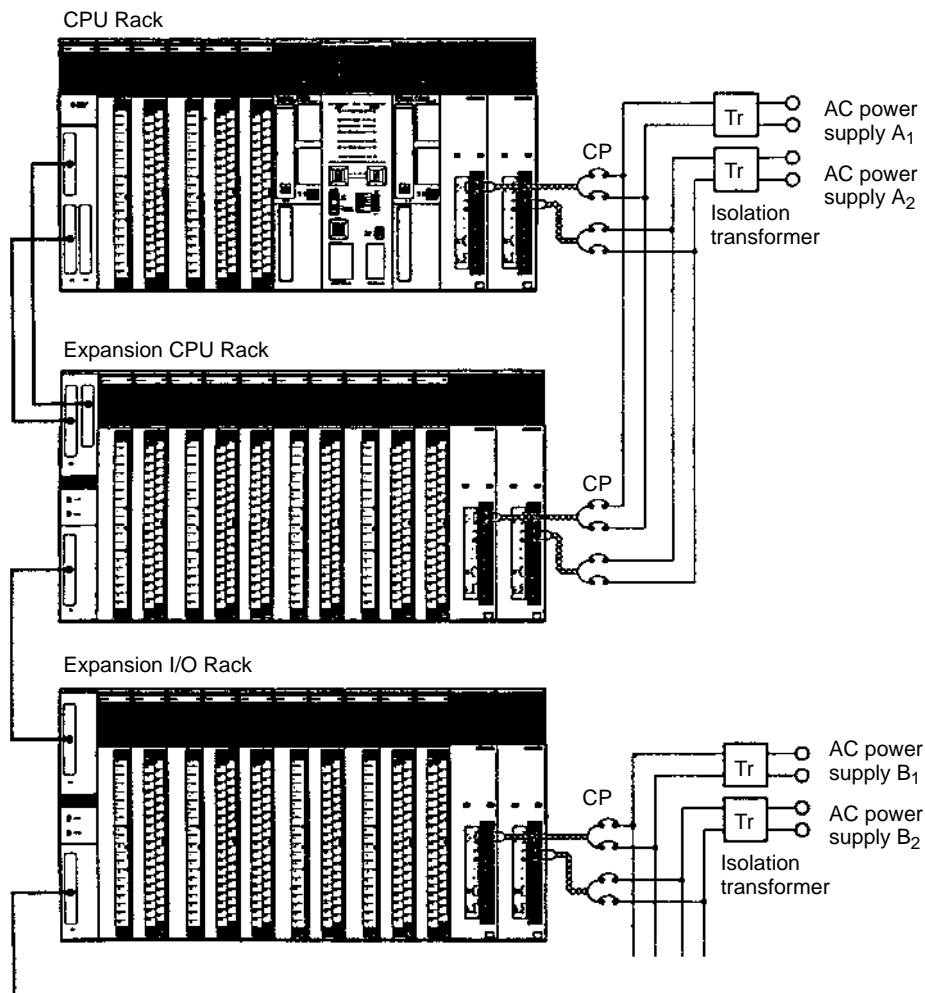
### 3-6-3 Expansion CPU Rack Wiring Example



### 3-6-4 Expansion I/O Rack Wiring Examples



**! WARNING** Wire the Units so that a Power Supply Unit can be replaced safely and easily when the power is ON, and so that power will not be interrupted to other Racks. To prevent danger when branching the wiring to the terminal blocks of the Power Supply Units when a Unit is replaced, use repeater terminals for branching, and provide a circuit-breaker for every Power Supply Unit.



### 3-6-5 Power Supply Wiring

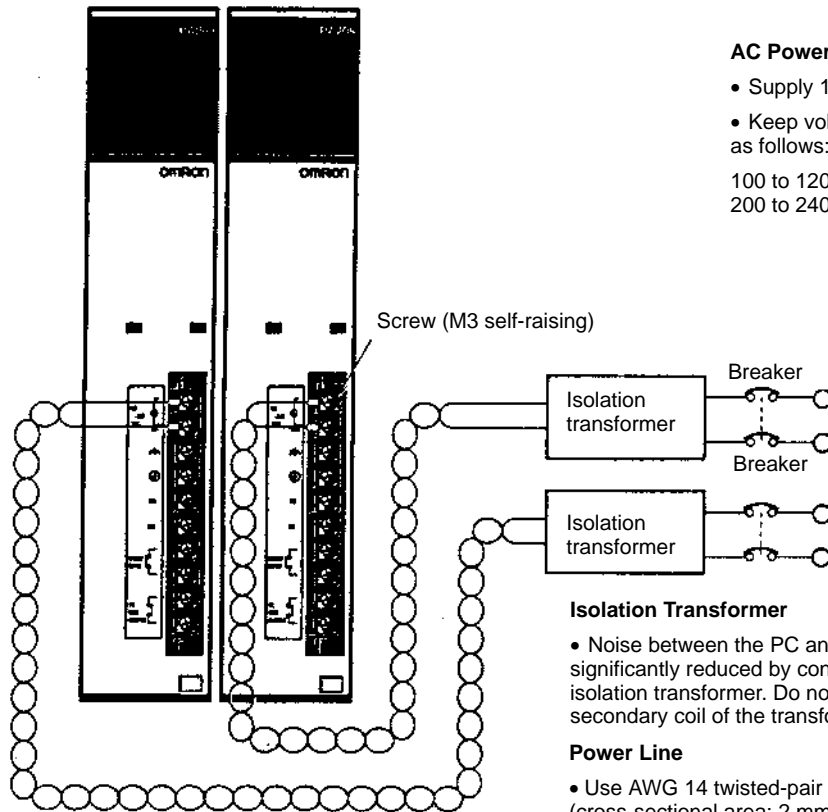
Use a commercially available 100 to 120-VAC or 200 to 240-VAC power source to supply power to the AC Power Supply Unit and a 24-VDC power source for the DC Power Supply Unit. Expansion I/O Racks and Expansion CPU Racks must also be connected to a power source via a Power Supply Unit. If possible, use independent power sources for the Racks, input devices, and output devices.

Supply power to the various parts of the system (power equipment, controls, PC system, and DC I/O, etc.) via separate power supplies.

Always supply power to the CPU Rack and Expansion CPU Rack from the same power source. If power is supplied from separate sources or if power is not supplied to the Expansion CPU Rack, the CPU Unit may not operate.

Turn ON the power to the Expansion I/O Racks before turning ON the power to the CPU Rack.

The following diagrams show the proper way to connect the power supply to the Power Supply Unit. The terminals marked "NC" are not connected internally.



**AC Power Supply**

- Supply 100 to 120 VAC or 200 to 240 VAC.
- Keep voltage fluctuations within the specified range, as follows:
 

100 to 120 VAC:	85 to 132 VAC voltage fluctuation
200 to 240 VAC:	170 to 264 VAC voltage fluctuation

**Isolation Transformer**

- Noise between the PC and ground can be significantly reduced by connecting an isolation transformer. Do not ground the secondary coil of the transformer.

**Power Line**

- Use AWG 14 twisted-pair cable (cross-sectional area: 2 mm<sup>2</sup> min.)

**! WARNING** Wire the Power Supply Unit only to the specified AC voltage. Wiring to the wrong voltage can cause fires.

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

**! WARNING** Tighten the screws on the terminal block for AC power supply to a torque of 0.8 N•m. Loose screws may result in short-circuits, malfunctions, or burning.

**! Caution** Abide by the following precautions when wiring the Power Supply Units. Failure to abide by these precautions may cause malfunctions or damage to the Unit.

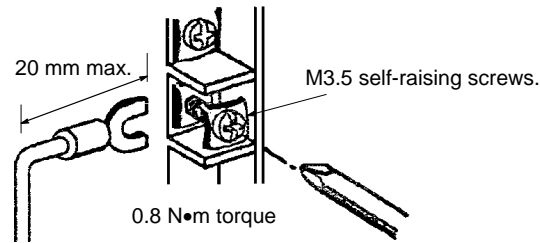
- Be sure that no wire clippings or other foreign materials enter the Units when wiring.
- Provide circuit breakers and other protective devices to protect the system against external short circuits.
- Check and recheck all wiring before supplying power to the system.

**Power Capacity**

A CVM1D PC consumes up to 200 VA per Rack. Power consumption varies with the system configuration (refer to 3-6-10 *Current Consumption*). When power is applied, a surge current five times the steady-state current will flow to the PC.

### Terminals Screws and Crimp Terminals

Connect the lead wires to the terminals as shown below. Tighten the screws to a torque of 0.8 N·m.





Attach solderless type (crimp) terminals to the ends of the lead wires, using terminals having the dimensions shown in the following diagram suitable for M3.5 self-raising screws.



**Note** The power supply terminal block is detachable so be sure to check the terminal block to be sure it is firmly locked in place after wiring the terminals.

**! WARNING** Always attach crimp terminals to the power supply lines to ensure proper connection. Connecting loose wires can cause fires.

### 3-6-6 Grounding

The line ground (LG: ) terminal of the Power Supply Unit is a noise-filtered neutral terminal. Short the line ground terminal to the ground (GR: ) terminal to improve noise resistance.

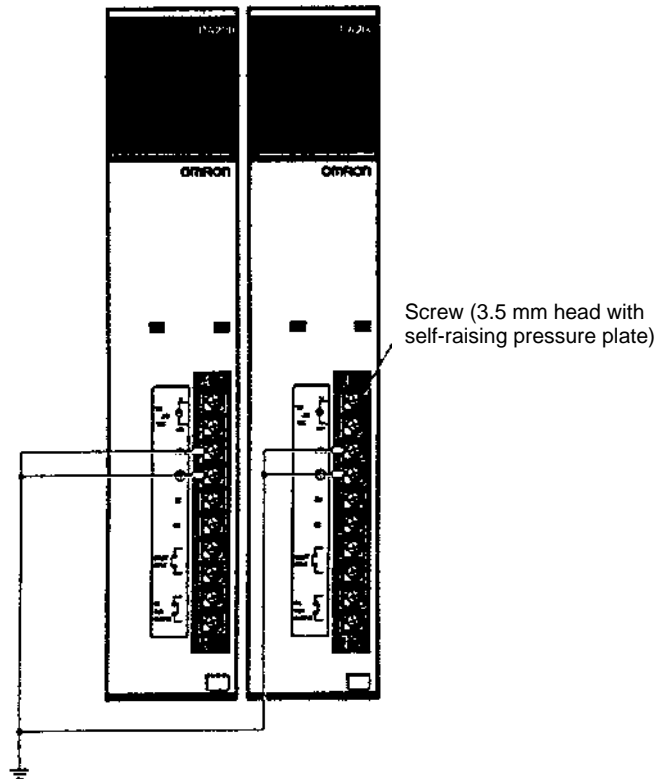
To avoid electrical shock, attach a grounded AWG 14 wire (cross-sectional area of 2 mm<sup>2</sup>) to the ground terminal. The ground resistance must be 100 Ω or less and must be checked periodically to be sure that environmental conditions have not deteriorated ground capacity. Do not use a wire longer than 20 m.

PC operation may be adversely affected if the ground wire is shared with other equipment or if the ground wire is attached to the metal structure of a building.



When using Expansion I/O Racks, the Racks must also be grounded to the ground terminal. The same ground can be used for all Racks.

CVM1D-PA208/212



For grounding use 2 mm<sup>2</sup> cable. Be sure to keep the length of the cable less than 20 meters.

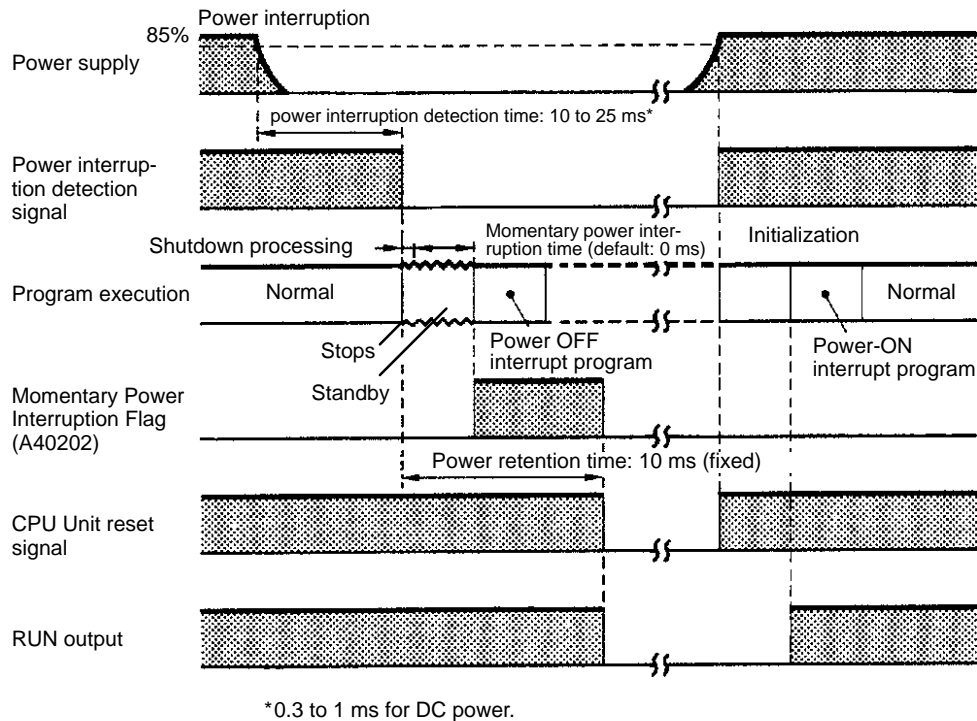
**! WARNING** Always attach crimp terminals to the ground lines to ensure proper connection. Connecting loose wires can cause fires.

**! Caution** Ground the Power Supply Units separately from other devices.

**Note** If you suspect that grounding is the cause of operational errors, isolate the Back-planes of the CPU, Expansion CPU, and Expansion I/O Rack from the control panel before mounting. For methods of isolation, refer to 3-6-9 *Using the Noise-preventing Spacers*.

### 3-6-7 Power Interruptions

A sequence circuit is built into the PC to handle power interruptions. This circuit prevents malfunctions due to momentary power loss or voltage drops. A timing diagram for the operation of this circuit is shown below.



The PC ignores all momentary power interruptions if the interruption lasts no longer than 10 ms. If the interruption lasts between 10 and 25 ms, the interruption may or may not be detected. If the supply voltage drops below 85% of the rated voltage for longer than 25 ms (less for the DC Power Supply Unit), a power interruption detection signal is output and program execution is halted.

If power is not restored within 10 ms (the power retention time) after the power interruption detection signal is output, the PC stops operating and all outputs are turned OFF.

If after power interruption detection, power is restored within a period defined as the momentary power interruption time (default value: 0 ms), the CPU Unit will resume operation. If the momentary power interruption time elapses and power has not been restored, the CPU Unit will begin execution of the power OFF interrupt program if one has been programmed. The CPU Unit stops operating after the lapse of the power retention time (10 ms).

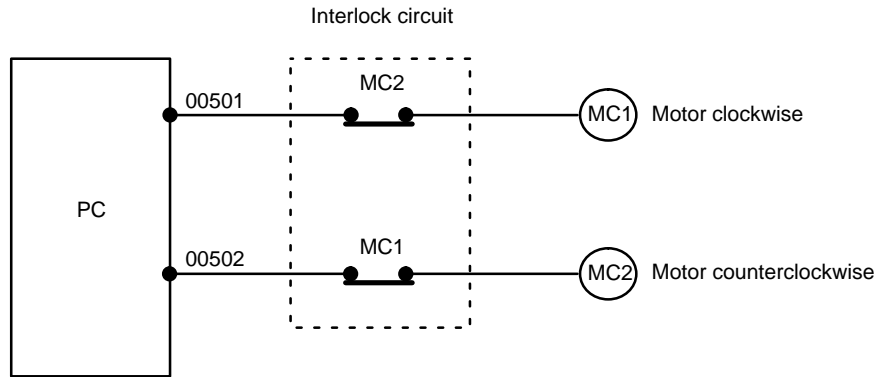
**Note** The momentary power interruption time for CVM1D PCs is fixed to 0 ms.

#### Automatic Recovery

Operation is resumed automatically when the voltage is restored to more than 85% of the rated value.

### Interlock Circuits

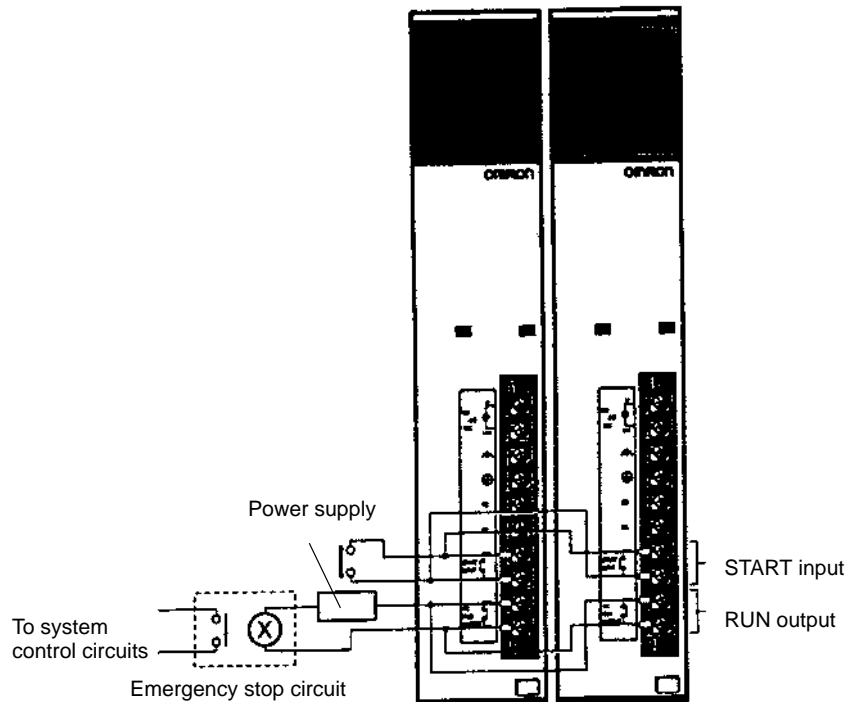
When the PC controls an operation such as the clockwise and counterclockwise operation of a motor, provide an external interlock such as the one shown below to prevent both the forward and reverse outputs from turning ON at the same time.



This circuit prevents outputs MC1 and MC2 from both being ON at the same time. Even if the PC is programmed improperly or malfunctions, the motor is protected.

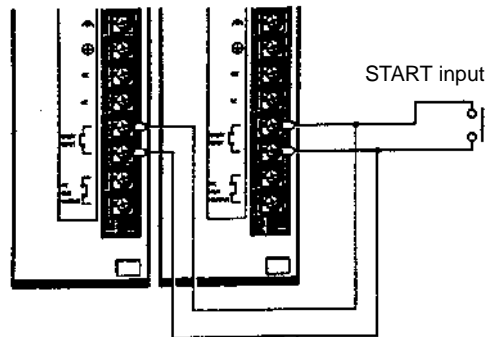
### 3-6-8 Wiring START Input and RUN Output

The Power Supply Units mounted to the CPU Rack provide a START input and a RUN output. These terminals can be used to help control system operation.



**START Input**

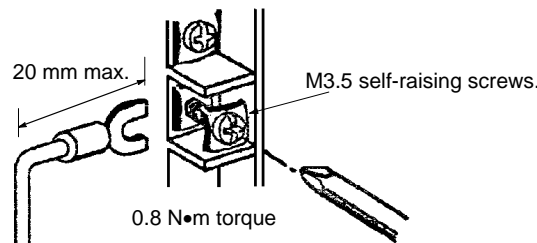
START INPUT wiring (short-circuit) is required for the Power Supply Units on the CPU Rack. When CVM1D operation is started by an external sequence, the contacts must be connected so that the START INPUT terminals turn ON for both Power Supply Units at the same time. If they do not turn ON simultaneously for both Power Supply Units, an error will be generated.



The START INPUT terminals are short-circuited at the factory with a short bar. The short bar can be removed and the terminals wired to a 10-mA, 24-VDC external input to control PC operation. When these terminals are open, PC operation will stop.

**Terminals Screws and Crimp Terminals**

Connect the lead wires to the terminals as shown below. Tighten the screws to a torque of 0.8 N•m max.



Attach solderless type (crimp) terminals to the ends of the lead wires, using terminals having the dimensions shown in the following diagram suitable for M3.5 self-raising screws.



**RUN Output**

The RUN output terminals will be ON (closed) when the PC is operating in RUN or MONITOR mode. These terminals can thus be wired to provide an external signal indicating the operating status of the PC, such as is used in the emergency stop circuit shown in 3-6-1 *Emergency Stop Circuit*.

Maximum switching capacity:  
 250 VAC/2 A (COS  $\phi$  = 1)  
 250 VAC/0.5 A (COS  $\phi$  = 0.4)  
 24 VDC/2A

**⚠ WARNING** Always attach crimp terminals to the wires to ensure proper connection. Connecting loose wires can cause fires.

**⚠ Caution** Abide by the following precautions when wiring the Power Supply Units. Failure to abide by these precautions may cause faulty operation or damage to the Unit.

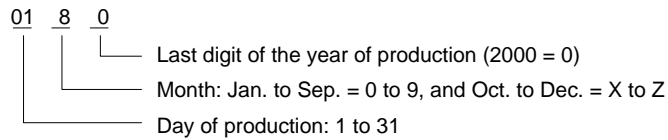
- Be sure that no wire clippings or other foreign materials enter the Units when wiring.
- Check and recheck all wiring before supplying power to the system.

### 3-6-9 Using the Noise-preventing Spacers

When using a SYSMAC CVM1, CV500, CV1000, CV2000, or CVM1D PC near a power device, a operating errors may result due to noise, so be sure to use the Noise-preventing Spacers. By using Noise-preventing Spacers when mounting a CPU Backplane, Expansion CPU Backplane, or Expansion I/O Backplane, you can isolate the Unit from the control panel to prevent external noise.

Noise-preventing Spacers are provided with CV-series Backplanes with the production number 0180 or later (i.e., manufactured 01 August 2000 or later).

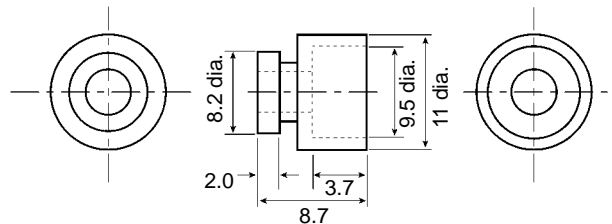
Reading the Production Number



If using a Backplane with a production number of 3170 (manufactured 31 July 2000) or earlier, purchase the Noise-preventing Spacers separately using the following model numbers.

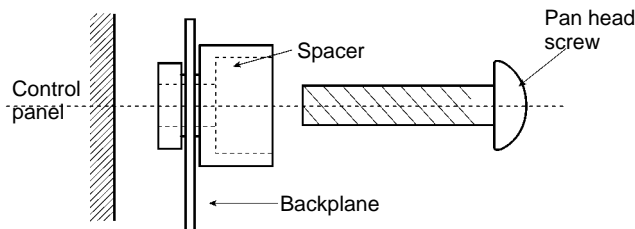
Model	Quantity
CV500-ATT04	50
CV500-ATT05	4

Spacer dimensions



#### Isolating a Backplane

Mount one isolating Spacer each in each of the four mounting holes on the Backplane in the direction shown in the following diagram, and then tighten the screws. The recommended torque is 1.9 N·m.



#### Precautions for Use

- Make sure that the Spacers are mounted in the direction shown above. Mounting in an incorrect direction may result in the device becoming detached.
- When mounting a Backplane using Spacers, the vibration and shock resistance given in the manual can no longer be assured. The mounting height will

also be raised by approximately 2 mm, so make sure that the front panel of the Unit, the connector cables, etc., do not touch any other device.

- In an environment where noise occurs, noise from the power supply cable may also affect the device. Use a noise filter and isolation transformer or similar device to screen the noise.

### 3-6-10 Current Consumption

The Power Supply Units are limited in the total current they can supply to Units on the Racks. Make sure that the total current consumption of all the Units on a Rack does not exceed the maximum available current on the Rack for the Power Supply Unit being used.

#### Available Current from Power Supply Units

##### CPU Racks

The maximum current supplied from the Power Supply Units is as follows:

Power Supply Unit	Available current (5 VDC)
CVM1D-PA208	8 A
CVM1D-PA212	12 A

The current consumption of Units that must be connected to the system is as follows:

Unit	Model	Current consumption (5 VDC)
CPU Backplane	CVM1D-BC051	---
CPU Unit	CVM1D-CPU21	1.2 A max. (See note.)
Duplex Unit	CVM1D-DPL01	1.2 A max.
I/O Control Unit	CV500-IC101	1.3 A max.
	CV500-IC201	1.2 A max.
	CV500-IC301	0.2 A max.

**Note** Two CPU Units are required for duplex system operations, so double the current of one CPU Unit when calculating the current consumption.

##### Expansion CPU Racks

The following power supply and current consumption apply when CVM1D Expansion CPU Racks are used.

The maximum current supplied from the Power Supply Units is as follows:

Power Supply Unit	Available current (5 VDC)
CVM1D-PA208	8 A
CVM1D-PA212	12 A

The current consumption of Units that must be connected to the system is as follows:

Unit	Model	Current consumption (5 VDC)
Expansion CPU Backplane	CVM1D-BI101	---
I/O Interface Unit	CV500-II101	1.3 A max.

The following power supply and current consumption apply when CV-series Expansion CPU Racks are used.

The maximum current supplied from the Power Supply Units is as follows:

Power Supply Unit	Available current (5 VDC)
CVM1-PA208	8 A
CV500-PS221	12 A
CV500-PS211	12 A

The current consumption of Units that must be connected to the system is as follows:

Unit	Model	Current consumption (5 VDC)
Expansion CPU Backplane	CVM1D-BI111	---
I/O Interface Unit	CV500-II101	1.3 A max.

## Expansion I/O Racks

### CVM1D Expansion I/O Racks

The maximum current supplied from the Power Supply Units is as follows:

Power Supply Unit	Available current (5 VDC)
CVM1D-PA208	8 A
CVM1D-PA212	12 A

The current consumption of Units that must be connected to the system is as follows:

Unit	Model	Current consumption (5 VDC)
Expansion I/O Backplane	CVM1D-BI102	---
I/O Interface Unit	CV500-II201	1.2 A max.

### CV-series Expansion I/O Racks

The maximum current supplied from the Power Supply Units is as follows:

Power Supply Unit	Available current (5 VDC)
CVM1D-PA208	8 A
CV500-PS221	12 A
CV500-PS211	12 A

The current consumption of Units that must be connected to the system is as follows:

Unit	Model	Current consumption (5 VDC)
Expansion I/O Backplane	CV500-BI042	---
	CV500-BI062	---
	CV500-BI114	---
I/O Interface Unit	CV500-II201	1.2 A max.

### C500-series Expansion I/O Racks

The maximum current supplied from the Power Supply Units is as follows:

Power Supply Unit	Available current (5 VDC)
C500-PS222	7 A
C500-PS212	7 A

The current consumption of Units that must be connected to the system is as follows:

Unit	Model	Current consumption (5 VDC)
Expansion I/O Backplane	C500-BI081	---
I/O Interface Unit	C500-II002	0.2 A

**Slave Racks**

The current consumption for Units on Slave Racks is the same as for Expansion I/O Racks. Add the current consumption for each Slave Unit in the system.

**Input Units**

Unit	Model	Consumption (A)
DC Input Unit	3G2A5-ID112	0.01
	3G2A5-ID114	0.34
	3G2A5-ID212	0.3
	3G2A5-ID213	0.02
	3G2A5-ID215	0.16
	3G2A5-ID218	0.26
	C500-ID218CN	0.2
	3G2A5-ID219	0.34
Input Unit (8-point)	3G2A5-ID216	0.2
AC Input Unit	3G2A5-IA121	0.18
	3G2A5-IA222	0.18
	C500-IA223	0.18
	3G2A5-IA122	0.18
TTL Input Unit	C500-ID501CN	0.2
AC/DC Input Unit	3G2A5-IM211	0.01
	3G2A5-IM212	0.2

**Output Units**

Unit	Model	Consumption (A)
Contact Output Unit	3G2A5-OC221	0.1
	3G2A5-OC223	0.1
	3G2A5-OC224	0.2
Transistor Output Unit	3G2A5-OD211	0.3
	3G2A5-OD212	0.23
	3G2A5-OD213	0.46
	3G2A5-OD215	0.2
	3G2A5-OD411	0.16
	3G2A5-OD412	0.23
	C500-OD217	0.16
	C500-OD218	0.23
	C500-OD219	0.16
	C500-OD414	0.23
	C500-OD415CN	0.23
Triac Output Unit	C500-OA225	0.2
	C500-OA226	0.45
TTL Output Unit	C500-OD501CN	0.25
DC Input/Transistor Output Unit	C500-MD211CN	0.26
Dummy I/O Unit	3G2A5-DUM01	0.035



## Special I/O Units

Unit	Model	Consumption (A)
Analog Input Unit	3G2A5-AD001 to- AD005	0.3
	3G2A5-AD006/007	0.75
	C500-AD101	0.88
	C500-AD501	1.2
Analog Output Unit	3G2A5-DA001 to -DA005	0.55
	C500-DA101	1.3
	C500-DA501	0.75
High-speed Counter Unit	3G2A5-CT001	0.3
	3G2A5-CT012	0.55
	C500-CT021	0.35
	C500-CT041	1.0
Magnetic Card Reader Unit	3G2A5-MGC01-E	1.0
PID Control Unit	3G2A5-PID01-E	1.4
Temperature Sensor Unit	C500-TS501	1.4
	C500-TS502	1.3
Position Control Unit	C500-NC113	0.75
	C500-NC211	0.75
	3G2A5-NC103-E	Total 1.4
	3G2A5-TU001	
	3G2A5-NC111-EV1	Total 1.0
	3G2A5-TU001	
	3G2A5-NC121-E	Total 1.7
	3G2A5-TU001	
C500-NC222-E	Total 1.3	
3G2A5-TU002		
Cam Positioner Unit	C500-CP131	0.8
Voice Unit	C500-OV001	0.35
ID Sensor Unit	C500-IDS□□	0.4
CRT I/F Unit	C500-GDI11/12	0.6
Ladder Program I/O Unit	C500-LPD01-V1	0.8
ASCII Unit	C500-ASC04	0.27
Fuzzy Logic Unit	C500-FZ001	0.5

## CPU Bus Units and Remote I/O Units

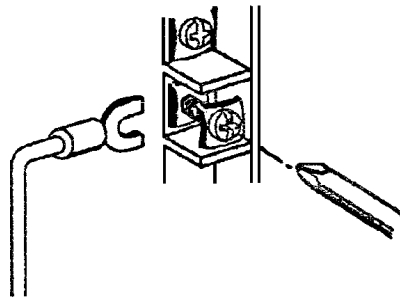
Unit	Model	Consumption (A)
SYSMAC NET Link Unit	CV500-SNT31	0.9
SYSMAC LINK Unit	CV500-SLK11/22	0.5
SYSMAC BUS/2 Remote I/O Master Unit	CV500-RM211/221	0.5
CompoBus/D Master Unit	CVM1-DRM21	0.25
Host Link Unit	CV500-LK201	0.6
Ethernet Unit	CV500-ETN01	1.7
BASIC Unit	CV500-BSC11/21	0.5
	CV500-BSC51/61	
	CV500-BSC31/41	0.3
Personal Computer Unit	CV500-VP□□□-E	2.3
Motion Control Unit	CV500-MC221/421	1.0

Unit	Model	Consumption (A)
Temperature Controller Data Link Unit	CV500-TDL21	0.5
Remote I/O Master Unit	3G2A5-RM001-(P)EV1	0.7
	C500-RM201	0.3
I/O Link Unit	3G2A5-LK010-(P)E	0.6
Controller Link Unit	CV500-CLK21	0.3

## 3-7 Wiring I/O Units

### 3-7-1 I/O Unit Wiring Precautions

Connect the I/O Devices to the I/O Units using AWG 22 lead wire (cross-sectional area: 0.3 mm<sup>2</sup>) for 19-terminal terminal blocks and AWG 22 to 18 lead wire (cross-sectional area: 0.3 to 0.75 mm<sup>2</sup>) for 10-terminal terminal blocks. The terminals have screws with 3.5-mm diameter heads and self-raising pressure plates. Connect the lead wires to the terminals as shown. Tighten the screws to a torque of 0.8 N • m.



Attach solderless type (crimp) terminals to the ends of the lead wires. Use terminals having the dimensions shown in the following diagram.



**⚠ WARNING** Always attach crimp terminals to the wires to ensure proper connection. Connecting loose wires can cause fires.

**⚠ Caution** Abide by the following precautions when wiring the I/O Units. Failure to abide by these precautions may cause faulty operation or damage to the Unit.

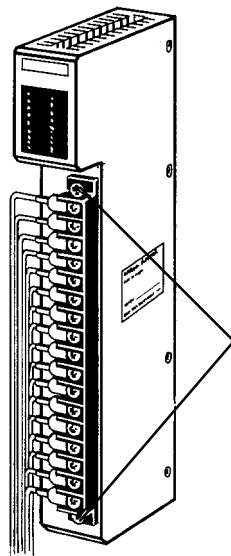
- Be sure that no wire clippings or other foreign materials enter the Units when wiring.
- Recheck all wiring before supplying power to the system.
- Recheck terminal blocks before mounting them to the Unit.

**Note** 1. Putting I/O lines and high-tension lines or power lines in the same duct or conduit may cause the I/O lines to be affected by noise. This may cause a malfunction in the Unit or may damage the Unit or I/O devices.

2. Use reinforced insulation or double insulation on the DC power supply connected to DC I/O Units when complying with EC directives (low voltage).
3. Use separate power supplies for Relay Output Units and DC I/O Units when complying with EC directives (low voltage).

**Terminal Blocks**

The terminal block of an I/O Unit can be removed by loosening the mounting screws. You do not have to remove the lead wires from the terminal block in order to remove the block from an I/O Unit.



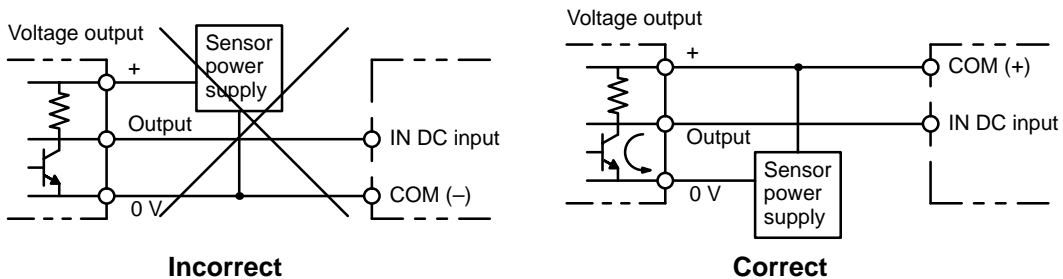
**Terminal block mounting screws**

Loosen the terminal block mounting screws to remove the terminal block from the I/O Unit. Make sure the mounting screws on the terminal block are tightened after wiring is complete and the terminal block is re-mounted to the I/O Unit.

**3-7-2 Input Units**

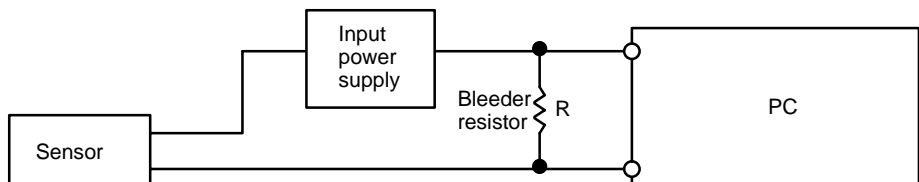
**Voltage Inputs**

Do not wire voltage inputs as shown on the left below.



**Input Leakage Current**

When two-wire sensors, such as photoelectric sensors, proximity sensors or limit switches with indicators are connected to the PC as input devices, the input bit may be turned ON erroneously by leakage current. In order to prevent this, connect a bleeder resistor across the input to reduce the input impedance.



If the leakage current is less than 1.3 mA, there should be no problem. If the leakage current is greater than 1.3 mA, determine the value and rating for the bleeder resistor using the following formulas.

$$I = \text{leakage current in mA}$$

$$R = \frac{7.2}{2.4 \times I - 3} \text{ k}\Omega \text{ max.}$$

$$W = \frac{2.3}{R} \text{ W min.}$$

I = Leakage current in mA  
 R = Bleeder resistance (kΩ)  
 W = Bleeder resistor wattage (W)

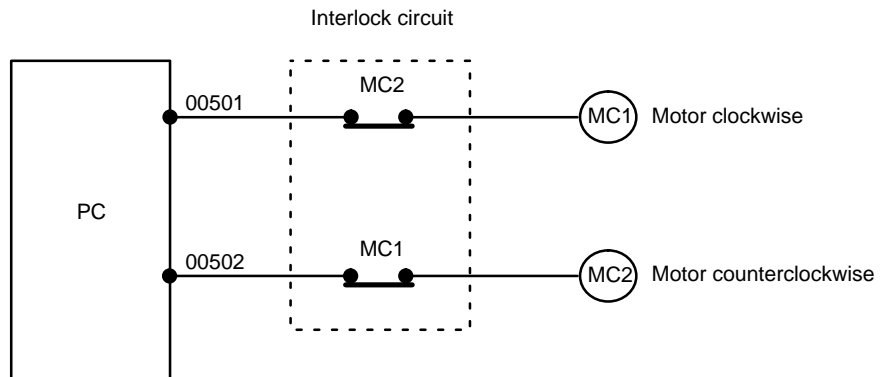
### 3-7-3 Output Units

#### Output Short Protection

Output devices and Output Units can be damaged if the load connected to an output terminal is shorted. Attach a fuse to the output circuit to protect your system. A fuse is recommended even if the Output Unit is provided with an internal fuse (e.g., Transistor and Triac Output Units), to increase easy of maintenance and provide extra protection.

#### Interlock Circuits

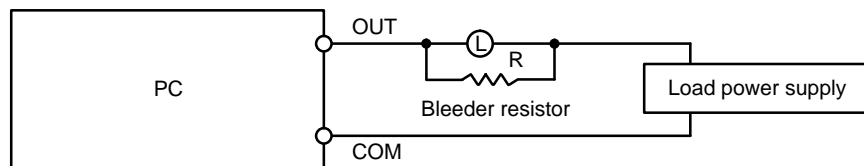
When the PC controls an operation such as the clockwise and counterclockwise operation of a motor, provide an external interlock such as the one shown below to prevent both the forward and reverse outputs from turning ON at the same time.



This circuit prevents outputs MC1 and MC2 from both being ON at the same time. Even if the PC is programmed improperly or malfunctions, the motor is protected.

#### Output Leakage Current

If a transistor or triac Output Unit is used to drive a low voltage load, the leakage current may prevent the output device from turning OFF. To prevent this, connect a bleeder resistor in parallel with the load as shown in the following table.



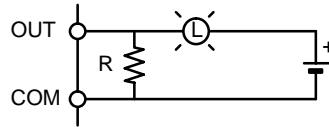
Select the bleeder resistor using the following formula.

$$R < \frac{E_{ON}}{I}$$

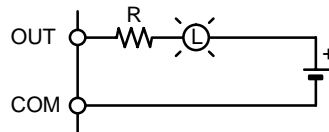
where  
 I = leakage current in mA  
 R = Bleeder resistance (kΩ)  
 Eon = ON voltage of the load

**Output Surge Current**

When connecting a Transistor or Triac Output Unit to an output device having a high surge current (such as an incandescent lamp), care must be taken to avoid damage to the Output Unit. The Transistor and Triac Output Units are capable of withstanding a surge current of ten times the rated current. If the surge current for a particular device exceeds this amount, use one of the following circuit configurations to protect the Output Unit.



The above circuit protects the Output Unit by letting the load draw a small current (about one third the rated current) while the output is OFF, significantly reducing the surge current. The following circuit reduces the surge current by employing a current-limiting resistor.



**Transistor Output Residual Voltage**

A Transistor Output Unit's output cannot be directly connected to a TTL input because of the transistor's residual voltage. When connecting TTL circuits to transistor Output Units, connect a pull-up resistor and a CMOS IC between the two.

**3-7-4 Wiring Examples**

The following examples illustrate how to connect I/O devices to I/O Units. During wiring, work slowly and carefully. If an input device is connected to an Output Unit, damage may result. Check all I/O devices to make sure they meet the specifications. Be sure to allow for leakage currents and load inductance.

**Input Units**

**DC Inputs**



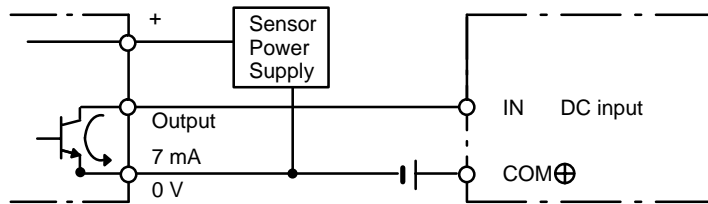
Sensor Inputs

When using the following configurations, the sensor and Input Unit should receive their power from the same source.

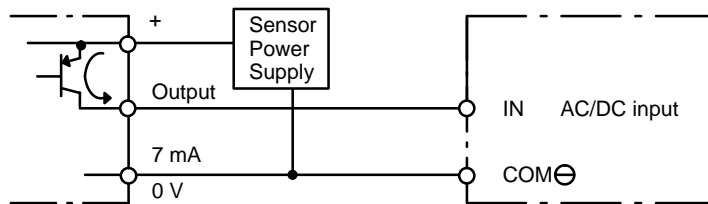
NPN current output



NPN open-collector output

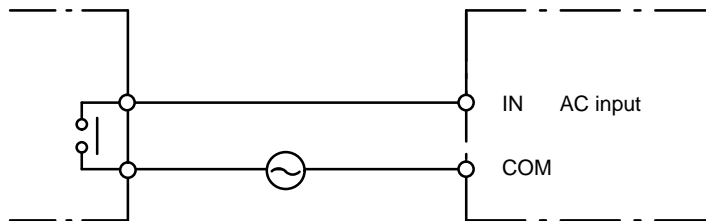


PNP current output

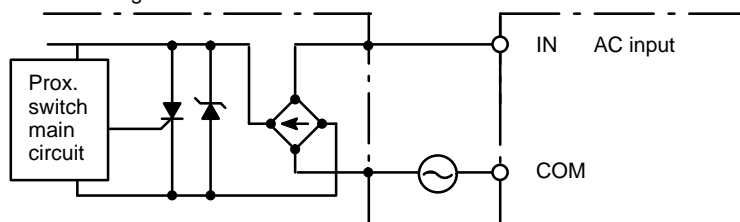


AC Inputs

Contact output



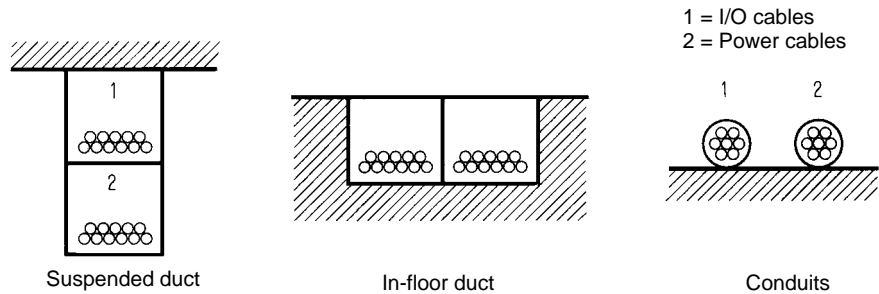
AC Switching



### 3-7-5 I/O Signal Noise Prevention

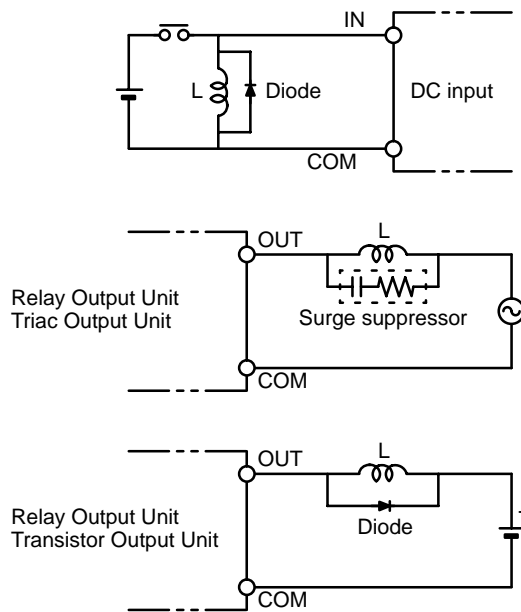
#### I/O Signal Lines

Whenever possible, place I/O signal lines and power lines in separate ducts or tubes. If placing them together cannot be avoided, use shielded cable to minimize the effects of noise, and connect the shielded end to the GR terminal.



#### Inductive Load Surge Suppressor

When an inductive load is connected to an I/O Unit, connect a surge suppressor or diode in parallel with the load, as shown in the following diagram. The diode will adsorb the back electromagnetic field generated by the load.



#### Surge Suppressor

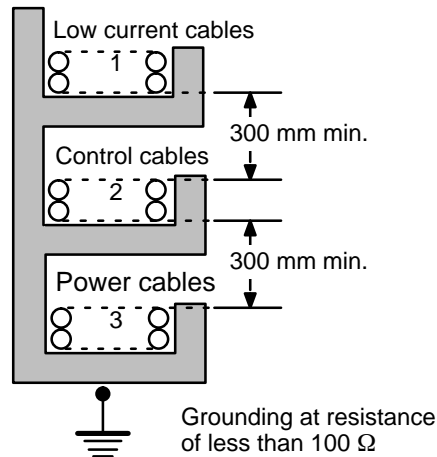
Resistance: 50  $\Omega$   
 Capacitor: 0.47  $\mu\text{F}$   
 Voltage: 200 V

#### Diode

Leading-edge peak inverse voltage: At least 3 times load voltage  
 Average rectified current: 1 A

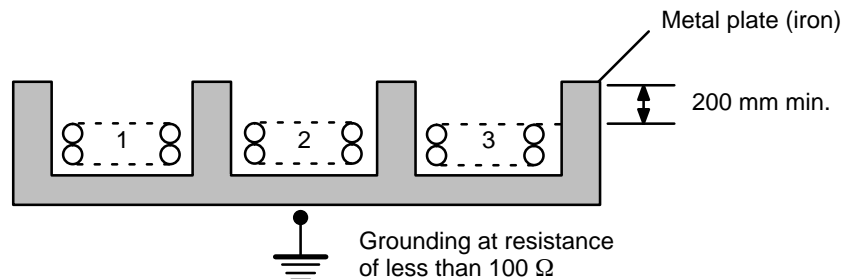
### 3-7-6 External Wiring

If power cables carrying more than 10 A at 400 V or 20 A at 220 V must be run parallel to I/O wiring, leave at least 300 mm between the power cables and the I/O wiring, as shown in the following diagram.



- 1 = I/O wiring
- 2 = General control wiring
- 3 = Power cables

If the I/O wiring and power cables must be placed in the same duct (for example, where they are connected to the equipment), shield them from each other using grounded metal plates.



- 1 = I/O wiring
- 2 = General control wiring
- 3 = Power cables

## 3-8 Compliance with EC Directives

The following precautions must be abided by when installing CVM1D PCs to meet EC Directives.

- 1, 2, 3...**
1. CVM1D PCs are classified as open-structure devices and must be installed inside a control panel.
  2. Use reinforced insulation or double insulation on the DC power supply connected to CV500-PS211 Power Supply Unit and DC I/O Units.
  3. Use separate power supplies for Relay Output Units and DC I/O Units.
  4. The maximum switching capacity of the CV500-PS211 Power Supply Unit is 2 A at 24 VDC when complying with EC Directives (low-voltage directives).



5. CVM1D PCs that meet EC Directives meet the common emission standard (EN50081-2) of the EMC Directives as individual products. When assembled into machinery, however, the noise generated by switching relay outputs can fail to meet the standard. When noise is excessive, surge killers must be installed or other measures must be taken outside of the PC. The measures required to meet the standard will vary with the load being driven, wiring, the configuration of the machinery, etc.

The following examples show means of reducing noise. These means will only reduce the amount of noise and will not eliminate noise. They are provided here as examples only.

## Requirements

The following conditions can be used to determine if measures to reduce noise are necessary. Refer to the EN50081-2 Standard for details.

- If the loads of the devices into which the PC is built are switched less than 5 times a minute, then no measures need to be taken.
- If the loads of the devices into which the PC is built are switched 5 times or more a minute, then measures need to be taken.

## Examples

### Inductive Load Surge Suppressor

Connect a surge suppressor or diode in parallel with the load, as shown in the following diagrams, when switching inductive loads.

#### CR Method (AC or DC)

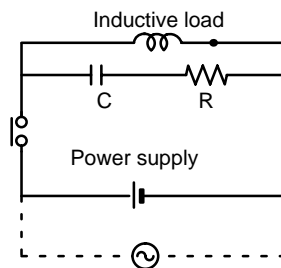
The reset time will be increased if the load is a relay, solenoid, or similar device. Connect the CR between the load connections for 24-V and 48-V power supply voltages and between the contact connections for 100 to 200-V power supply voltages.

The capacitor and resistors can be based on the following guidelines.

- C: 0.5 to 1  $\mu$ F for each amp of contact current  
 R: 0.5 to 1  $\Omega$  for each volt of contact voltage.

You will need to adjust the above values depending on the characteristics of the load, relay, etc., based on the discharge suppression of the capacitor when the contacts are open and the current control effect of the resistor the next time the circuit is closed.

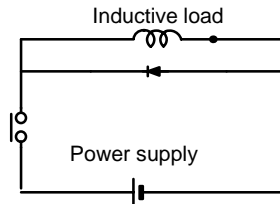
The dielectric strength of the capacitor generally needs to be between 200 and 300 V. Use an AC capacitor (without polarity) in an AC circuit.



#### Diode Method (DC Only)

The energy stored in the coil is impressed on the coil as a current by the action of the parallel diode and converted to Joule heat by the resistance of the inductive load. Here, the reset time will be increased even more than for the CR method.

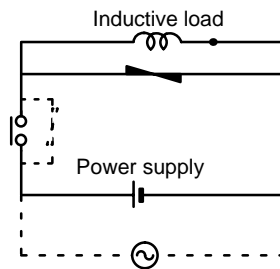
The reverse dielectric strength of the diode must be 10 times the circuit voltage and the forward current must be at least as high as that of the load. If the circuit voltage is low enough, as it is for most electronic circuits, then the reverse dielectric strength of the diode can be as low as 2 to 3 times the circuit voltage.



**Varistor (AC or DC)**

The method uses the fixed voltage characteristics of a varistor to prevent high voltages from being applied to the contacts. Here, as well, the reset time will be increase somewhat.

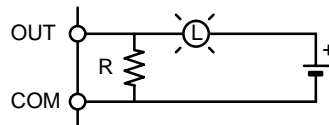
Connect the varistor between the load connections for 24-V and 48-V power supply voltages and between the contact connections for 100 to 200-V power supply voltages.



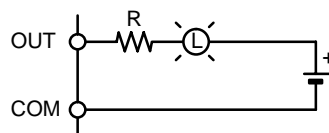
**Output Surge Current**

When connecting an output device having a high surge current (such as an incandescent lamp), use one of the following circuit configurations to protect the Output Unit.

The following circuit lets the load draw a small current (about one third the rated current) while the output is OFF, significantly reducing the surge current.



The following circuit reduces the surge current by employing a current-limiting resistor.



# SECTION 4

## System Startup and Trial Operation

This section describes procedures for the starting up the system and performing trial operation.

4-1	System Startup Preparations .....
4-1-1	Check Points before Startup .....
4-1-2	Startup Procedure .....
4-2	Duplex System Startup .....
4-3	Startup of the Simplex System .....
4-4	Preparations for Trial Operation .....

## 4-1 System Startup Preparations

### 4-1-1 Check Points before Startup

After mounting the CVM1D Units and completing necessary wiring, check the following points to prepare for trial operation.

#### Installation

- Is the Backplane firmly secured?
- Are all the Units securely mounted?
- Are all the mounting screws securely tightened?
- Is a battery installed in the CPU Unit? (When using an EM Unit and Memory Card, check specifications and installation conditions.)

Refer to *3-3 Installation*.

#### Switch Setting

Are Unit DIP switches properly set?

Refer to *Section 4 System Startup and Trial Operation*.

#### Connection of Cables and Connectors

- Are the cables properly connected between Racks? Are the connectors properly locked?
- Are the cables properly connected between Units?
- Is a Terminating Resistor Unit connected to the I/O Control Unit on the last Expansion I/O Rack?

Refer to *3-4 Rack Connections*.

#### Wiring

- Are both the power supply wiring and ground wiring correct?
- Are the START INPUT and PC RUN OUTPUT of the Duplex Unit properly wired?
- Are the I/O wirings correct?
- Are the terminal block screws tightened to the specified torque?

Refer to *3-6 Power Supply Unit Wiring* and *3-7 Wiring I/O Units*.

#### Memory Card (If Required)

Check the following items when using a duplex system.

- Is the EM Unit mounted in the active CPU Unit?
- When one Memory Card is installed in the active CPU Unit and another in the standby CPU Unit, is the program the same in both Memory Cards?

Refer to page 33.

#### EM Unit (If Required)

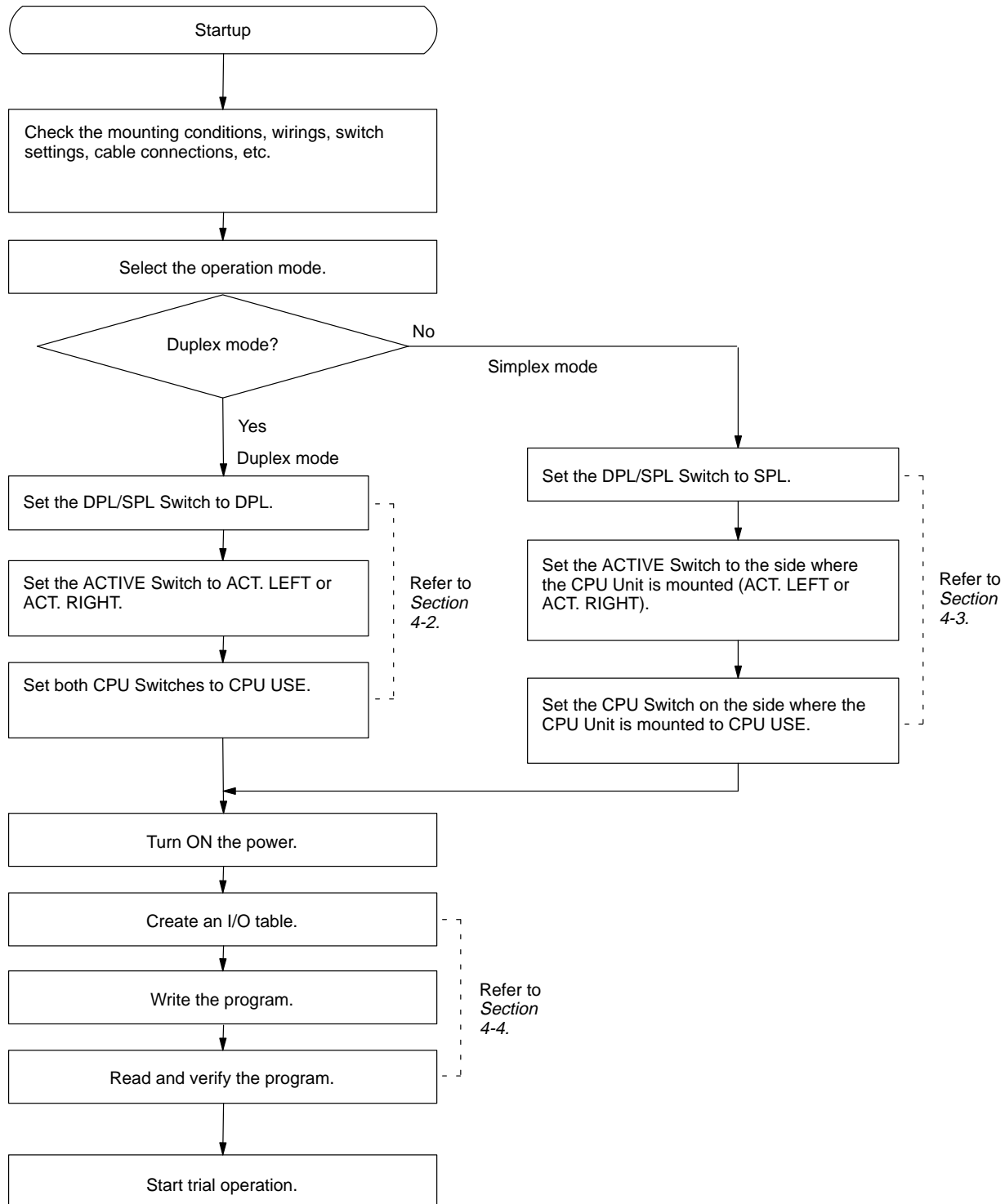
Check the following items when using a duplex system.

- Do the EM Units mounted in both CPU Units have the same specifications?

Refer to page 33.

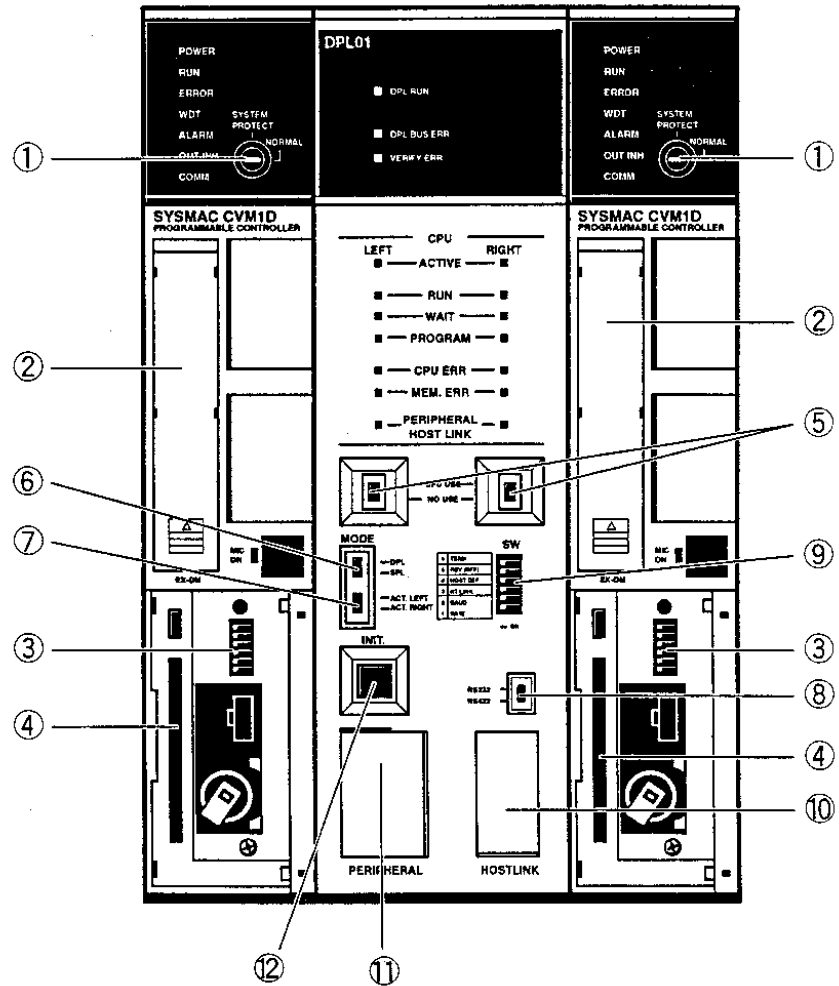
### 4-1-2 Startup Procedure

The CVM1D can be operated either in duplex mode or simplex mode. Start up the system according to the mode.



## 4-2 Duplex System Startup

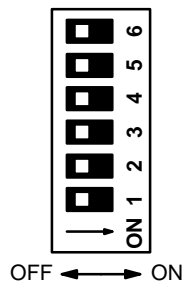
To start up a duplex system, first set the CPU Units and Duplex Unit according to the following procedure with the power turned OFF.



### Setting the CPU Unit

For the CPU Unit, no particular switch settings are required. When using Expansion DM, mount an EM Unit. When using file memory, install a Memory Card.

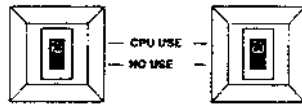
- 1, 2, 3...
1. The SYSTEM PROTECT Key is provided to protect programs. If the program doesn't need to be protected, set the SYSTEM PROTECT Key to NORMAL.
  2. Mount an EM Unit. (Refer to page 33.)
  3. Set the DIP switch for the PC Setup. (Refer to page 32.)



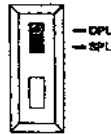
4. Install a Memory Card. (Refer to page 33.)

Setting the Duplex Unit

- 5. Set both CPU Switches to CPU USE.



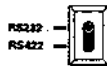
- 6. Set the DPL/SPL Switch to DPL (duplex mode).



- 7. Set the ACTIVE Switch to either ACT. LEFT or ACT. RIGHT depending on which CPU Unit is to be used for normal operation.



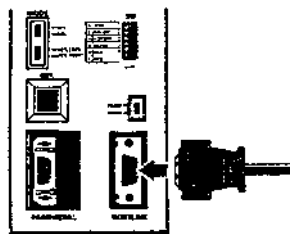
- 8. Set the Host Link Communications Switch to either RS-232 or RS-422 depending on which Host Link connector is to be used.



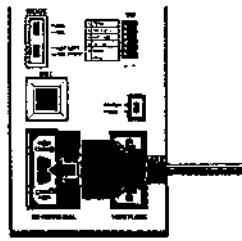
- 9. Set the Communications Setting Switch to the communications specifications of the Host Link connector. Refer to page 32 for details on DIP switch settings.



- 10. Connect the HOST LINK connector to the RS-232/422 line of the host computer or PT if a connection is to be used.



11. Connect a Programming Device, such as a Programming Console or the SYSMAC Support Software, to the PERIPHERAL connector.

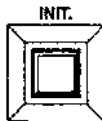


### Turning ON the Power

The indicators will appear as shown in the *User program transfer/verification* column on page 92 right after the power is turned ON and then change to the status as shown in the *Power ON (After duplex initialization)* column.

**Note** When the program contents of both CPU Units change, such as when the CPU Units are replaced, the indicator will change to the status for a Duplex Verification Error. Refer to *6-2 Error Indicators*.

12. Use the INIT (initialization) switch to initialize Duplex mode. It takes approximately 10 seconds to complete this initialization without an EM Unit. When changing the CPU Unit Switches, press the INIT switch to used the new settings.

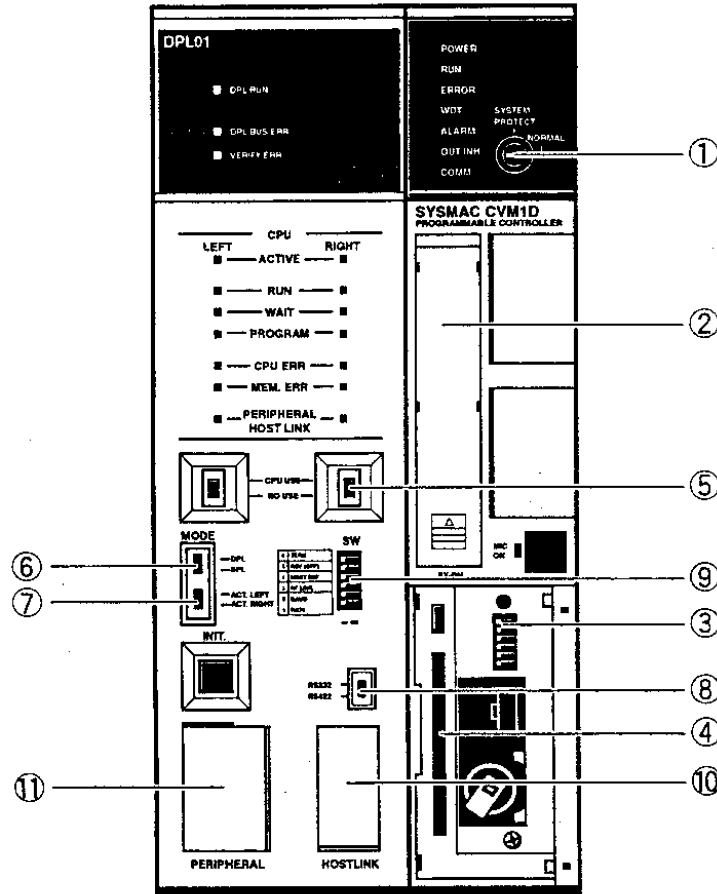


When the CPU Units and Duplex Unit settings have been completed, refer to *4-4 Preparations for Trial Operation*.



### 4-3 Startup of the Simplex System

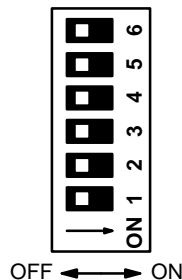
In simplex mode, the system is controlled by only one CPU Unit. The CPU Unit can be mounted to the slot on either the right or left side of the Duplex Unit. Use the following procedure to start up the system.



#### Setting the CPU Unit

No particular switch settings are required for the CPU Unit. When using Expansion DM, mount an EM Unit. When using File Memory, install a Memory Card.

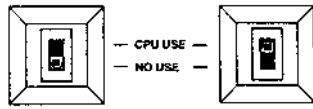
- 1, 2, 3...
1. The SYSTEM PROTECT Key is provided to protect programs. If the program doesn't need to be protected, set the SYSTEM PROTECT Key to NORMAL.
  2. Mount an EM Unit. (Refer to page 33.)
  3. Set the DIP switch for PC Setup. (Refer to page 32.)



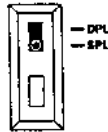
4. Install a Memory Card. (Refer to page 33.)

Setting the Duplex Unit

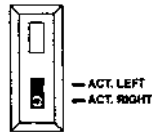
- 5. Set the CPU Switch for the CPU Unit to be mounted to CPU USE.



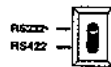
- 6. Set the DPL/SPL Switch to SPL (simplex mode).



- 7. Set the ACTIVE Switch to either ACT. LEFT or ACT. RIGHT depending on the side to which the CPU Unit is mounted.



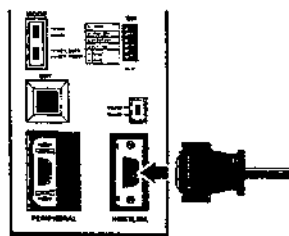
- 8. Set the Host Link Communications Switch to either RS-232 or RS-422 depending on which Host Link connector is to be used.



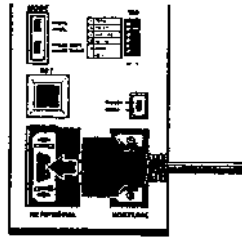
- 9. Set the Communications Setting Switch to the communications specifications of the Host Link connector. Refer to page 32 for details on DIP switch settings.



- 10. Connect the HOST LINK connector to the RS-232/422 line of the host computer or PT if one of these is to be used.



11. Connect a Programming Device, such as a Programming Console or the SYSMAC Support Software, to the PERIPHERAL connector.



**Turning ON the Power**

The indicators will be as shown in the "Power ON" column on page 93 right after the power is turned ON.

When the CPU Unit and Duplex Unit settings have been completed, refer to 4-4 Preparations for Trial Operation.

## 4-4 Preparations for Trial Operation

**Setting Expansion Rack Numbers**

Set the rack numbers (No. 1 to 7) for the Expansion Racks using the I/O Interface Unit on each Rack.

- Refer to the *CVM1D Duplex System Operation Manual (W351)* for details on word allocations.
- Make sure not to use the same number twice.

The rack number set when the power is turned ON remains in effect until the power is turned OFF and then ON again.

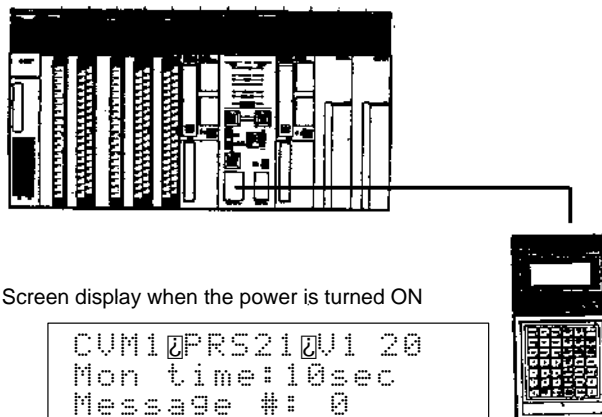
**Creating an I/O Table**

Create an I/O table after completing wiring, switch settings, and connection of Programming Devices, such as the Programming Console or SYSMAC Support Software.

Mount all the I/O Units, Special I/O Units, and CPU Bus Units to be used. Turn ON the power with the START INPUT left open and then set to PROGRAM mode using a Programming Device, such as a Programming Console.

The following procedure is a brief description of how an I/O table is created using the Programming Console. For details, refer to *CVM1-PRS21-EV1 Programming Console Operation Manual (W222)* and other applicable manuals.

- 1, 2, 3... 1. Connect the Programming Console, set the PROGRAM mode, and then turn ON the power supply.



Screen display when the power is turned ON

```
CVM10PRS210V1 20
Mon time:10sec
Message #: 0
Read Setup Yes
```

**Note** Use version 2.0 or later for the CVM1D.

2. Change to the I/O table create menu.

CLR

```
CVM1D0CPU21
```

CLR

```
000000 PRG
```

FUN SHIFT CH

I/O table create screen

```
I/O table
0:Create
1:Compare
2:RePlace I/O
```

3. Select **0:Create**.

0

Password input screen for creating an I/O table.

```
I/O table Create
      ?????
```

4. Input the password 9713.

9 7 1 3

```
I/O table Create
      9713
```

WRITE

```
I/O table Create
Clear CPU BUnit?
0:Clear
1:Hold
```

5. Select **0:Clear** to start I/O table creation.

0

I/O table creation completion screen

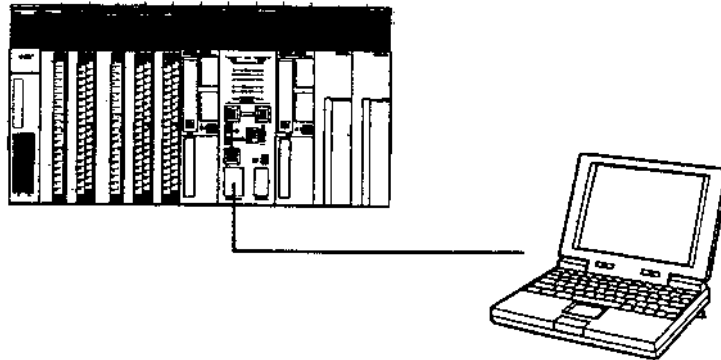
```
I/O table Create
Clear CPU BUnit

OK
```

6. When an I/O table has been created, verify the table and check word allocation for each Unit. For further details, refer to *CVM1-PRS21-EV1 Programming Console Operation Manual (W222)* or other relevant manuals.

**Writing Programs**

When registration in the I/O table has been finished, make sure that the I/O words allocated to each Unit match the addresses used in the user program. Create the ladder program using a Programming Device and transfer the data to the CVM1D.



**Note** Although the Programming Device is connected to the Duplex Unit, writing is performed for the active CPU Unit. By pressing the INIT switch, the same program or data can be written to the standby CPU Unit in simplex mode.

**Trial Operation**

When all the startup preparations have been completed, start trial operation. Turn OFF the power once and perform the following before starting.

- Detach the output wires so that the system will not be affected by any faulty operation.
- Short-circuit the START INPUT on each of the two Power Supply Units for the CPU Units.
- If a Communications Unit is mounted, provide appropriate measures to prevent any influence on other systems.

**Indicators When Power is Turned ON**

The indicators on every Unit will be as shown in the following table during duplex system operation, immediately after powerup, and when duplex initialization has been performed.

Unit	Status	Power ON (After duplex initialization)	User program transfer/verification	PROGRAM mode	Duplex system in operation	Description	
Duplex Unit	DPL RUN	Lit	Flashing	Lit	Lit	Lit while both the active and standby CPU Units are operating normally in synchronization. Also lit in PROGRAM mode.	
	DPL BUS ERR	Not lit	Not lit	Not lit	Not lit	Lit when a bus error occurs in the duplex system.	
	VERIFY ERR	Not lit	Not lit	Not lit	Not lit	Lit when the program or memory in one of the CPU Units does not match that of the other Unit. (Check UM, EEPROM, file memory, protect key, and EM size)	
	CPU ACTIVE	Left	One lit; the other not lit.	One lit; the other not lit.	One lit; the other not lit.	One lit; the other not lit.	Indicator on the CPU Unit set to ACTIVE (controlling the system) is lit.
		Right					
	RUN	Left	Not lit	Not lit	Not lit	Lit	Lit during operation (in MONITOR mode or RUN mode).
		Right	Not lit	Not lit	Not lit	Lit	In Duplex mode, the indicators on both CPU Units are lit.
	WAIT	Left	Not lit	Lit	Not lit	Not lit	Lit in Duplex mode under the following conditions. <ul style="list-style-type: none"> <li>• Either transferring or verifying (including UM protect) data in the UM, EEPROM, Memory Card, expansion data memory, or IOM (I/O memory).</li> <li>• START INPUT or power to Slave Rack is not turned ON.</li> <li>• Operation startup error (duplex bus error or duplex verification error) has occurred.</li> </ul>
		Right	Not lit	Lit	Not lit	Not lit	
	PROGRAM	Left	Lit	Not lit	Lit	Not lit	Lit when the CPU Unit is set to PROGRAM mode. Both indicators are lit in Duplex mode.
		Right	Lit	Not lit	Lit	Not lit	
	CPU ERR	Left	Not lit	Not lit	Not lit	Not lit	Lit when an error occurs in the CPU Unit.
		Right	Not lit	Not lit	Not lit	Not lit	
	MEM. ERR	Left	Not lit	Not lit	Not lit	Not lit	Lit when an error occurs in the internal memory, Memory Card, or the EM Unit.
Right		Not lit	Not lit	Not lit	Not lit		
PE-RIPHERAL HOST LINK	Left	One lit; the other not lit.	One lit; the other not lit.	One lit; the other not lit.	One lit; the other not lit.	Indicates which CPU Unit is connected to the Host Link or a Programming Device.	
	Right						
Left CPU	POWER	Lit	Lit	Lit	Lit	Lit while power (5 VDC) is supplied to the CPU Unit.	
	RUN	Not lit	Not lit	Not lit	Lit	Lit while the CPU Unit is processing program in RUN or MONITOR mode.	
	ERROR	Not lit	Not lit	Not lit	Not lit	Lit when the CPU Unit detects a fatal error (such as memory error).	
	WDT	Not lit	Not lit	Not lit	Not lit	Lit when a watchdog timer error is detected.	
	ALARM	Not lit	Not lit	Not lit	Not lit	Lit when non-fatal error is detected.	
	OUTINH	Not lit	Not lit	Not lit	Not lit	Lit when Load OFF Bit (A00015) is turned ON.	
	COMM.	Not lit	Not lit	Not lit	Not lit	Lit while communications take place with the host computer.	

Unit	Status	Power ON (After duplex initialization)	User program transfer/ verification	PROGRAM mode	Duplex system in operation	Description
Right CPU	POWER	Lit	Lit	Lit	Lit	Same as the above.
	RUN	Not lit	Not lit	Not lit	Lit	
	ERROR	Not lit	Not lit	Not lit	Not lit	
	WDT	Not lit	Not lit	Not lit	Not lit	
	ALARM	Not lit	Not lit	Not lit	Not lit	
	OUTINH	Not lit	Not lit	Not lit	Not lit	
	COMM.	Not lit	Not lit	Not lit	Not lit	

**Indicators in Simplex Mode**

The indicators for each Unit will be as shown in the following table during simplex system operation.

Unit	Status	Power ON	Simplex system operation	Program mode	Load shutdown	Description	
Duplex Unit	DPL RUN	Not lit	Not lit	Not lit	Not lit	Always OFF in Simplex mode.	
	DPL BUS ERR	Not lit	Not lit	Not lit	Not lit		
	VERIFY ERR	Not lit	Not lit	Not lit	Not lit		
	CPU ACTIVE	Left	Lit	Lit	Lit	Lit	LED on the side the CPU Unit is mounted is lit.
		Right	Not lit	Not lit	Not lit	Not lit	
	RUN	Left	Not lit	Lit	Not lit	Lit	Lit during operation (in MONITOR mode or RUN mode).
		Right	Not lit	Not lit	Not lit	Not lit	
	WAIT	Left	Not lit	Not lit	Not lit	Not lit	Always OFF in Simplex mode.
		Right	Not lit	Not lit	Not lit	Not lit	
	PROGRAM	Left	Lit	Not lit	Lit	Not lit	Lit when the CPU Unit is set to PROGRAM mode.
		Right	Not lit	Not lit	Not lit	Not lit	
	CPU ERR	Left	Not lit	Not lit	Not lit	Not lit	Lit when an error occurs in the CPU Unit.
		Right	Not lit	Not lit	Not lit	Not lit	
	MEM. ERR	Left	Not lit	Not lit	Not lit	Not lit	Lit when an error occurs in the internal memory, Memory Card, or EM Unit.
Right		Not lit	Not lit	Not lit	Not lit		
PERIPHERAL HOST LINK	Left	Lit	Lit	Lit	Lit	Indicates which CPU Unit is connected to the Host Link or Programming Device.	
	Right	Not lit	Not lit	Not lit	Not lit		
CPU	POWER	Lit	Lit	Lit	Lit	Lit while power (5 VDC) is supplied to the CPU Unit.	
	RUN	Not lit	Lit	Not lit	Lit	Lit while the CPU Unit is processing program in RUN or MONITOR mode.	
	ERROR	Not lit	Not lit	Not lit	Not lit	Lit when the CPU Unit detects a fatal error (such as memory error).	
	WDT	Not lit	Not lit	Not lit	Not lit	Lit when a watchdog timer error is detected.	
	ALARM	Not lit	Not lit	Not lit	Not lit	Lit when non-fatal error is detected.	
	OUTINH	Not lit	Not lit	Not lit	Lit	Lit when Load OFF Bit (A00015) turns ON.	
	COMM.	Not lit	Not lit	Not lit	Not lit	Lit while communications are taking place with the host computer.	

# SECTION 5

## Inspection and Maintenance

This section describes the procedures necessary for periodic inspection and maintenance.

- 5-1 Consumable Parts .....
- 5-2 Inspections .....
- 5-3 I/O Unit Online Replacement .....
- 5-3-1 Data Output to AR Area .....
- 5-3-2 Online Replacement Procedure .....
- 5-3-3 Replacing Fuses .....
- 5-3-4 Replacing Relays .....
- 5-4 Replacing a CPU Unit .....
- 5-4-1 Replacement Procedure .....
- 5-4-2 Replacing a CPU Battery .....
- 5-4-3 Replacing a Memory Card Battery .....
- 5-5 Replacing a Power Supply Unit .....



## 5-1 Consumable Parts

It is recommended that a spare Unit always be kept on hand to ensure continued smooth operations in case a Unit should need to be replaced. In addition, the following consumable parts should always be kept available.

- Backup battery for CPU Unit: C500-BAT08  
Be sure to have a replacement battery ready before the currently installed battery reaches the end of its service life.
- Fuses for Output Units
- Output relays for Contact-type Output Units

**Note** Always keep spare items on hand so that they can be used as immediate replacements.

## 5-2 Inspections

The main components of a SYSMAC PC are semiconductors, and there are few consumable parts. Environmental conditions, however, can lead to electrical element deterioration, so regular inspections are required.

The standard period for inspections is six months to one year, but more frequent inspections may be required depending on the operating environment.

	Inspection item	Details	Criteria	Remarks
1	Power supply	Determine whether the voltage fluctuation is within the standard at the power supply terminal.	100 VAC (85 to 132 VAC) 200 VAC (170 to 264 VAC)	Tester
2	Environmental conditions	Is the ambient temperature inside the panel appropriate?	0 to 55°C	Thermometer
		Is the ambient humidity inside the panel appropriate?	10% to 90% RH with no condensation	Hydroscope
		Has dirt or dust collected?	None	Visual inspection
3	I/O power supply	Is the voltage fluctuation measured at the I/O terminal within the standard range?	Must conform to the specifications for individual Units.	Tester
4	Installation status	Are all units securely installed?	Nothing is loose	Tighten with screwdriver.
		Are all connection cables and connectors inserted completely and locked?	Nothing is loose	
		Are any of the external wiring screws loose?	Nothing is loose	
		Are any of the external wiring cables frayed?	No external abnormalities	Visual inspection
5	Unit condition	Power Supply Unit	POWER indicator must be lit on both Units.	Visual inspection
		CPU Unit	POWER indicator must be lit on both Units. The ERR indicator must not be lit.	
6	Product service life	Output Unit (Relay)	<u>Electrical:</u> Resistance load: 300,000 operations Inductive load: 100,000 operations <u>Mechanical:</u> 5,000,000 operations	---
		CPU Unit battery		---

**Handling Precautions**

Turn the power OFF before replacing the Unit.

If a Unit is found to be faulty and is replaced, check the new Unit to make sure there is no error.

When returning a faulty Unit for repair, make a detailed note of the Unit's malfunction and take it with the Unit to the nearest OMRON office or sales representative.

If a contact is faulty, put some industrial alcohol on a clean cotton cloth and wipe the surface. Then install the Unit.

**Required Tools and Equipment****Standard Tools**

- Screwdrivers (Phillips and flat-blade)
- Voltage tester or digital voltage meter
- Industrial alcohol and a cotton cloth

**Measurement Devices**

- Synchroscope
- Cathode-ray oscilloscope
- Thermometer, hydroscope

## 5-3 I/O Unit Online Replacement

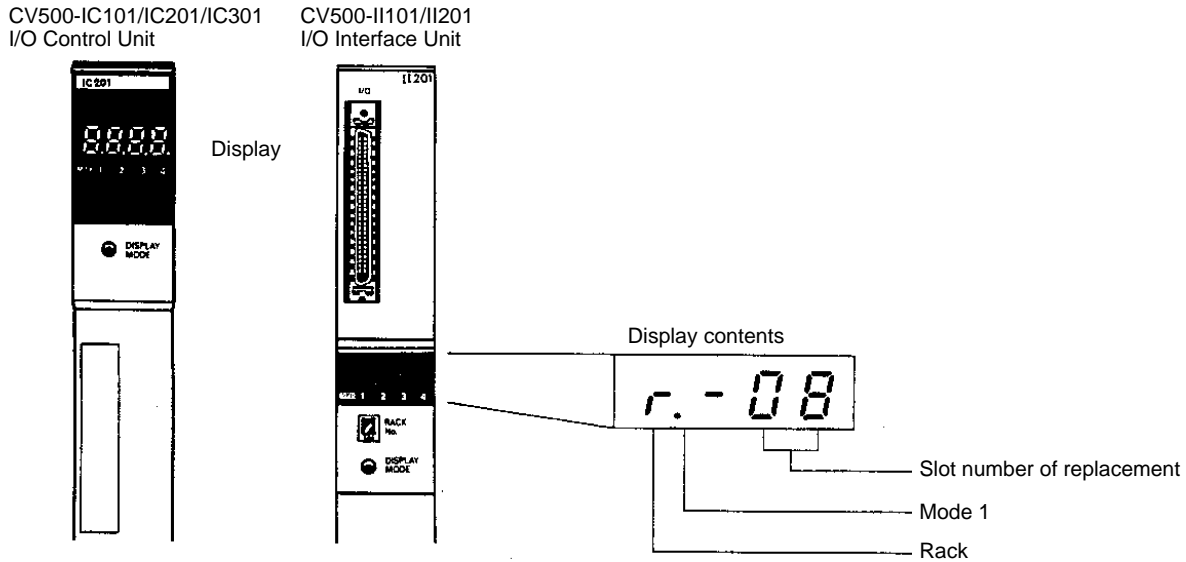
Online replacement is a function that allows I/O Units to be replaced without stopping PC operation.

**Online Replacement Restrictions**

Item	Details
Applicable Units	8/16/32/64-pt. I/O Units (Not possible for Interrupt Input Units, Special I/O Units, CPU Bus Units, or Communications Units.)
Number of Units	Only one Unit on one Rack can be replaced for each operation.
Racks	<ul style="list-style-type: none"> <li>• CPU Rack (when CVM1D-BC051 CPU Backplane is used)</li> <li>• Expansion CPU Rack (when CVM1D-BI101 Expansion CPU Backplane is used)</li> <li>• Expansion I/O Rack (when CVM1D-BI102 Expansion I/O Backplane is used)</li> </ul>
Programming Device	CVM1-PRS21-EV1 Programming Console
Execution modes	Duplex mode, simplex mode

During online replacement, the inputs and outputs of the Unit being replaced are stopped, and I/O data is not refreshed for that Rack. Set the I/O status is to either be cleared or saved while the Programming Console is performing online replacement operations.

The I/O online replacement conditions can be read at the display of an I/O Control Unit or I/O Interface Unit mounted on that Rack.



### 5-3-1 Data Output to AR Area

During online replacement, the I/O online replacement conditions are output to word A399 in the AR Area, as shown in the following table.

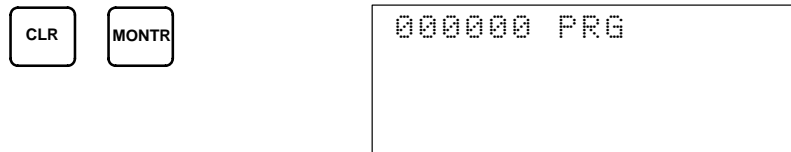
#### Word A399: I/O Online Replacement Conditions

Word	Bits	Output contents	
A399	00 to 07	Slot number (Rack position) of replaced Unit: 00 to 09 (2 digits BCD)	
	08 to 11	Slot number (Rack) of replaced Unit: 0 to 7 (1 digit BCD)	
	12 to 13	Not used. (Reserved for system.)	
	14	Data contents of I/O Units other than replaced Unit.	0: Clear 1: Save
	15	I/O online replacement status	0: Not I/O online replacement 1: I/O online replacement

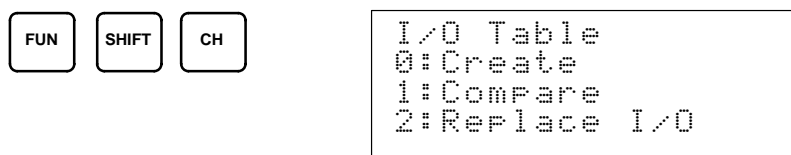
### 5-3-2 Online Replacement Procedure

**Caution** Use version 2.0 or later of the Programming Console for the CVM1D. Online Unit replacement is not supported by and error messages unique to the CVM1D will not be displayed with earlier versions.

- 1, 2, 3... 1. Connect the CVM1-PRS21-EV1 Programming Console to the Duplex Unit, and prepare an I/O Unit of the same model as the one to be replaced.
2. Bring up the Programming Console's initial screen.



3. Read the display for creating the I/O table.



4. Select 2: Replace I/O.

2

```
Replace I/O ?
Rack 2
Slot ?
```

5. Specify the rack number.

5

```
Replace I/O ?
Rack 5
Slot ?
```

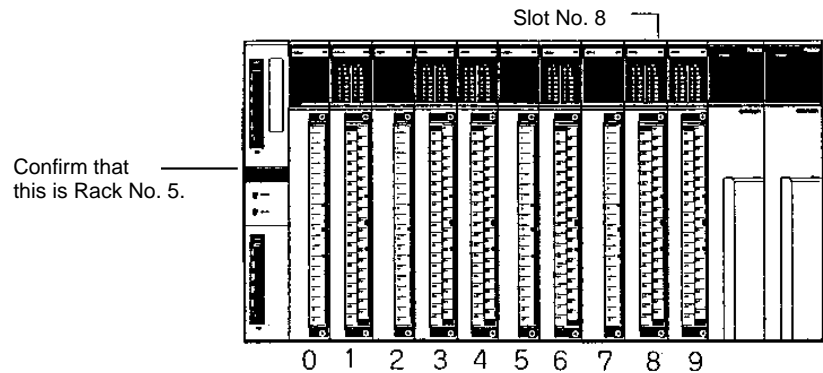
The rack number for the CPU Rack is 0. The rack numbers for the Expansion Racks are 1 to 7, and is set on the I/O Interface Unit.

6. Specify the slot number.

8

(Beginning with 0, in order from the left side of the Rack.)

```
Replace I/O ?
Rack 5
Slot 8
```



7. Press the SRCH Key to display the classification of the mounted Unit.

SRCH

```
Replace I/O ?
Rack 5
Slot 8
00**
```

**Unit Classification Display**

Unit	16 pts	32 pts	64 pts
Input	I***	II**	IIII
Output	O***	OO**	OOOO

8. Press the DEL Key to display the selection screen for saving or clearing output data to other Output Units on the Rack.

DEL

```
Replace I/O St ?
Rack OUT?
0:Clear
1:Hold
```

9. Select **1**: **Hold** to save the data.



```
Replace I/O St ?  
Rack OUT
```

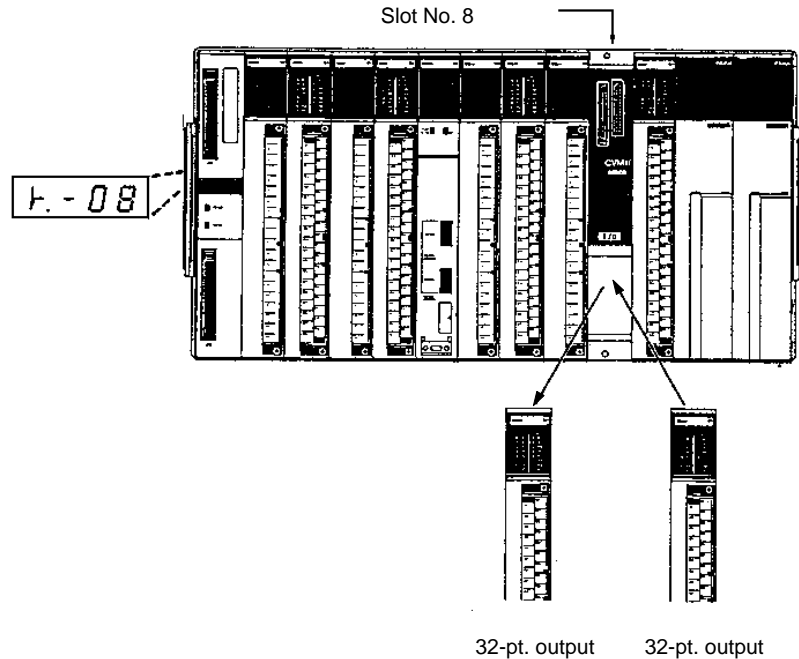
10. Press the Up Cursor Key to replace the Output Unit.



```
Replace I/O ?  
Rack 5  
Slot 8  
█ 00**
```

Output data will not be refreshed after this key is pressed.

11. Disconnect the Output Unit at the connector terminals, and then replace it.



Be careful to insert the replacement Unit in the proper position and direction for mounting to the connector terminals.

12. After the Unit has been replaced, press the INS Key and then the Down Cursor Key to end the operation.



```
Replace I/O End?  
Rack 5  
Slot 8  
█ 00**
```



```
Replace I/O ?  
Rack 5  
Slot 8  
00**
```

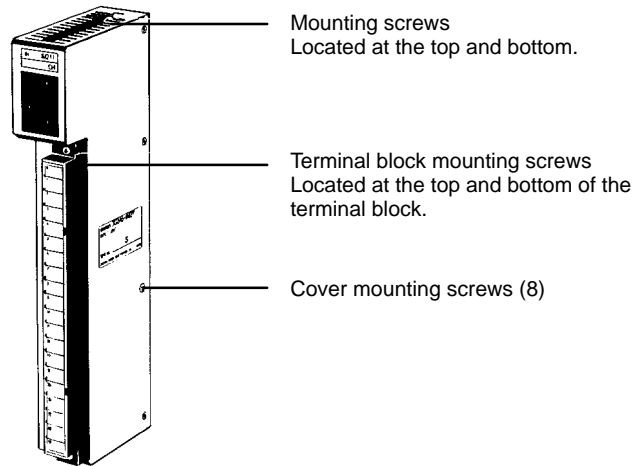
After this key is pressed, output data will be refreshed again.

### 5-3-3 Replacing Fuses

To replace a fuse in an Output Unit, take the following steps. Use the following fuses.

Unit	Fuse specifications
C500-OD411, C500-OD217, and C500-OA223	250 V, 5 A MF51SH (JIS), 20 mm x 5.2 mm dia.
C500-OA121 or C500-OA222	250 V, 5 A Model SS2 (SOC Corporation), 32 mm x 6.35 mm dia.
C500-OD219	250 V, 10 A GGL-10 (Nagasawa Electric)

- 1, 2, 3...**
1. Turn off the power to the PC.
  2. Detach the terminal block from the Output Unit by removing the screws located at the top and bottom of the terminal block.



3. Remove the screws that mount the Output Unit to the Backplane. Pull the Output Unit toward you and remove it from the Backplane.
4. There are eight screws on each side of the Output Unit. Remove these screws to detach the case from the cover.
5. Pull out the printed circuit board.
6. Replace the fuse with a new one.
7. Reassemble the Unit.

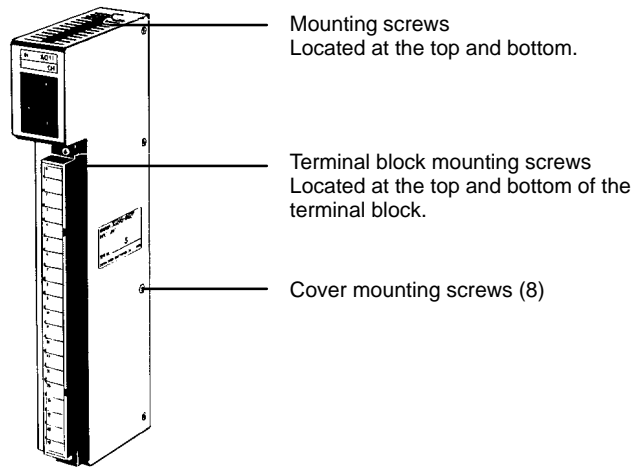
### 5-3-4 Replacing Relays

To replace a Relay in an Output Unit, take the following steps. Use the following relays.

Unit	Fuse specifications
C500-OD221, C500-OD223, and C500-OD224	G6B-1174P-FD-US-M, 24 VDC

- 1, 2, 3...**
1. Turn off the power to the PC.

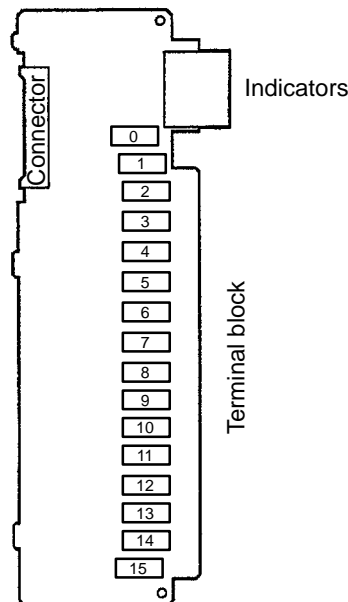
2. Detach the terminal block from the Output Unit, by removing the screws located at the top and bottom of the terminal block.



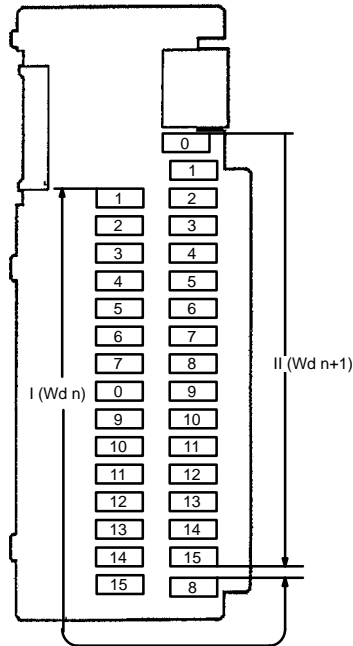
3. Remove the screws that mount the Output Unit to the Backplane. Pulling the Unit toward you, remove the Output Unit from the Backplane.
4. There are eight screws on each side of the Output Unit. Remove these screws to detach the case from the cover.
5. Pull out the printed circuit board.
6. Use the Relay Puller to pull out the Relay. Insert a new Relay.
7. Reassemble the Unit.

**Note** To remove the relay, use the P6B-Y1 Relay Puller. Be sure to insert the relay in the socket in the correct direction. The relay cannot be inserted in the wrong direction and if excessive force is applied to the relay, the pins of the relay may bend. The locations of relays on the PC boards are illustrated in the following figures.

**C500-OC221/223**



C500-OC224



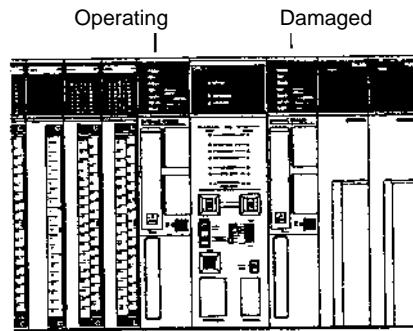
## 5-4 Replacing a CPU Unit

In a duplex system, even if the CPU Unit is damaged while running, a standby CPU Unit continues operations. The defective CPU Unit should be quickly replaced in order to return to duplex mode operation.

### 5-4-1 Replacement Procedure

- 1, 2, 3... 1. Set the CPU usage switch at the Unit to be replaced to “NO USE.” When the power supply is turned OFF, check to be sure that the CPU Unit’s POWER indicator is not lit.

In this example, the CPU Unit on the right is damaged, and the CPU Unit on the left has switched to operating in simplex mode.



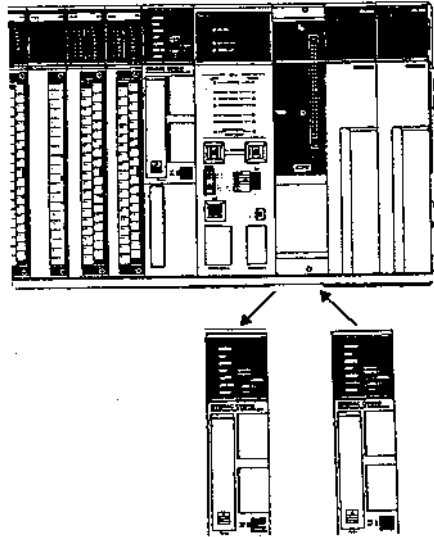
POWER indicator is not lit after the power is turned OFF.

Set the CPU usage switch to “NO USE.”

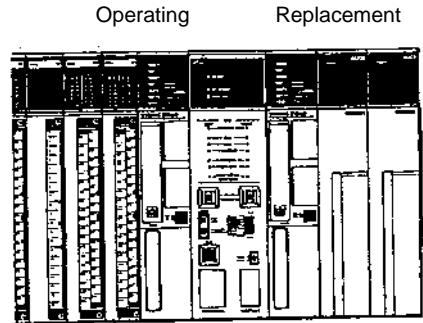
2. Replace the defective CPU Unit with a new one.  
 Make sure that the settings on the new CPU Unit are the same as those of the one being replaced.
- Use the same number of EM banks.



- Use the same Memory Card and duplex switch settings.



3. Set the CPU usage switch on the replacement CPU Unit to "CPU USE." The POWER indicator on the replacement CPU Unit should light when the power supply is turned ON.

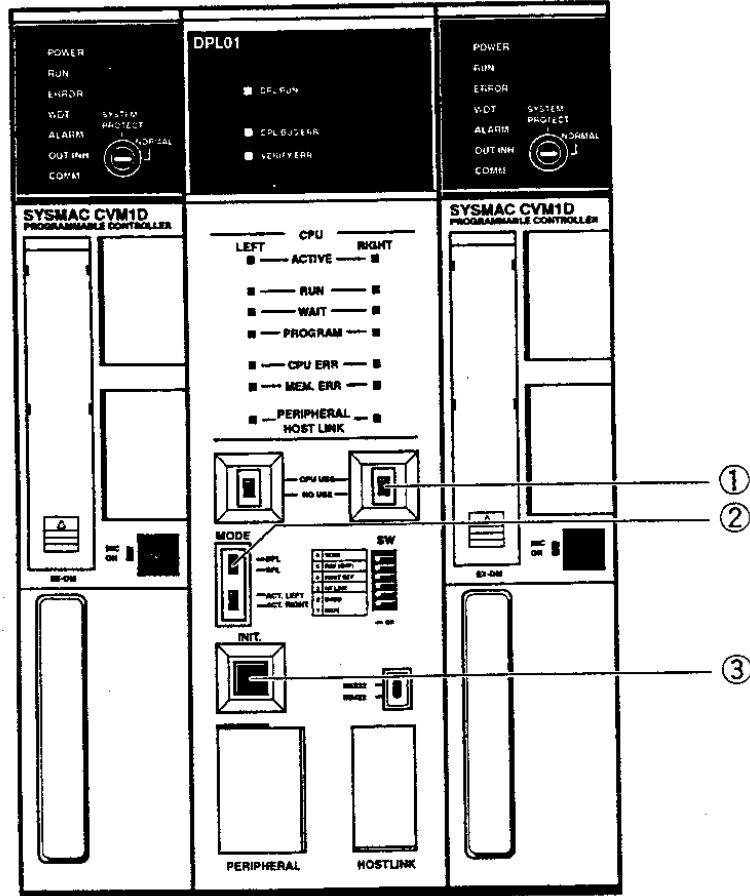


Turn ON the CPU Unit's power supply switch. Set the CPU usage switch to "CPU USE." The POWER indicator should be lit.

4. When an error occurs at a CPU Unit in a duplex system, operation switches to simplex mode using only the normal CPU Unit. The program and automatic data transfers cannot be resumed merely by replacing the defective CPU Unit. Operation will continue in simplex mode, and will not switch over if an error occurs at the CPU Unit that is still operating. To return to duplex mode operation, it is necessary to press the Initialize Button. When that switch is pressed, the program and data will be transferred from the active (ACT) CPU Unit to the standby (STB) CPU Unit. (This takes approximately 10 seconds without EM).
  - Set the replacement CPU Unit to CPU USE. (1)
  - Check to make sure that the mode is "DPL." (2)
  - Press the Initialize Button. (3)

When the Initialize Button is pressed, operation will switch back to duplex mode.

After setting the CPU usage switch to CPU USE, wait at least three seconds before pressing the Initialize Button. The CPU's internal processing takes approximately three seconds after the switch is set to CPU USE, so the Initialize Button will not be effective during that interval.



### 5-4-2 Replacing a CPU Battery

When the battery is nearly discharged, the ALARM indicator will blink, bit A42615 will turn ON, and the message "BATT LOW" will appear on the Programming Device. In duplex mode, bit A42613 will turn ON when the battery is low in the active CPU Unit, and bit A42611 will turn ON if it is low in the standby CPU Unit.

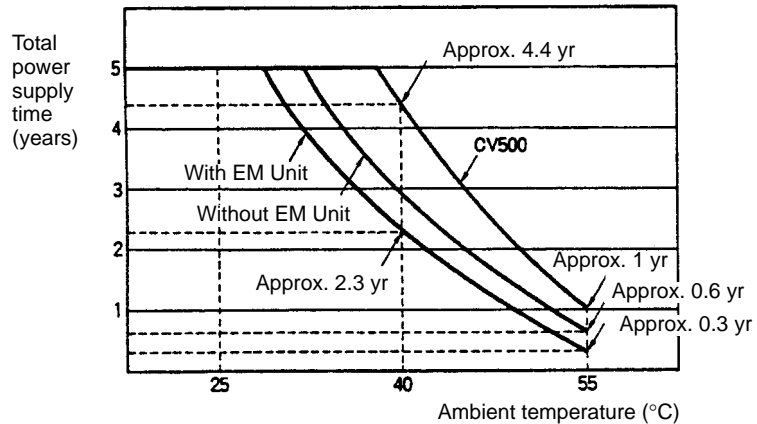
When this occurs, replace the battery within one week to avoid loss of data. The battery and connector are provided as a set. To replace the Battery Set, follow the steps below. The entire replacement must be completed within five minutes to ensure that the data will not be lost.

**! Caution** Do not short circuit, charge, disassemble, or expose the battery to heat. The battery fluid is flammable and if mishandled, may cause a fire or explosion. Do not incinerate the battery after use.

The maximum expected service life of the battery is five years for any CPU Unit; the actual service life depends on how much it is used for supplying power to the CPU Unit. The memory backup times are given in the following table.

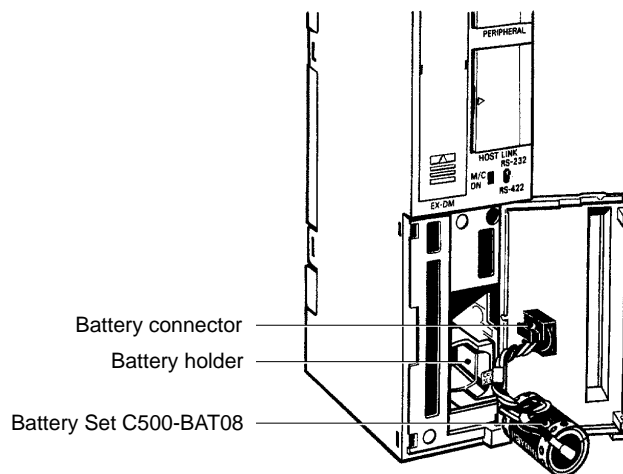
Backup time without power supplied	
Guaranteed value	Effective value
2,900 hours (approx. 0.3 year)	43,000 hours (approx. 5 years)

Guaranteed value: Memory backup time without power supplied at 55°C.  
 Effective value: Memory backup time without power supplied at 25°C.



**Battery Replacement**

- 1, 2, 3...
1. Turn ON power to the PC (if not on yet).
  2. Wait for at least 10 seconds after turning ON power and then turn OFF power to the PC. (Although the battery can be replaced while power is being applied to the PC, it is not recommended, as short-circuiting is likely to occur.)
  3. Remove the cover from the battery compartment.
  4. Remove the old Battery Set.
  5. Install the new Battery Set as shown below.



6. Replace the cover of the battery compartment.
7. When a Programming Console is mounted to the CPU after the battery has been replaced, "BATT LOW" will be displayed. This message can be cleared by pressing CLR, FUN, MONTR, or just turning the power to the PC OFF and ON again.

**Note** The maximum life of the battery is five years, regardless of whether power is supplied to the CPU. The memory backup duration when power is not supplied to the CPU varies with the ambient temperature. Details regarding the service life of the battery are provided in *Appendix B Specifications*.

### 5-4-3 Replacing a Memory Card Battery

The RAM Memory Card is provided with a backup memory battery.

When the Memory Card is mounted to the CPU and the battery life is close to expiring, the CPU ALARM indicator will blink, bit A42614 will turn ON, and the message "BATT LOW" will appear on the Programming Device. In duplex mode, bit A42612 will turn ON when the battery is low in the active Memory Card, and bit A42610 will turn ON if it is low in the standby Memory Card.

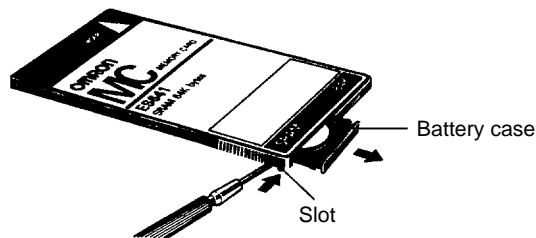
When this occurs, replace the battery within one week to avoid loss of data. The entire replacement must be completed within one minute to ensure that the data will not be lost.

Use one of the following replacement batteries.

Model	Capacity	Battery life
HMC-ES641	64 Kbytes	5 years
HMC-ES151	128 Kbytes	2 years
HMC-ES251	256 Kbytes	1 years
HMC-ES551	512 Kbytes	0.5 years

**Caution** Do not short circuit, charge, disassemble, or expose the lithium battery to heat. The battery fluid is flammable and if mishandled, may cause a fire or explosion. Do not incinerate the battery after use.

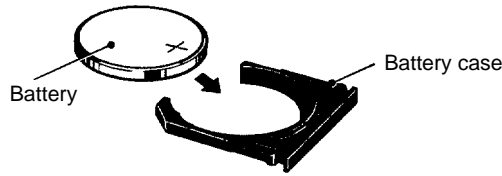
#### Battery Replacement



**Caution** Steps 4 through 7 of the following procedure must be completed within one minute. If the new battery is not inserted within one minute, the contents of memory will be lost.

- 1, 2, 3...**
1. If the Memory Card (M/C) indicator is not lit, press the Memory Card power supply switch to turn ON power to the Memory Card and leave it ON for at least 10 seconds.
  2. Press the Memory Card power supply switch to turn OFF the Memory Card indicator.
  3. Press the Memory Card eject button and remove the Memory Card.
  4. Release the battery case by inserting the tip of a pen (or similar object) in the slot on the side of the Memory Card as shown.
  5. Remove the old battery from the case.

6. Install the new battery as shown, with the positive terminal to the top.



7. Insert the battery case back into the Memory Card. Be sure that the case is installed all the way in.

## 5-5 Replacing a Power Supply Unit

With the CVM1D's redundant power supply system, if either Power Supply Unit fails it can be replaced without interrupting system operation.

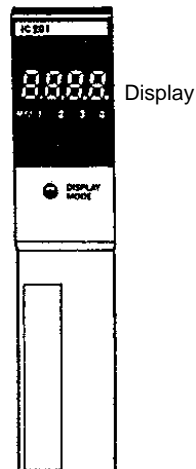
### Online Replacement Restrictions

Item	Details
Applicable Racks	<ul style="list-style-type: none"> <li>• CPU Rack (when CVM1D-BC051 CPU Backplane is used)</li> <li>• Expansion CPU Rack (when CVM1D-BI101 Expansion CPU Backplane is used)</li> <li>• Expansion I/O Rack (when CVM1D-BI102 Expansion I/O Backplane is used)</li> </ul>
Power Supply Unit error detection	<ul style="list-style-type: none"> <li>• Detection of 5-VDC-output voltage drop</li> <li>• Detection of disagreement between START INPUT terminals for the two Power Supply Units on the CPU Rack.</li> </ul>
Power Supply Unit error output	Errors at Power Supply Units on CPU Racks, Expansion CPU Racks, and Expansion I/O Racks are output to words A397 and A398 in the AR Area.
Power Supply Unit error display	Errors are displayed at the I/O Control Unit or I/O Interface Unit mounted to the Rack where the error was detected.

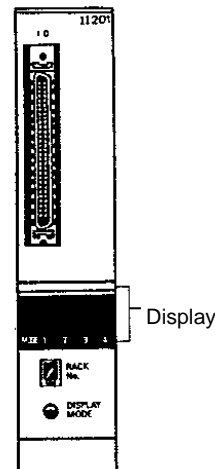
### Error Display

When an error is detected at a Power Supply Unit, it can be read at the display of the I/O Control Unit or I/O Interface Unit.

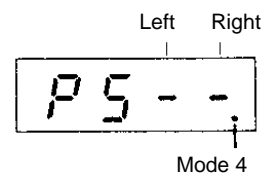
CV500-IC101/IC201/IC301  
I/O Control Unit



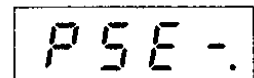
CV500-II101/II201  
I/O Interface Unit



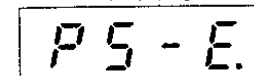
Normal Display



Error Display (Left Unit)



Error Display (Right Unit)



**Power Supply Error Output**

When an error is detected at a Power Supply Unit on a CPU Rack, Expansion CPU Rack, or Expansion I/O Rack, the content of the error can be read in words A397 and A398, as shown in the following table.

Word	Bits	Contents	
A397	00	The START INPUT for the right Power Supply Unit on the CPU Rack is OFF.	0: START INPUT is ON. 1: START INPUT is OFF.
	01	The START INPUT for the left Power Supply Unit on the CPU Rack is OFF.	
	02 to 15	Not used. (Reserved for system.)	
A398	00	Error at right Power Supply Unit on CPU Rack (Rack #0).	0: No error. 1: Error detected.
	01	Error at left Power Supply Unit on CPU Rack (Rack #0).	
	02	Error at right Power Supply Unit on Expansion Rack (Rack #1).	
	03	Error at left Power Supply Unit on Expansion Rack (Rack #1).	
	04	Error at right Power Supply Unit on Expansion Rack (Rack #2).	
	05	Error at left Power Supply Unit on Expansion Rack (Rack #2).	
	06	Error at right Power Supply Unit on Expansion Rack (Rack #3).	
	07	Error at left Power Supply Unit on Expansion Rack (Rack #3).	
	08	Error at right Power Supply Unit on Expansion Rack (Rack #4).	
	09	Error at left Power Supply Unit on Expansion Rack (Rack #4).	
	10	Error at right Power Supply Unit on Expansion Rack (Rack #5).	
	11	Error at left Power Supply Unit on Expansion Rack (Rack #5).	
	12	Error at right Power Supply Unit on Expansion Rack (Rack #6).	
	13	Error at left Power Supply Unit on Expansion Rack (Rack #6).	
	14	Error at right Power Supply Unit on Expansion Rack (Rack #7).	
15	Error at left Power Supply Unit on Expansion Rack (Rack #7).		

**Note** Errors that occur at Slave Racks are not output to the AR Area.

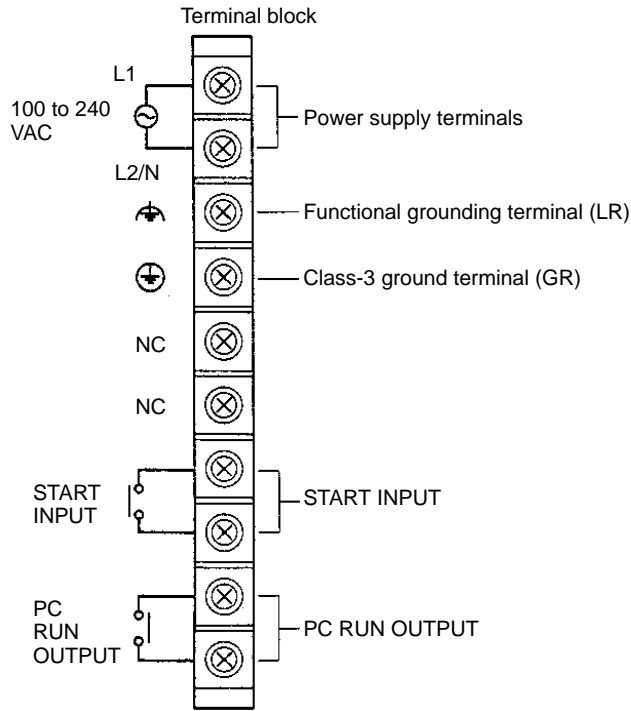
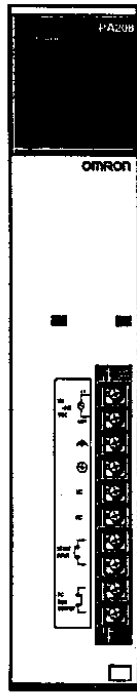
**Replacement Procedure**

If a Power Supply Unit error is detected by means of the I/O Control Unit or I/O Interface Unit, or the AR Area, use the following procedure to replace the Unit.

- 1, 2, 3... 1. When the error is detected, first check whether the START INPUT terminals are ON for both the right and left Power Supply Units. This can be done by monitoring bits A39700 and A39701. If either of the START INPUT terminals is OFF, it will be detected as a Power Supply Unit error.
2. Disconnect the wiring of the defective Power Supply Unit.
  - Be careful to first turn OFF the power supply. Touching the wiring while the power supply is ON may result in electrical shock.
  - If the output terminal block wiring is being used with an external sequence circuit during operation, be sure to short-circuit the wiring so that removing the Unit will have no adverse effect.

**WARNING** Do not touch the terminal block while the power is ON. Doing so may result in electrical shock.

CVM1D-PA208  
CVM1D-PA212



3. Remove the Power Supply Unit.
4. Mount a new Power Supply Unit. Use the same model for both the right and left Units.
5. Connect the wiring.

# SECTION 6

## Troubleshooting

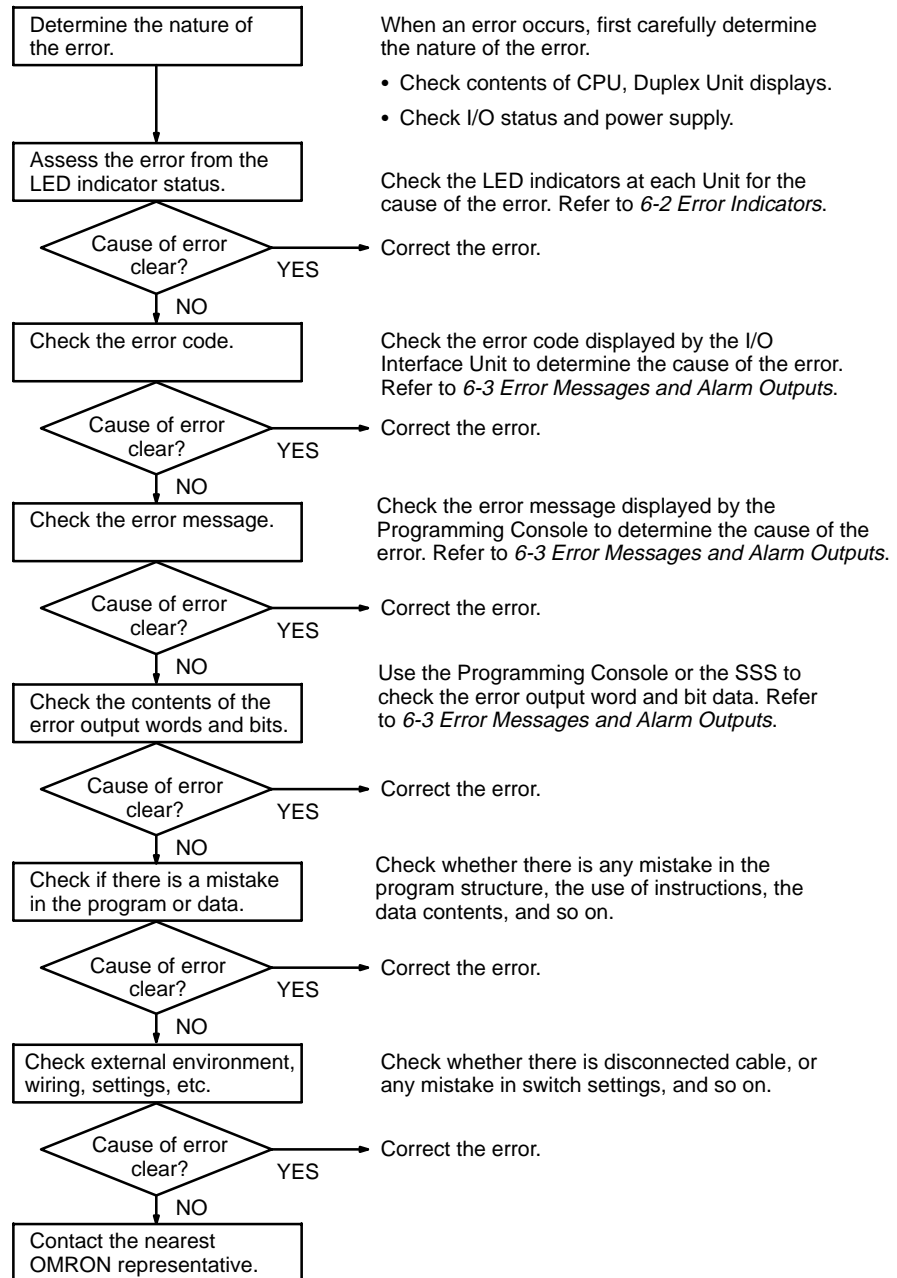
This section describes the self-diagnostic functions of the PC and provides troubleshooting techniques and error corrections.

6-1	Troubleshooting Procedure .....
6-2	Error Indicators .....
6-3	Error Messages and Alarm Outputs .....
6-4	Troubleshooting Flowcharts .....
6-5	Error Processing and Correction .....



# 6-1 Troubleshooting Procedure

When an error occurs, use the following procedure to do a systematic check to determine the cause of the error as quickly as possible and correct it.



## 6-2 Error Indicators

Simplex mode		Fatal errors			Non-fatal errors			Outputs turned OFF
Duplex mode		Operation change		Fatal errors		Non-fatal errors		
		CPU error WDT operation	CPU error MEM ERR	I/O bus error, CPU bus error, etc. (Note 1.)	Duplication bus error, duplicated verification error at powerup	Duplication bus error, duplicated verification error	I/O verification error, CPU Bus Unit error, etc. (Note 2.)	
CPU Unit	POWER	Lit	Lit	Lit	Lit	Lit	Lit	Lit
	RUN	Not lit	Not lit	Not lit	Not lit	Lit	Lit	---
	ERROR	Lit/Not lit	Lit	Lit	Not lit	Not lit	Not lit	---
	WDT	Lit	Not lit	Not lit	Not lit	Not lit	Not lit	---
	ALARM	Not lit	Not lit	Not lit	Not lit	Lit	Lit	---
	OUT INH	---	---	---	---	---	---	Lit
	COMM	---	---	---	---	---	---	---
Duplex Unit	DPL RUN	Not lit	Not lit	Lit	Not lit	Not lit	Lit	---
	DPL BUS ERR	Not lit	Not lit	Not lit	Lit	Lit	Not lit	---
	VERIFY ERR	Not lit	Not lit	Not lit	Lit	Lit	Not lit	---
	ACTIVE	Lit at normal Unit.	Lit at normal Unit.	Lit	Not lit	Lit	Lit	---
	RUN	Lit at normal Unit.	Lit at normal Unit.	Not lit	Not lit	Lit	Lit	---
	WAIT	Not lit	Not lit	Not lit	Lit (ACT)	Not lit	Not lit	---
	PROGRAM	Not lit	Not lit	Not lit	Lit (STB)	Not lit	Not lit	---
	CPU ERR	Lit	Not lit	Lit	Not lit	Not lit	Not lit	---
	MEM. ERR	Not lit	Lit	Not lit	Not lit	Not lit	Not lit	---

- Note**
1. Duplicated number, I/O points over, I/O setting error, program error, cycle time over, SFC stop error, system failure (FALS)
  2. System failure (FALS), JMP error, indirect DM BCD error, SYSMAC BUS/2 error, SYSMAC BUS error, battery failure, CPU Bus Unit setting error, duplicated power supply error
  3. ---: Lit or Not lit

## 6-3 Error Messages and Alarm Outputs

Status		Error	Program- ming De- vice error message	Auxiliary Area data			Cause	Corrective action
SPL	DPL			Error flags	Error code	Error data		
Startup errors	Startup errors	Waiting for START INPUT	CPU WAITING	A30600	---	A397	START INPUT of CPU Rack Power Supply Unit is OFF.	Connect a short-circuit so that the START INPUT for the Power Supply Unit on the CPU Rack will enter.
		No SYSMAC BUS terminator	CPU WAITING	A30602	---	---	Terminator is not set.	Turn on the power to the Remote I/O Slave Unit. Specify the Unit connected last as the terminator or wait until CPU Bus Units complete initialization.
		CPU Bus Unit initialization	CPU WAITING	A30603	---	---	Terminator of SYSMAC BUS/2 is missing, or CPU Bus Unit is still initializing.	Turn on the power to the Remote I/O Slave Unit. Specify the Unit connected last as the terminator.
		I/O verify error (PC Setup)	CPU WAITING	A30601 A40209	00E7	---	I/O Unit has been removed.	Verify the I/O table. Correct the table if necessary by create a new one.
Run- ning er- rors		Duplication bus error (power ON)	CPU WAITING	A30604	---	---	An error was detected in the redundant system's synchronous transfer bus.	Turn the power OFF and then ON again.  If the error is not corrected, replace the Duplex Unit or the Backplane.
		Duplication verification error (power ON)	CPU WAITING	A30605	---	---	The ACT/STB memory contents (user program, Expansion DM) contents do not match the Expansion DM size.	Check/correct the program. Correctly mount the EM Unit.

Status		Error	Program- ing De- vice error message	Auxiliary Area data			Cause	Corrective action
SPL	DPL			Error flags	Error code	Error data		
Fatal errors	Op- eration change	CPU error (WDT)	WDT ERR	---	80FF	---	A watchdog timer error was detected by the CPU's self-diagnostic function (WDT).	Turn the power OFF and then ON again.  If the error is not corrected, replace the CPU Unit.
		CPU error (Memory error)	MEMORY ERR	A40115	80F1	A403	A memory parity error was detected by the CPU's self-diagnostic function.	Check/correct the program. Correctly mount the Memory Card and EM Unit.
Fatal errors	I/O bus error	I/O BUS error	I/O BUS ERR	A40114	80C0 to 80C7 80CE, 80CF	A404	Erroneous data transferred between CPU and I/O Units	Check the cables between the Racks. Perform the error clear operation after corrective action has been taken.
		Duplicated number	NO DUPL ERR	A40113	80E9	A409 A410	Rack numbers and CPU Bus Unit unit numbers or I/O words are assigned in duplicate.	Set the Rack No. and Unit No. again. Then turn the power OFF and ON again. Perform the error clear operation after corrective action has been taken.
		CPU bus error	CPU BUS ERR	A40112	8100 to 8115	A405	Error in data transfer between CPU and CPU Bus Unit or watchdog timer error in CPU Bus Unit.	Check the cables between the CPU Rack and Expansion CPU Rack. Perform the error clear operation after corrective actions have been taken.
		I/O points over	I/O OVER	A40111	80E1	A407 A408 A478	Too many I/O points or too many Units are registered in the I/O table.	Read the I/O table to check the number of words allocated. Correct the table if necessary by creating a new one.
		I/O setting error	I/O SET ERR	A40110	80E0	---	Input/Output designation is wrong for I/O Unit.	Verify the I/O table. Correct the table if necessary.
		Program error	NO END INSTR PROGRAM OVER	A40109	80F0	---	END(001) is missing, or the capacity of the user memory is exceeded.	Correct the program. Perform the error clear operation after corrective actions have been taken.
		Cycle time over	SCAN TIME OVER	A40108	809F	A462/463 (Maximum Cycle Time) A464/465 (Minimum Cycle Time)	Cycle time monitor time is exceeded.	Check the program or set time for monitoring the cycle.
		System failure (FALS)	SYSTEM FAL	A40106	C101 to C2FF	---	FALS was executed in program.	Check/correct the program.

Status		Error	Program- ing De- vice error message	Auxiliary Area data			Cause	Corrective action
SPL	DPL			Error flags	Error code	Error data		
Non-fatal errors	Non-fatal errors	Duplication bus error	DPL BUS ERR	A40200	000E	A396	An error was detected in the redundant system's synchronous transfer bus.	Check and correct the program.
---		Duplication verification error.	DPL VERIFY ERR	A40201	0011		The ACT/STB memory contents (user program, Expansion DM) contents do not match the Expansion DM size.	Check and correct the program. Correctly mount the EM Unit.
Non-fatal errors		System error (FAL)	SYSTEM ERR FAL	A40215	4101 to 42FF (*)	A430 to A461 (FAL No.)	Program has executed FAL	Check the program.
		JMP error	JMP ERR	A40213	00F9	---	Destination of JMP/CJP/CJPN is missing.	Check and correct the program.
		Indirect DM BCD error	INDIRECT DM BCD ERR	A40212	00F8	---	Data for indirectly addressed DM is not BCD.	
		I/O verification error	I/O VERIFY ERR	A40209	00E7	---	I/O table contains a different number of I/O points than is actually mounted.	Verify the I/O table. After the corrective actions have been taken, create a new I/O table.
		CPU Bus Unit error	CPU SPECIAL UNIT ERR	A40207	0200 to 0215 0231 (**)	A422 (CPU Bus Unit Error Unit Number) A42315 (CPU Bus Link Error Flag)	Parity error occurs during data transfer between CPU and CPU Bus Unit.	Check the Unit.
		SYSMAC BUS/2 error	SYSMAC BUS/2 ERR	A40206	00B0 to 00B3 (***)	A424 (SYSMAC BUS/2 Error Master Number) A480 to A499 (SYSMAC BUS/2 Error Unit Number)	Error occurs between Master and Slave in SYSMAC BUS/2.	Check transmission lines for SYSMAC BUS/2. Check to see if SYSMAC BUS/2 Slave is normal.
		SYSMAC BUS error	SYSMAC BUS ERR	A40205	00A0 to 00A7 (****)	A425 (SYSMAC BUS Error Master Number) A470 to A477 (SYSMAC BUS Error Codes)	Error occurs between Master and Slave in SYSMAC BUS.	Check transmission lines for SYSMAC BUS. Check to see if SYSMAC BUS Slave is normal.
		Battery failure	BATTERY ERR	A40204	00F7	A42615 (PC Battery Low Flag) A42614 (Memory Card Battery Low Flag)	Battery of CPU or Memory Card is not connected or battery voltage is low.	Replace the battery of the CPU or Memory Card. Check the connections of the CPU battery.
		CPU Bus Unit setting error	CPU SPECIAL UNIT SETTING ERR	A40203	0400 to 0415 (**)	A427	Number assigned to CPU Bus Unit does not agree with registered unit number.	Check the Unit.

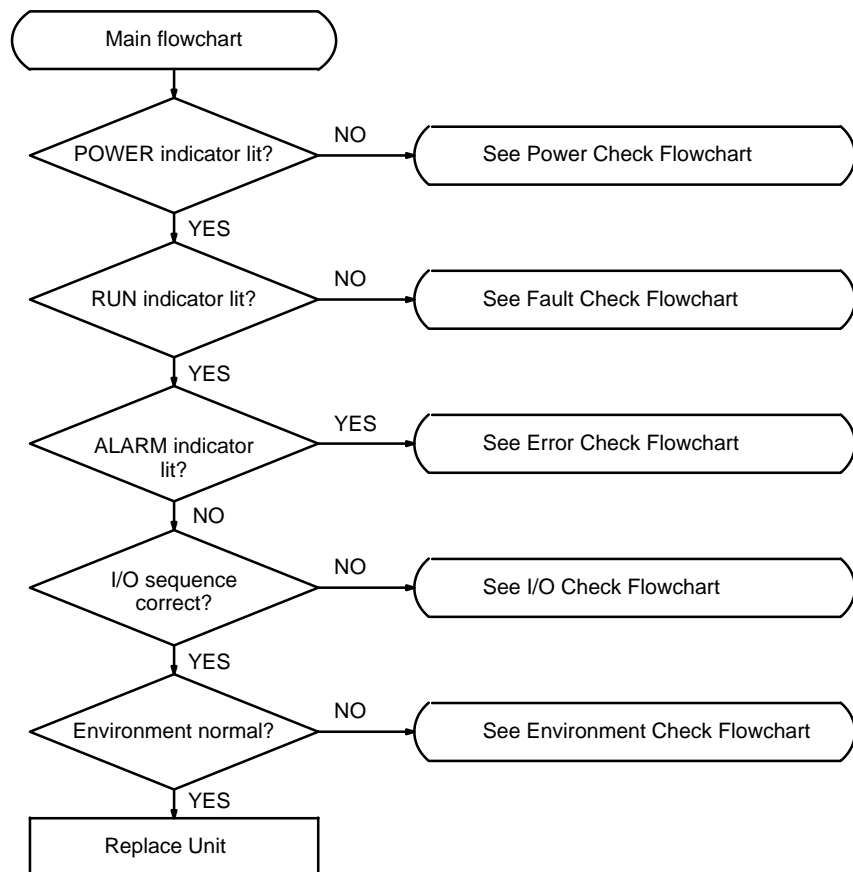
Status		Error	Program- ming De- vice error message	Auxiliary Area data			Cause	Corrective action
SPL	DPL			Error flags	Error code	Error data		
---	Non- fatal errors	Duplication power supply error	POWER ERR Displayed at IOC/IOIF. PSE-: Left PS-E: Right	A40214	0001	A398	Power Supply Unit failure. A voltage drop has been detected for the output voltage at one of the power supplies (right or left).	Check the defective Power Supply Unit by means of the I/O Interface Unit display, and so on, and replace it with a new Unit.  Replace the Power Supply Unit with the same model as the other one being used.

**Note** \* 101 through 2FF indicate FAL Nos.  
 \*\* 00 through 15 indicate the Unit Nos. of the CPU Bus Units. 31 indicates a CPU bus link error.  
 \*\*\* 0 through 3 indicate the RM addresses of SYSMAC BUS/2.  
 \*\*\*\* 0 through 7 indicate the RM addresses of SYSMAC BUS.

## 6-4 Troubleshooting Flowcharts

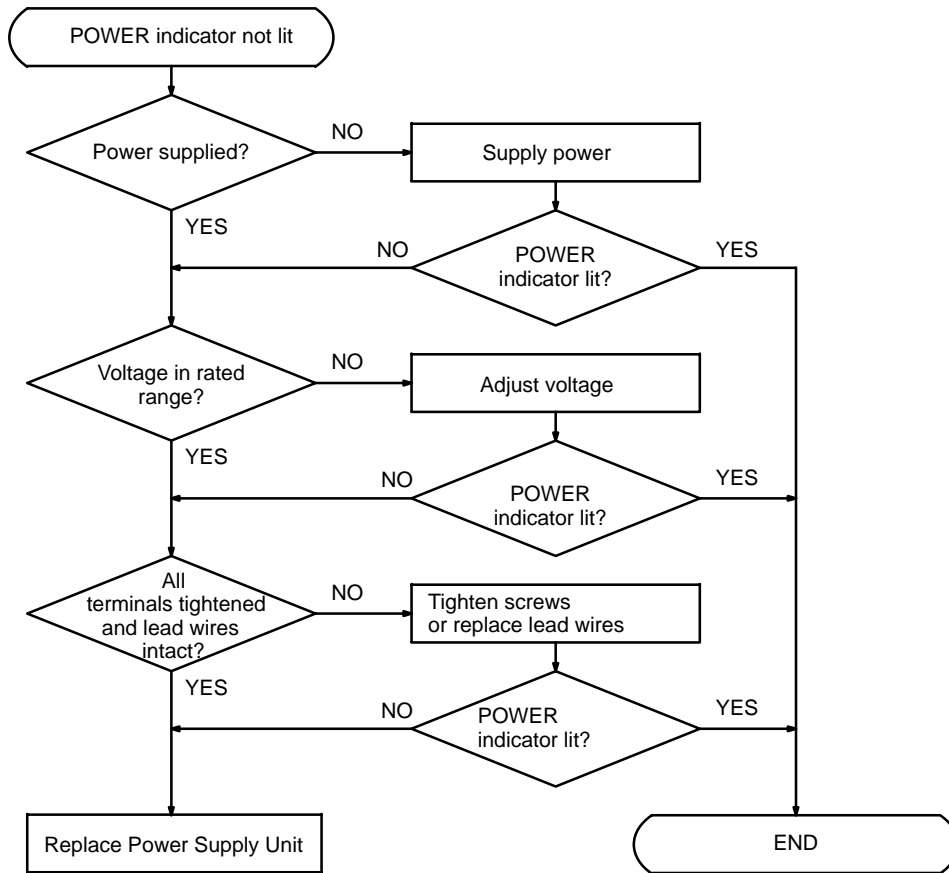
### Main Flowchart

When an unknown error arises, the following troubleshooting flowchart can be used to help locate the problem.



**Note** Before replacing a Unit, be sure to turn off the power to the PC. The same applies when replacing the EM Unit, batteries, wiring, and cables.

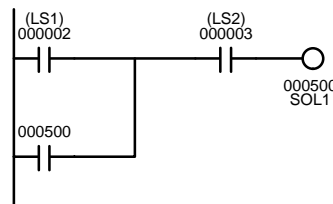
Power Check Flowchart



Unit	Supply voltage	Operating voltage range
CVM1D-PA212	100 to 120 VAC	85 to 132 VAC
CVM1D-PA208	200 to 240 VAC	170 to 264 VAC

I/O Check Flowchart

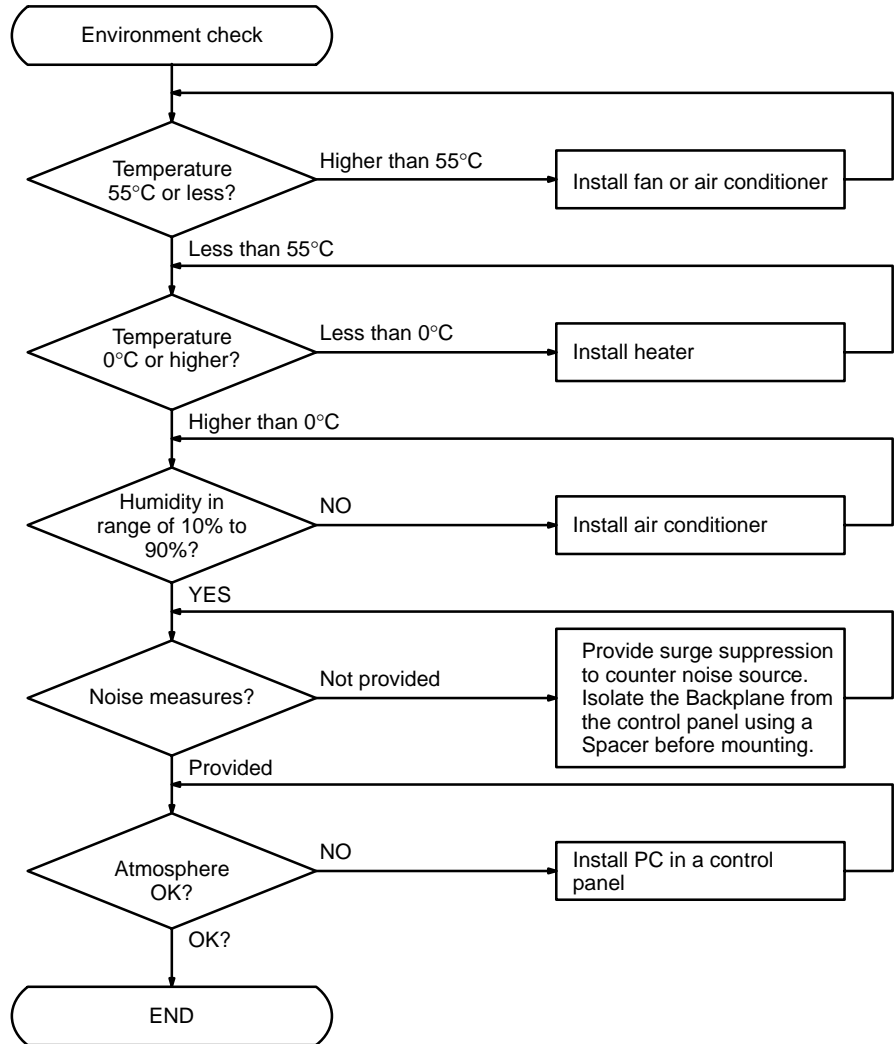
It is assumed that the ladder diagram shown below is programmed and that SOL1 malfunctions.







Environment Check Flowchart



## 6-5 Error Processing and Correction

### CPU Rack/Expansion CPU Rack/Expansion I/O Rack

Symptom	Cause	Remedy
POWER indicator is not lit.	PCB short-circuited or damaged by heat.	Replace Power Supply Unit or Backplane.
RUN indicator is not lit.	(1) START INPUT terminals are OFF.	Short-circuit START INPUT terminals.
	(2) Error in program.	Correct program
	(3) Power line is faulty.	Replace Power Supply Unit.
PC RUN OUTPUT does not turn ON. RUN indicator lit.	Internal circuitry of Power Supply Unit is faulty.	Replace Power Supply Unit.
Link Unit or CPU Bus Unit does not operate or malfunctions.	(1) CPU cable is faulty.	Replace CPU cable.
	(2) CPU bus is faulty.	Replace Backplane.
	(3) Expansion CPU Rack is faulty.	Replace I/O Control or I/O Interface Unit.
Bit does not operate.	I/O bus faulty.	Replace Backplane.
Error occurs in units of 8 points.	(1) I/O cable is faulty.	Replace I/O cable.
	(2) I/O bus is faulty.	Replace Backplane.
	(3) Expansion I/O Rack is faulty.	Replace I/O Control or I/O Interface Unit.
I/O bit turns ON	I/O bus is faulty.	Replace Backplane.
All bits for one Unit do not turn ON.	I/O bus is faulty.	Replace Backplane.
DPL BUS ERR indicator is lit.	The redundant system is faulty.	Replace Duplex Unit or Backplane.
VERIFY ERR indicator is lit.	The redundant system or the CPU bus is faulty.	Replace Duplex Unit or Backplane.

**Input Units**

Symptom	Cause	Remedy
Not all inputs turn ON or indicators are not lit.	(1) Power is not supplied to Input Unit.	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 (indicator lit).	Input circuit is faulty.	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.	Adjust external input voltage to within rated range.
	(2) Malfunction due to noise.	Protective measures against noise, such as: (1) Install surge suppressor. (2) Install insulation transformer. (3) Install shielded cable. (4) Isolate the Backplane from the control panel before mounting.
	(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.	(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.
Input indicator is not lit in normal operation.	Faulty indicator	Replace Unit.

# Appendix A

## Standard Models

### CPU Racks

Name	Specifications		Model
CPU Backplane	5 slots		CVM1D-BC051
CPU Unit	Two are required in a duplex system.		CVM1D-CPU21
Duplex Unit	Must also be used in simplex system.		CVM1D-DPL01
Power Supply Unit	100 to 120/200 to 240 VAC (In a system with dual power supplies, use two Power Supply Units of the same model.)	8 A	CVM1D-PA208
		12 A	CVM1D-PA212
I/O Control Unit	To connect Expansion CPU Racks*		CV500-IC101
	To connect Expansion I/O Racks*		CV500-IC201
	To connect C500 Expansion I/O Racks		CV500-IC301
Memory Card	RAM	64K bytes	HMC-ES641
		128K bytes	HMC-ES151
		256K bytes	HMC-ES251
		512K bytes	HMC-ES551
	EEPROM	64K bytes	HMC-EE641
		128K bytes	HMC-EE151
	EPROM (Requires CV500-MCW01 Memory Card.)	512 bytes	HMC-EP551
		1M bytes	HMC-EP161
EM Unit (Expansion DM Memory Unit)	64K bytes		CV1000-DM641
	128K bytes		CV1000-DM151
	256K bytes		CV1000-DM251

**Note** \*Two CV500-TER01 Terminating Resistance Units are provided with each CV500-IC101/IC201 I/O Control Unit.

## Expansion CPU Racks

Name	Specifications	Model	
Expansion CPU Backplane	10 slots	CVM1D-BI101	
Power Supply Unit	100 to 120/200 to 240 VAC (In a system with dual power supplies, use two Power Supply Units of the same model.)	8 A	CVM1D-PA208
		12 A	CVM1D-PA212
I/O Interface Unit	For Expansion CPU Rack	CV500-II101	
CPU Bus Cable	Length: 30 cm	CV500-CN311	
	Length: 60 cm	CV500-CN611	
I/O Cable	Length: 30 cm	CV500-CN312	
	Length: 60 cm	CV500-CN612	
Terminating Resistance Unit	Mount to an I/O Expansion Unit to be used as a terminator. Two Terminating Resistance Units are provided the CV500-IC101/201 I/O Control Unit.	CV500-TER01	

## Expansion I/O Backplanes

Name	Specifications	Model	
Expansion I/O Backplane	10 slots	CVM1D-BI102	
Power Supply Unit	100 to 120/200 to 240 VAC (In a system with dual power supplies, use two Power Supply Units of the same model.)	8 A	CVM1D-PA208
		12 A	CVM1D-PA212
I/O Interface Unit	For Expansion I/O Rack	CV500-II201	
I/O Cable	Length: 30 cm	CV500-CN312	
	Length: 60 cm	CV500-CN612	
	Length: 1 m	CV500-CN122	
	Length: 2 m	CV500-CN222	
	Length: 3 m	CV500-CN322	
	Length: 5 m	CV500-CN522	
	Length: 10 m	CV500-CN132	
	Length: 20 m	CV500-CN232	
	Length: 30 m	CV500-CN332	
	Length: 40 m	CV500-CN432	
	Length: 50 m	CV500-CN532	
Terminating Resistance Unit	Mount to an I/O Expansion Unit to be used as a terminator. Two Terminating Resistance Units are provided the CV500-IC101/201 I/O Control Unit.	CV500-TER01	

## Input Units

Name		Specifications			Model
Input Units	DC	16 mA, 5 to 12 VDC; ON delay: 1.5 ms, OFF delay: 1.5 ms	16 pts	8 pts/common; 2 circuits	3G2A5-ID112
		10 mA, 12 to 24 VDC; ON delay: 1.5 ms, OFF delay: 1.5 ms	16 pts	8 pts/common; 2 circuits	3G2A5-ID213
		10 mA, 12 to 24 VDC; ON delay: 1.5 ms, OFF delay: 1.5 ms	32 pts	8 pts/common; 4 circuits	3G2A5-ID215
		10 mA, 12 to 24 VDC; ON delay: 1.5 ms, OFF delay: 1.5 ms	32 pts	8 pts/common; 4 circuits	3G2A5-ID218
		10 mA, 12 to 24 VDC; connector	32 pts	8 pts/common; 4 circuits	C500-ID218CN
		7 mA, 12 VDC; static; ON delay: 1.5 ms, OFF delay: 1.5 ms	64 pts	8 pts/common; 8 circuits	C500-ID114
		10 mA, 24 VDC; dynamic scan	64 pts	---	3G2A5-ID212
		7 mA, 24 VDC; ON delay: 1.5 ms, OFF delay: 1.5 ms	64 pts	8 pts/common; 8 circuits	3G2A5-ID219
	AC	10 mA, 100 to 120 VAC; ON delay: 35 ms, OFF delay: 55 ms	16 pts	8 pts/common; 2 circuits	3G2A5-IA121
		10 mA, 200 to 240 VAC; ON delay: 35 ms, OFF delay: 55 ms	16 pts	8 pts/common; 2 circuits	3G2A5-IA222
		10 mA, 100 to 120 VAC; ON delay: 35 ms, OFF delay: 55 ms	32 pts	8 pts/common; 4 circuits	3G2A5-IA122
		10 mA, 200 to 240 VAC; ON delay: 35 ms, OFF delay: 55 ms	32 pts	8 pts/common; 4 circuits	C500-IA223
	AC/DC	10 mA, 12 to 24 VAC/DC; ON delay: 15 ms, OFF delay: 15 ms	16 pts	8 pts/common; 2 circuits	3G2A5-IM211
		10 mA, 12 to 24 VAC/DC; ON delay: 15 ms, OFF delay: 15 ms	32 pts	8 pts/common; 4 circuits	3G2A5-IM212
	TTL	3.5 mA, 5 VDC; connector	32 pts	8 pts/common; 4 circuits	C500-ID501CN

## Output Units

Name		Specifications			Model
Output Units	Contact	2 A, 250 VAC/24 VDC; with relay sockets; 8 commons	16 pts	8 pts/common; 2 circuits	3G2A5-OC221
		2 A, 250 VAC/24 VDC; with relay sockets; all outputs independent	16 pts	Independent commons	3G2A5-OC223
		2 A, 250 VAC/24 VDC; with relay sockets	32 pts	8 pts/common; 4 circuits	3G2A5-OC224
	Transistor	1 A, 12 to 24 VDC; no output when external power supply is OFF	16 pts	8 pts/common; 2 circuits	C500-OD217
		2.1 A, 12 to 24 VDC	16 pts	8 pts/common; 2 circuits	C500-OD219
		1 A, 12 to 48 VDC	16 pts	16 pts/common; 1 circuit	3G2A5-OD411
		50 mA, 24 VDC; all outputs independent	16 pts	Independent commons	3G2A5-OD215
		0.3 A, 12 to 24 VDC	32 pts	16 pts/common; 2 circuits	C500-OD218
		0.3 A, 12 to 48 VDC	32 pts	16 pts/common; 2 circuits	C500-OD414
		0.3 A, 12 to 48 VDC; negative common; terminal block	32 pts	32 pts/common; 1 circuit	3G2A5-OD412
		0.3 A, 12 to 24 VDC; positive common	32 pts	16 pts/common; 2 circuits	3G2A5-OD212
		0.3 A, 12 to 48 VDC; negative common; connector	32 pts	16 pts/common; 2 circuits	C500-OD415CN
		0.1 A, 24 VDC; dynamic scan	64 pts	---	3G2A5-OD211
		0.1 A, 24 VDC; static connector	64 pts	8 pts/common; 8 circuits	3G2A5-OD213
		Triac	1 A, 100 to 240 VAC	32 pts	8 pts/common; 4 circuits
1.2 A, 100 to 240 VAC	16 pts		8 pts/common; 2 circuits	C500-OA226	
TTL	35 mA, 5 VDC; connector	32 pts	8 pts/common; 4 circuits	C500-OD501CN	
DC Input/Transistor Output Unit	12 to 24-VDC inputs: 10 mA; 12 to 24-VDC outputs: 0.3 connector	16 pts each	---	C500-MD211CN	
Dummy I/O Unit	Input or output	16, 32, or 64 points	---	3G2A5-DUM01	
I/O Power Supply Unit	Input: 100 to 120/200 to 240 VAC Output: 2A, 24 VDC		---	CV500-IPS01	

## Special I/O Units

Name	Specifications		Model
Analog Input Unit	4 to 20 mA, 1 to 5 V; 2 inputs	2 pts	3G2A5-AD001
	0 to 10 V; 2 inputs	2 pts	3G2A5-AD002
	0 to 5 V; 2 inputs	2 pts	3G2A5-AD003
	-10 to 10 V; 2 inputs	2 pts	3G2A5-AD004
	-5 to 5 V; 2 inputs	2 pts	3G2A5-AD005
	4 to 20 mA, 1 to 5 V; 4 inputs	4 pts	3G2A5-AD006
	0 to 10 V; 4 inputs	4 pts	3G2A5-AD007
	0 to 10 V, 0 to 20 mA (selectable); 8 inputs	8 pts	C500-AD101
	0 to 5 V, 0 to 10 V -5 to 5 V, -10 to 10 V, 0 to 20 mA, -20 to 20 mA; 16 inputs	16 pts	C500-AD501
Analog Output Unit	4 to 20 mA, 1 to 5 V; 2 outputs	2 pts	3G2A5-DA001
	0 to 10 V; 2 outputs	2 pts	3G2A5-DA002
	0 to 5 V; 2 outputs	2 pts	3G2A5-DA003
	-10 to 10 V; 2 outputs	2 pts	3G2A5-DA004
	-5 to 5 V; 2 outputs	2 pts	3G2A5-DA005
	0 to 20 mA, 1 to 5 V/0 to 10 V (selectable); 4 outputs	4 pts	C500-DA101
	-10 to 10 V, 4 outputs	4 pts	C500-DA103
Temperature Sensor Unit	Voltage inputs, supports 8 types of thermocouples	8 pts	C500-TS501
	Platinum resistance thermometer		C500-TS502
High-speed Counter Unit	6-digit BCD; 50 kcps; one counted input; 1 pair of SV	1 pt	3G2A5-CT001
	6-digit BCD; 50 kcps; one counted input; 8 pair of SV	1 pt	3G2A5-CT012
	50 kcps; 7 operating modes	2 pts	C500-CT021
	6-digit BCD; 20 kcps; four counted inputs; 6 modes	4 pts	C500-CT041
Position Control Unit	For stepping motor; one axis		3G2A5-NC111-EV1
	For pulse motors; two axes		C500-NC222-E
	1-axis control		C500-NC113
	2-axis control		C500-NC211
	Encoder Adapter		3G2A5-AE001
	Teaching Box	For 1 axis	3G2A5-TU001-E
		For 2 axes	C500-TU002-E
	Connecting Cable: To connect C500-TU002-E Teaching Box to C500-NC222-E.	2 m	C200H-CN222
		4 m	C200H-CN422
Connecting Cable: To connect C500-TU002-E Teaching Box to 3G2A5-NC103-E/NC111-EV1 Position Control Unit.		C500-CN422	
Cam Positioner Unit	External outputs: 8 pts; Words output to PC: 2 (16 pts.)		C500-CP131
ASCII Unit	RAM and EEPROM		C500-ASC04
Ladder Program I/O Unit	Has 40 instructions (same as a C20P.) Input and output points (16 each.)		C500-LDP01-V1
ID Sensor Unit	Electromagnetic type	General-purpose	C500--V1
		Long-distance	C500-IDS02
	Microwave type	General-purpose	C500-IDS21
		Long-distance	C500-IDS22
	For the C500-IDS02		C500-IDA02
For the C500-IDS22		C500-IDA22	



## CPU Bus Units

The CV-series SYSMAC LINK, SYSMAC BUS/2, and SYSMAC NET Link Units are also classified as CPU Bus Units. CPU Bus Units must be mounted to the proper slots on CPU or Expansion CPU Racks.

Name	Specifications		Model		
Temperature Controller Data Link Unit	Connects up to 64 temperature control devices via 2 ports.		CV500-TDL21		
BASIC Unit	Must be mounted to CPU or CPU Expansion Rack	RS-232C x 2 RS-422 x 1	RAM EEPROM + RAM	CV500-BSC11 CV500-BSC21	
		RS-232C x 2 Centronics x 1	RAM EEPROM + RAM	CV500-BSC31 CV500-BSC41	
			RAM EEPROM + RAM	CV500-BSC51 CV500-BSC61	
		Personal Computer Unit	Without floating-point division	4MB main memory	CV500-VP213-E
				8MB main memory	CV500-VP217-E
			With floating-point division	4MB main memory	CV500-VP223-E
8MB main memory	CV500-VP227-E				
RAM Disk Board	2MB memory		CV500-MR261		
PC Card Interface Board	For PCMCIA 2.1 Type I and II cards		CV500-MP602		
Floppy Disk Drive	One floppy disk drive		CV500-FDD01		
	Two floppy disk drives		CV500-FDD02		
Floppy/Hard Disk Drive	For 100 VAC		CV500-FHD01-E		
	For 200 VAC		CV500-FHD02-E		
Backup Battery Set	---		CV500-BAT08		
Motion Control Unit	2 axes		CV500-MC221		
	4 axes		CV500-MC421		
Teaching Box Connecting Cables	Cable length: 2 m		CV500-CN224		
	Cable length: 4 m		CV500-CN424		
	Cable length: 6 m		CV500-CN624		
MC Support Software	For IBM PC/AT or compatible		CV500-ZN3AT1-E		

## Network Units and Remote I/O Units

The CV-series SYSMAC LINK, SYSMAC BUS/2, SYSMAC NET Link Units, and Ethernet Units are classified as CPU Bus Units.

Name		Specifications			Model			
SYSMAC NET Link Unit		General-purpose			CV500-SNT31			
SYSMAC LINK Unit		Optical			CV500-SLK11			
		Coaxial			CV500-SLK21			
		Power Feeder Unit		For optical SYSMAC LINK Unit		C1000H-APS01		
		Controller Link Unit		Wired			CVM1-CLK21	
		M-NET Interface Unit		Wired			CV500-MIF01	
ME-NET Interface Unit		Coaxial			CV500-TLK01			
SYSMAC BUS/2		Remote I/O Master Unit		Optical	CV500-RM211			
				Wired	CV500-RM221			
		Remote I/O Slave Unit		Optical	CV500-RT211			
				Wired	CV500-RT221			
Ethernet Unit		Supports TCP/IP and UDP/ID			CV500-ETN01			
SYSMAC BUS		Optical Remote I/O Master Unit		APF/PCF		3G2A5-RM001-PEV1		
				PCF		3G2A5-RM001-EV1		
		Optical Remote I/O Slave Unit		APF/ PCF	W/1 optical connector	3G2A5-RT001-PEV1		
					W/2 optical connectors	3G2A5-RT002-PEV1		
				PCF	W/1 optical connector	3G2A5-RT001-EV1		
					W/2 optical connectors	3G2A5-RT002-EV1		
		Wired Remote I/O Master Unit		---			C500-RM201	
Wired Remote I/O Slave Unit		---			C500-RT201			
SYSMAC BUS Optical I/O Units		DC Input	No-voltage contact	8 pts	100-VAC power supply	APF/PCF	3G5A2-ID001-PE	
						PCF	3G5A2-ID001-E	
		AC/DC Input	12 to 24 VAC/DC	8 pts		APF/PCF	3G5A2-IM211-PE	
						PCF	3G5A2-IM211-E	
		AC Input	100 VAC	8 pts		APF/PCF	3G5A2-IA121-PE	
						PCF	3G5A2-IA121-E	
		Contact Output	2 A, 250 VAC/ 24 VDC	8 pts		100/200-VAC power supply	APF/PCF	3G5A2-OC221-PE
							PCF	3G5A2-OC221-E
		Transistor Output	0.3 A, 12 to 48 VDC	8 pts			APF/PCF	3G5A2-OD411-PE
							PCF	3G5A2-OD411-E

## Miscellaneous Remote I/O System Units

Link Adapters with the suffix -P in the model number can be extended up to 200 m by using plastic-clad optical fiber cable. Those without the suffix -P in the model number can be extended up to 800 m.

Name	Specifications	Model
Link Adapter	RS-422, 3 pcs	3G2A9-AL001
	Optical (APF/PCF), 3pcs	3G2A9-AL002-PE
	Optical (PCF), 3pcs	3G2A9-AL002-E
	Optical (APF/PCF), RS-422, RS-232C, 1 pc each	3G2A9-AL004-PE
	Optical (PCF), RS-422, RS-232C, 1 pc each	3G2A9-AL004-E

## All Plastic Optical-Fiber Cable (APF)

Name	Specifications	Model
Plastic Optical Fiber Cable	Cable only, 5 to 100 m in multiples of 5 m, or multiples of 200 or 500 m	3G5A2-PF002
Optical Connector A	2 pcs (brown), for plastic optical fiber 10 m long max.	3G5A2-CO001
Optical Connector B	2 pcs (black) for plastic optical fiber 8 to 20 m long	3G5A2-CO002
Plastic Optical Fiber Cable	1 m, w/optical connector A provided at both ends	3G5A2-PF101

## Plastic-Clad Optical-Fiber Cable (PCF)

Name	Specifications		Model
Optical Fiber Cable (indoor)	0.1 m, w/connector	Ambient temperature: -10° to 70°C	3G5A2-OF011
	1 m, w/connector		3G5A2-OF101
	2 m, w/connector		3G5A2-OF201
	3 m, w/connector		3G5A2-OF301
	5 m, w/connector		3G5A2-OF501
	10 m, w/connector		3G5A2-OF111
	20 m, w/connector		3G5A2-OF211
	30 m, w/connector		3G5A2-OF311
	40 m, w/connector		3G5A2-OF411
	50 m, w/connector		3G5A2-OF511
Optical Fiber Cable (indoor/outdoor)	1 to 500 m (order in units of 1 m)	Ambient temperature: -10° to 70°C	3G5A2-OF002
	501 to 800 m (order in units of 1 m)	Ambient temperature: 0° to 55°C (Must not be subjected to direct sunlight)	

## Hard-plastic-clad Quartz Fiber Cable: H-PCF

Up to 800 m of H-PCF cable can be used between Units in the following systems: SYSMAC NET, SYSMAC LINK, and SYSMAC BUS/2. In the SYSMAC BUS system, up to 100 m of H-PCF cable can be used between Units whose model number suffix contains a P and up to 200 m between other Units whose model number does not contain a P.

You can use connector-equipped cables or assemble cables yourself. The following are required to assemble H-PCF cable: the cable itself, Optical Connectors, Cable Assembly Tool, Cable Cutter Optical Power Tester, Head Unit, and Master Fiber. The user must assemble and test the optical connectors. Refer to the *H-PCF Installation Manual* for details.

H-PCF cables can be used at an ambient temperature of between  $-20^{\circ}$  and  $70^{\circ}\text{C}$ .

### H-PCF Optical Fiber Cords and Cables

Cable type	Cable color	Cable length	Model
Two optical conductors with feeder	Black	10 meters	S3200-HCLB101
		50 meters	S3200-HCLB501
		100 meters	S3200-HCLB102
		500 meters	S3200-HCLB502
		1,000 meters	S3200-HCLB103
	Orange	10 meters	S3200-HCLO101
		50 meters	S3200-HCLO501
		100 meters	S3200-HCLO102
		500 meters	S3200-HCLO502
		1,000 meters	S3200-HCLO103
Without feeder	Black	10 m	S3200-HCCB101
		50 m	S3200-HCCB501
		100 m	S3200-HCCB102
		500 m	S3200-HCCB502
	Orange	10 m	S3200-HCCO101
		50 m	S3200-HCCO501
		100 m	S3200-HCCO102
		500 m	S3200-HCCO502
Two-core optical cord	Black	10 m	S3200-HBCB101
		50 m	S3200-HBCB501
		100 m	S3200-HBCB102
		500 m	S3200-HBCB502
		1,000 m	S3200-HBCB103

## H-PCF Optical Fiber Cords and Cables with Connectors

The following diagram illustrates the model number for cables with connectors. Tension members and power lines are provided in the cable. Half-lock connectors use the S3200-COCF2511 and are compatible with C200H SYSMAC LINK or SYSMAC NET Link Unit connectors. Full-lock connectors use the S3200-COCF2011 and are compatible with CV-series SYSMAC LINK or SYSMAC NET and C1000H SYSMAC LINK Link Unit connectors. Full-lock connectors cannot be used with C200H connectors.

The above connectors cannot be used with C500 SYSMAC NET Link Unit connectors, cable relays, or NSB. Refer to the *SYSMAC NET Link System Manual* for appropriate connectors for these applications.

S3200-CN□□□□-□□-□□

Cable Length		Connector Type	
201	2 m	20-20	Full-lock connector on each end
501	5 m	20-25	One full-lock and one half-lock connector
102	10 m	25-25	Full lock connector on each end
152	15 m		
202	20 m		
Blank	Over 20 m*		*Specify lengths over 20 m separately when ordering.

## Optical Connectors

Name	Model
SYSMAC NET: CV500-SNT31 SYSMAC LINK: CV500-SLK11, C1000H-SLK11 SYSMAC BUS/2: CV500-RM211/RT211	S3200-COCF2011
SYSMAC NET: C200H-SNT31 SYSMAC LINK: C200H-SLK11	S3200-COCF2511
SYSMAC NET: C500-SNT31-V4 S3200-LSU03-01E/NSB11-E S3200-NSUA1-00E/NSUG4-00E FIT10-IF401	S3200-COCH62M
SYSMAC BUS: 3G2A5-RM001-(P)EV1 3G2A5-RT001/RT002-(P)EV1 3G2A9-AL□□-(P)E	S3200-COCH82
SYSMAC NET Relay (M) Connector	S3200-COCF62M
SYSMAC NET Relay (F) Connector	S3200-COCF62F

## Cable Assembly Tool and Cutter

Name	Model
Cable Assembly Tool	S3200-CAK1062

## Optical Power Tester

Name	Model
SYSMAC NET: CV500-SNT31	S3200-CAT2000
SYSMAC LINK: CV500-SLK11 SYSMAC BUS/2: CV500-RM211/RT211	S3200-CAT2700
SYSMAC BUS: 3G2A5-RM001-(P)EV1 3G2A5-RT001/RT002-(P)EV1	S3200-CAT2820
SYSMAC NET: S3200-LSU03-01E FIT10-IF401	S3200-CAT3200

**Note** Each Optical Power Tester is provided with a replaceable Head Unit. There is no difference in type among all Optical Power Testers except for the head unit. This means the S3200-CAT2000 Optical Power Tester, for example, can be used as the S3200-CAT2700, S3200-CAT2820, or S3200-CAT3200 Optical Power Tester by just replacing the Head Unit of the S3200-CAT2000 with those for the S3200-CAT2700, S3200-CAT2820, or S3200-CAT3200.

## Optical Power Tester Head Unit

Name	Model
SYSMAC NET: CV500-SNT31	S3200-CAT2002
SYSMAC LINK: CV500-SLK11	S3200-CAT2702
SYSMAC BUS/2: CV500-RM211/RT211	
SYSMAC BUS: 3G2A5-RM001-(P)EV1 3G2A5-RT001/RT002-(P)EV1	S3200-CAT2822
SYSMAC NET: S3200-LSU03-01E FIT10-IF401	S3200-CAT3202

## Programming Devices

Name	Specifications	Model	
CV Support Software Version 2 (CVSS) (See note)	Runs on an IBM PC/AT-compatible computer	3 1/2"	CV500-ZS3AT1-EV2
		5 1/4"	CV500-ZS5AT1-EV2
SYSMAC Support Software (SSS) (See note)	Runs on an IBM PC/AT-compatible computer	3 1/2"	C500-ZL3AT1-E
Memory Card Writer	---		CV500-MCW01-E
Programming Console	For CVM1/CV-series PCs only, cable required separately.		CVM1-PRS21-EV1

**Note** The CVSS does not support new instructions added for version-2 CVM1 PCs. The SSS does not support the CV500, CV1000, or CV2000.

## Optional

Name	Specifications	Model	
Battery	---	3G2A5-BAT08	
Memory Card Battery	---	HMC-BAT01	
I/O Terminal Cover	For 38-pin block, special type	3G2A5-COV11	
	For 38-pin block, standard	C500-COV12	
	For 20-pin block, standard	C500-COV13	
Connector Cover (see note)	Protector for I/O bus connector	3G2A5-COV01	
	Protector for CPU bus connector	CV500-COV01	
	Protector for Expansion I/O Rack IOIF connector	CV500-COV02	
	Protector for CPU Rack IOC or Expansion CPU Rack IOIF connector	CV500-COV03	
	Protector for Simple Expansion I/O Rack connector	CV500-COV04	
Space Unit	For I/O Unit	3G2A5-SP002	
Noise-preventing Spacers	Isolate the Backplanes of the CPU, Expansion CPU, and Expansion I/O Rack from the control panel before mounting.	50 pieces	CV500-ATT04
		4 pieces	CV500-ATT05

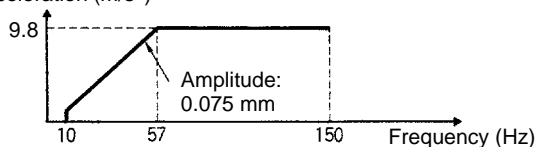
# Appendix B

## Specifications

### Common Specifications

Item	Specifications
Vibration resistance	10 to 57 Hz, 0.075-mm amplitude, 57 to 150 Hz, acceleration: 9.8 m/s <sup>2</sup> (see note) in X, Y, and Z directions for 80 minutes (Time coefficient; 8 minutes x coefficient factor 10 = total time 80 minutes) (according to JIS C0040)
Shock resistance	147 m/s <sup>2</sup> 3 times each in X, Y, and Z directions (according to JIS C0041)
Enclosure	Mounted in a panel
Ambient temperature	Operating: 0° to 55°C Storage: -20° to 75°C (except Memory Card and battery)
Humidity	10% to 90% (with no condensation)
Atmosphere	Must be free from corrosive gasses

**Note** Acceleration (m/s<sup>2</sup>)



### Power Supply Units

Item	Specifications	
	CVM1D-PA208	CVM1D-PA212
Racks	CPU Rack, Expansion CPU Rack, Expansion I/O Rack	
Input power supply	Rated voltage	100 to 120 VAC/200 to 240 VAC (automatic voltage switching)
	Frequency	50/60 Hz ±5%
		85 to 132 VAC/170 to 264 VAC
Power consumption	150 VA max.	200 VA max.
Inrush current	30 A max.	
Output capacity	8 A	12 A
Grounding	Less than 100 Ω	
Insulation resistance	20 MΩ min. (at 500 VDC) between AC external terminals and ⚡ (GR) terminals. (See note.)	
Dielectric strength	2,300 VAC 50/60 Hz for 1 min between AC external and ⚡ (GR) terminals, leakage current: 10 mA max. (See note)	
Noise immunity	1,500 Vp-p, pulse width: 100 ns to 1 μs, rise time: 1 ns (via noise simulation)	
Current protection	105% min.	
Voltage protection	6 V min.	
Start input	10 mA, 24 VDC	
Operating output contact	1a 250 VAC; 2A (COS φ = 1); 0.5 A (COS φ = 0.4); 24 VDC 2A	
Terminal screws	Size	M3.5
	Torque	0.8 N·m
Dimensions	250 x 47 x 96 mm (HxWxD)	
Weight	0.9 kilograms	

**Note** Disconnect the ⚡ (LG) terminal of the Power Supply Unit from the ⚡ (GR) terminal when performing insulation and dielectric strength tests. If the tests are repeatedly performed with the ⚡ (LG) and ⚡ (GR) terminals short-circuited, the internal components may be damaged.

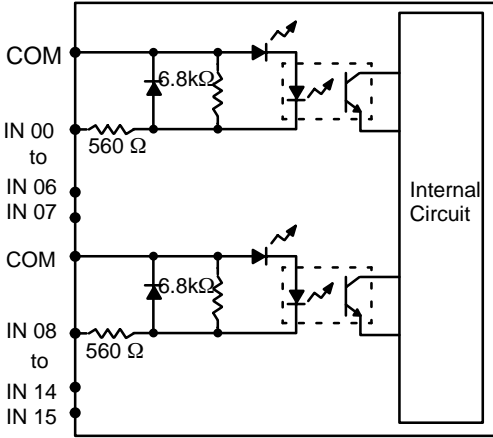
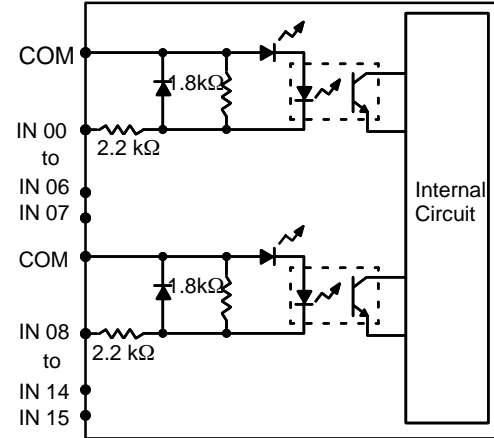
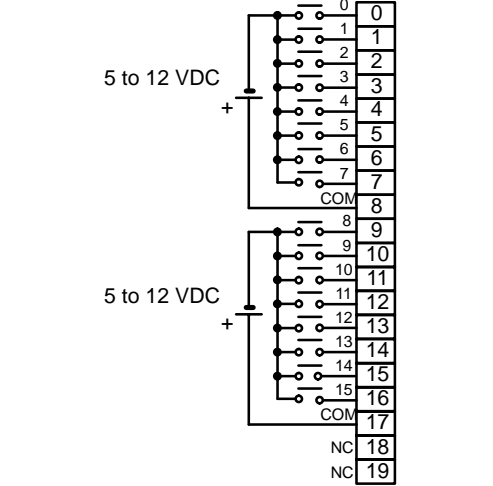
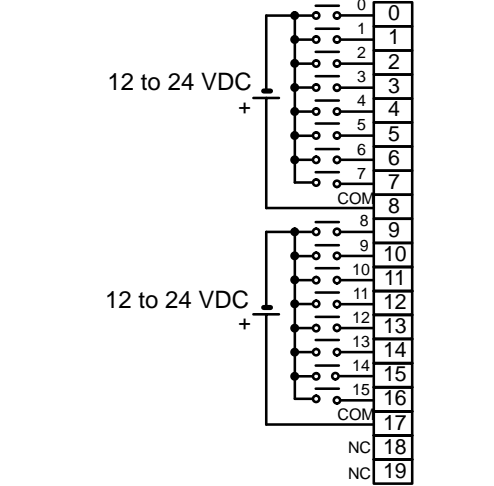
## CPU Specifications

CPU		CVM1D-CPU21
<b>Control method</b>		Stored program
<b>I/O control method (See note.)</b>		Cyclic and programmed refreshing
<b>Programming</b>		Ladder
<b>Instruction length</b>		1 to 8 words/instruction, 1 address/instruction
<b>Ladder instructions</b>		275 (500 variations )
<b>Execution time (μs)</b>	<b>Basic</b>	0.125 to 0.375
	<b>Special</b>	0.500 to 8.25
<b>Program capacity</b>		62K words
<b>Local I/O capacity</b>		2,048 pts (0000 to 0127)
<b>Remote I/O capacity</b>	<b>SYSMAC BUS/2</b>	2,048 pts
	<b>SYSMAC BUS</b>	2,048 pts
<b>Remote I/O bits</b>		SYSMAC BUS/2: 12,800 (0200 to 0999); SYSMAC BUS: 4,096 (2300 to 2555)
<b>Work bits</b>		1,152 (0128 to 0199) 6,400 (1900 to 2299)
<b>Link bits</b>		3,200: 100000 to 119915 (words 1000 to 1199)
<b>Holding bits</b>		4,800: 120000 to 149915 (words 1200 to 1499)
<b>CPU Bus Unit bits</b>		6,400: 150000 to 189915 (words 1500 to 1899)
<b>Temporary bits</b>		8 (TR0 to TR7)
<b>CPU bus link bits</b>		4,096: G00000 to G25515 (words G000 to G255)
<b>Auxiliary bits</b>		8,192: A00000 to A51115 (words A000 to A511)
<b>Timers</b>		1,024 (T0000 to T1023)
		Normal timers: 0 to 999.9 s, high-speed timers: 0 to 99.99 s
<b>Counters</b>		1,024 (C0000 to C1023)
		(0 to 9999 counts)
<b>Data memory</b>		24,576 words (D00000 to D24575)
<b>Expansion DM</b>		256K words (E00000 to E32765 x 8 banks)
<b>Data registers</b>		3 (DR0 to DR2)
<b>Index registers</b>		3 (IR0 to IR2)
<b>File memory</b>		Memory Cards: RAM (512K bytes), EEPROM (128K bytes), or EPROM (1M bytes)
<b>Control input signal</b>		START INPUT: In RUN mode, PC begins operation when input is ON and halts when it is OFF. Input specifications: 24 VDC, 10 mA
<b>Control output signal</b>		PC RUN OUTPUT: The RUN OUTPUT terminals are ON (closed) while PC is operating. Maximum switching capacity: 250 VAC/2 A (resistive load, $\cos\phi = 1$ ) 250 VAC/0.5 A (inductive load, $\cos\phi = 0.4$ ) 24 VDC/2 A
<b>Memory protection</b>		Holding bits (internal status maintained), contents of counters and data memory, SFC execution status (can be set)
<b>Battery life</b>		Service life: 5 years. The memory backup time when PC is not powered varies with the ambient temperature.
<b>Self-diagnostics</b>		CPU failure (watchdog timer), I/O verify error, I/O bus error, memory failure, remote I/O error, battery error, link error, or Special I/O Unit/CPU Bus Unit errors

**Note** The CVM1D does not support immediate, zero-cross, and scheduled refreshing. Although it is possible to specify immediate refreshing with instructions, faulty operation can occur with Duplex Systems. Do not use immediate refreshing with Duplex Systems. It can be used with Simplex Systems. (Although immediate, zero-cross, and scheduled refreshing can be specified in the PC Setup, these settings will be ignored.)



### DC Input Units

Item	3G2A5-ID112	3G2A5-ID213
Input Voltage	5 to 12 VDC +10%/-15%	12 to 24 VDC +10%/-15%
Input Impedance	560 Ω	2.2 kΩ
Input Current	16 mA typical (at 12 VDC)	10 mA typical (at 24 VDC)
ON Voltage	4.0 VDC min.	10.2 VDC min.
OFF Voltage	1.5 VDC max.	3.0 VDC max.
ON Delay	1.5 ms max.	1.5 ms max.
OFF Delay	1.5 ms max.	1.5 ms max.
No. of Inputs	16 (8 inputs/common, 2 circuits)	16 (8 inputs/common, 2 circuits)
Internal Current Consumption	10 mA, 5 VDC max.	20 mA, 5 VDC max.
Weight	450 grams max.	450 grams max.
Circuit Configuration	 <p>Two-wire sensors cannot be connected.</p>	
Terminal Connections		
Dimensions	A-shape	A-shape

### DC Input Units (Continued)

Item	3G2A5-ID215	3G2A5-ID218
Input Voltage	12 to 24 VDC $+10\%/_{-15\%}$	
Input Impedance	2.2 k $\Omega$	
Input Current	10 mA typical (at 24 VDC)	
ON Voltage	10.2 VDC min.	
OFF Voltage	3.0 VDC max.	
ON Delay	15 ms max.	1.5 ms max.
OFF Delay	15 ms max.	1.5 ms max.
No. of Inputs	32 (8 inputs/common, 4 circuits)	
Internal Current Consumption	160 mA, 5 VDC max.	260 mA, 5 VDC max.
Weight	450 grams max.	
Circuit Configuration		
Terminal Connections		
Dimensions	B-shape	

### DC Input Units (Continued)

Item	3G2A5-ID219
Input Voltage	24 VDC $+10\%/_{-15\%}$
Input Impedance	3.3 k $\Omega$
Input Current	7 mA typical (at 24 VDC)
ON Voltage	16.0 VDC min.
OFF Voltage	5.0 VDC max.
ON Delay	1.5 ms max.
OFF Delay	1.5 ms max.
No. of Inputs	64 (8 inputs/common, 8 circuits) (No. of contacts that can be turned ON depends on ambient temperature. See the characteristic data below.)
Internal Current Consumption	340 mA, 5 VDC max.
Weight	600 grams max.
Circuit Configuration	<p>No. of inputs that can be turned ON vs. temperature</p> <p>(Points)</p> <p>60 50 40 30 20 10 0</p> <p>Up to 35 points can be turned ON at 55°C.</p> <p>Temperature is 38°C when 64 points can be turned ON.</p> <p>0 10 20 30 40 50 60</p> <p>Temperature (°C)</p>
Terminal Connections	<p>24 VDC</p> <p>24 VDC</p> <p>24 VDC</p> <p>24 VDC</p>
Dimensions	D-shape

### DC Input Units (Continued)

Item	C500-ID114
Input Voltage	12 VDC $+10\%$ / $-15\%$
Input Impedance	1.5 k $\Omega$
Input Current	7 mA typical (at 12 VDC)
ON Voltage	8.0 VDC min.
OFF Voltage	3.0 VDC max.
ON Delay	1.5 ms max.
OFF Delay	1.5 ms max.
No. of Inputs	64 (8 inputs/common, 8 circuits) (No. of contacts that can be turned ON depends on ambient temperature. See the characteristic data below.)
Internal Current Consumption	340 mA, 5 VDC max.
Weight	600 grams max.
Circuit Configuration	
Terminal Connections	
Dimensions	D-shape

### DC Input Units (Continued)

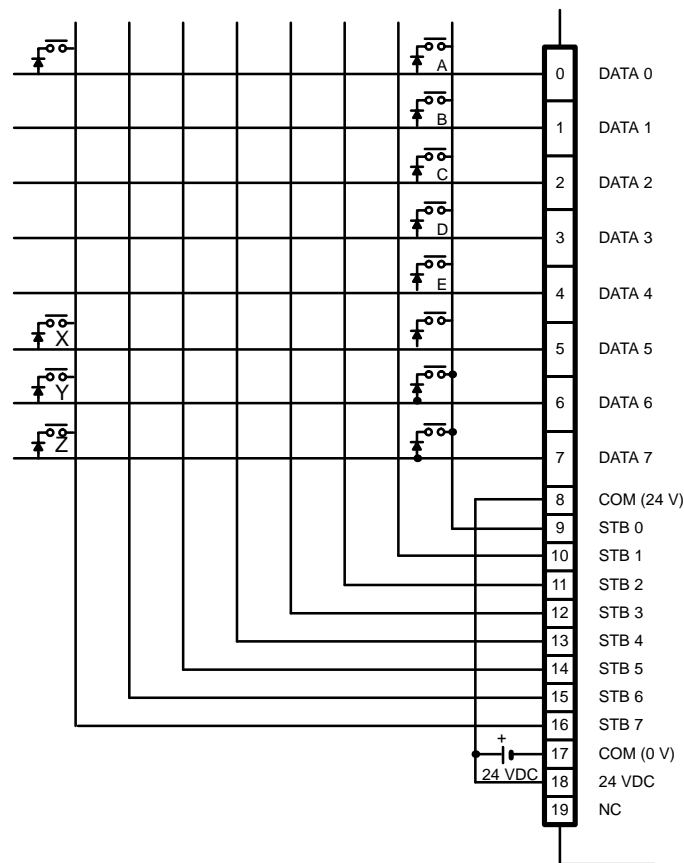
Item	C500-ID218CN
Input Voltage	12 to 24 VAC $+10\%/-15\%$
Input Impedance	2.2 k $\Omega$
Input Current	10 mA typical (at 24 VDC)
ON Voltage	10.2 VDC min.
OFF Voltage	3.0 VDC max.
ON Delay	1.5 ms max.
OFF Delay	1.5 ms max.
No. of Inputs	32 (8 inputs/common, 4 circuits)
Internal Current Consumption	200 mA, 5 VDC max.
Weight	450 grams max.
Circuit Configuration	
Terminal Connections	
Dimensions	E-shape, with no 4-terminal block

### Dynamic DC Input Unit

3G2A5-ID212			
Inputs		Outputs	
Input Voltage	24 VDC +10%/-15%	Max. Switching Capacity	0.1A, 24 VDC +10%/-15%
Input Impedance	2.2 kΩ	Leakage Current	0.1 mA max.
Input Current	10 mA typical (at 24 VDC)	Residual Voltage	1.5 V max.
ON Voltage	10.2 VDC min.	ON Delay	0.2 ms max.
OFF Voltage	3.0 VDC max.	OFF Delay	0.3 ms max.
ON Delay	1.5 ms max.	Power for External Supply	24 VDC ±10%
OFF Delay	1.5 ms max.		
General Specifications			
<p>Circuit Configuration</p>		<p>Terminal Connections</p>	
No. of Inputs	64, dynamic		
Internal Current Consumption	300 mA, 5 VDC max.		
Weight	450 grams max.		
Dimensions	A-shape		

### 3G2A5-ID212 Wiring Dynamic Inputs

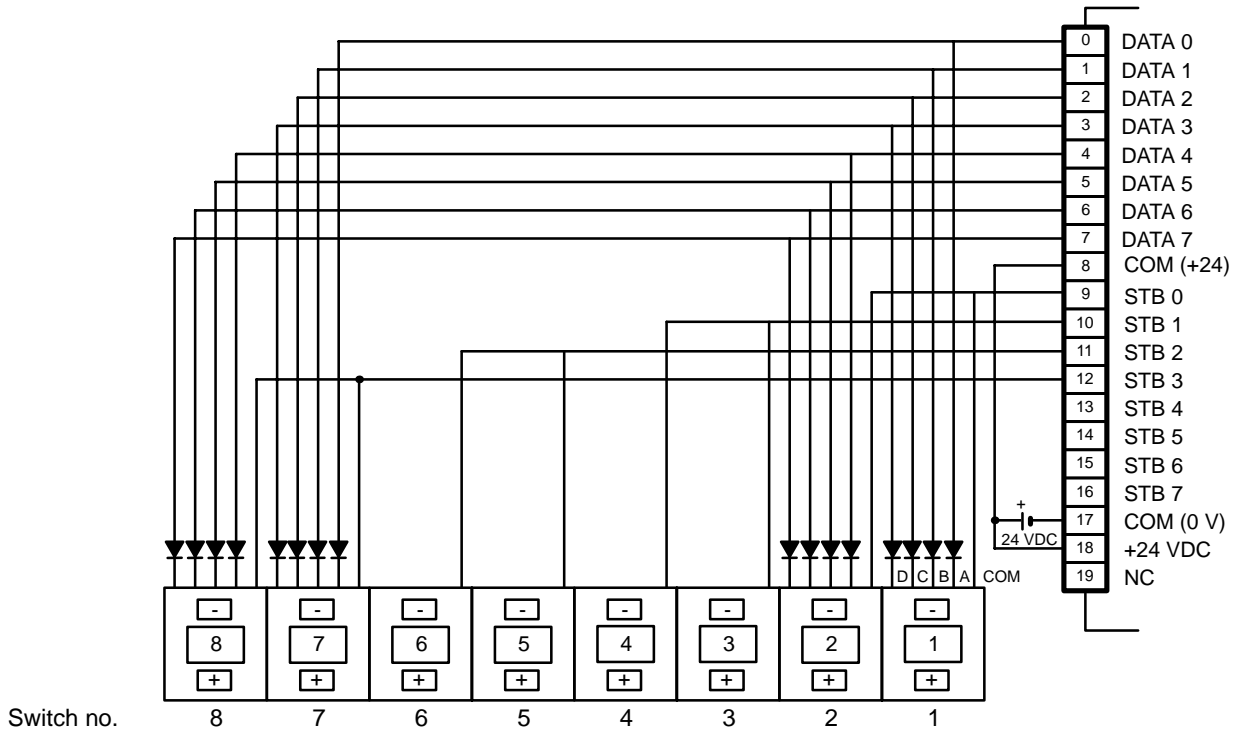
#### Connection Example 1 (Keyboard)A



Terminal Number	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word n												E	D	C	B	A
Word n + 1																
Word n + 2																
Word n + 3	Z	Y	X													

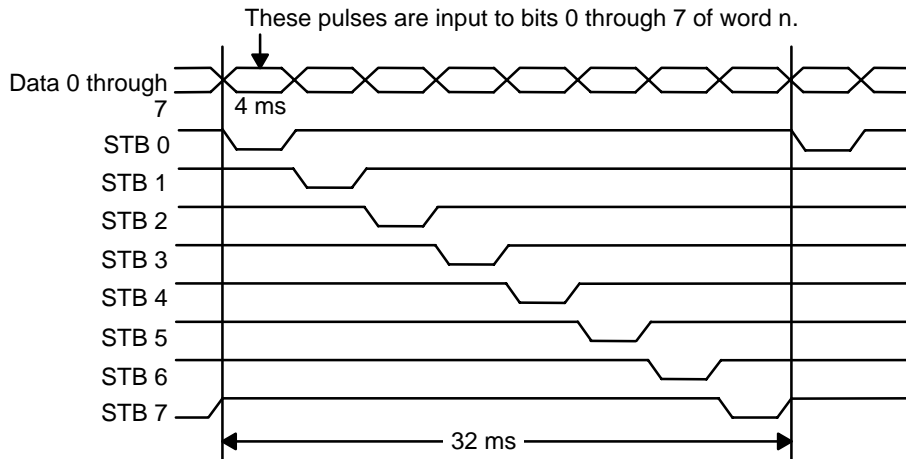
**Note** Because the DC Input Unit is operated on an extremely small current, make sure there is adequate distance between the DC Input Unit wires and high-tension equipment or power lines. If this cannot be avoided, use shielded cables when wiring the DC Input Unit. Be sure to keep the total length of the wires less than 10 m.

### Connection Example 2 (Digital Switches)



Terminal Number	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
<b>Word n</b>	Switch no. 4				Switch no. 3				Switch no. 2				Switch no. 1			
	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	1
<b>Word n + 1</b>	STB 1								STB 0							
	Switch no. 8				Switch no. 7				Switch no. 6				Switch no. 5			
	1	0	0	0	0	1	1	1	0	1	1	0	0	1	0	1
	STB 3								STB 2							

#### Timing





### AC Input Units

Item	3G2A5-IA121	3G2A5-IA222
Input Voltage	100 to 120 VAC +10%/-15%, 50/60 Hz	200 to 240 VAC +10%/-15%, 50/60 Hz
Input Impedance	9.7 kΩ (50 Hz), 8 kΩ (60 Hz)	22 kΩ (50 Hz), 18 kΩ (60 Hz)
Input Current	10 mA typical (at 100 VAC)	10 mA typical (at 200 VAC)
ON Voltage	60 VAC min.	120 VAC min.
OFF Voltage	20 VAC max.	40 VAC max.
ON Delay	35 ms max.	35 ms max.
OFF Delay	55 ms max.	55 ms max.
No. of Inputs	16 (8 inputs/common, 2 circuits)	16 (8 inputs/common, 2 circuits)
Internal Current Consumption	180 mA, 5 VDC max.	180 mA, 5 VDC max.
Weight	450 grams max.	450 grams max.
Circuit Configuration		
Terminal Connections		
Dimensions	A-shape	A-shape

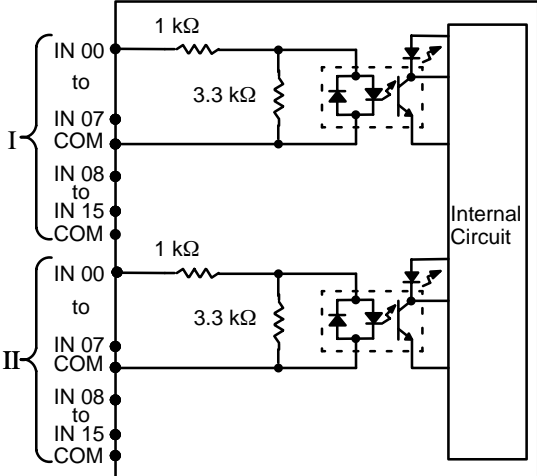
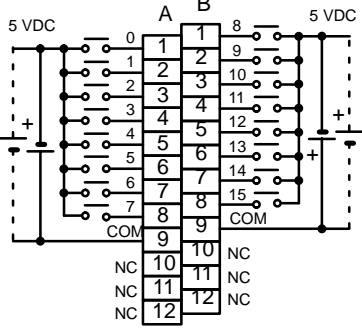
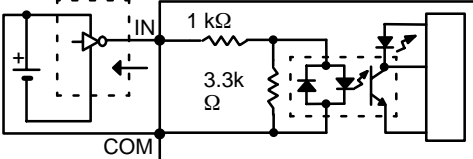
### AC Input Units (Continued)

Item	3G2A5-IA122	C500-IA223
Input Voltage	100 to 120 VAC +10%/-15%, 50/60 Hz	200 to 240 VAC +10%/-15%, 50/60 Hz
Input Impedance	9.7 kΩ (50 Hz), 8 kΩ (60 Hz)	22 kΩ (50 Hz), 18 kΩ (60 Hz)
Input Current	10 mA typical (at 100 VAC)	10 mA typical (at 200 VAC)
ON Voltage	60 VAC min.	120 VAC min.
OFF Voltage	20 VAC max.	40 VAC max.
ON Delay	35 ms max.	35 ms max.
OFF Delay	55 ms max.	55 ms max.
No. of Inputs	32 (8 inputs/common, 4 circuits)	32 (8 inputs/common, 4 circuits)
Internal Current Consumption	180 mA, 5 VDC max.	180 mA, 5 VDC max.
Weight	600 grams max.	600 grams max.
Circuit Configuration		
Terminal Connections		
Dimensions	C-shape	C-shape

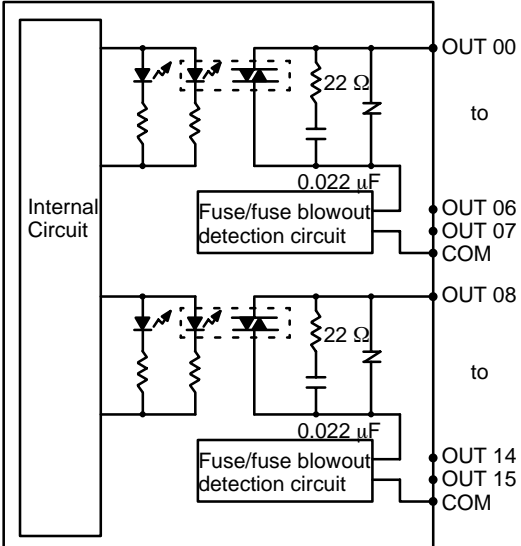
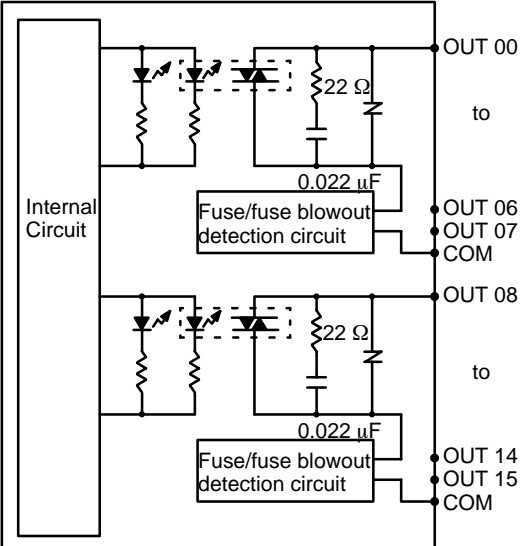
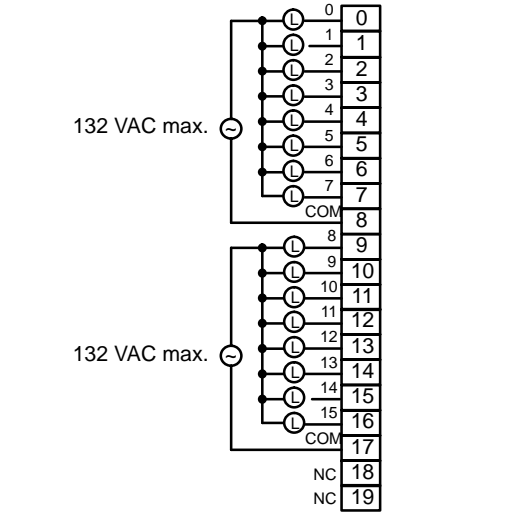
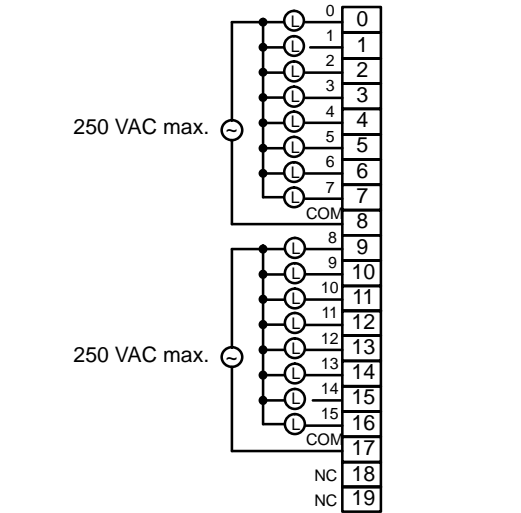
### AC/DC Input Units

Item	3G2A5-IM211	3G2A5-IM212
Input Voltage	12 to 24 VAC/DC +10%/−15%, 50/60 Hz	12 to 24 VAC/DC +10%/−15%, 50/60 Hz
Input Impedance	1.8 Ω	2.2 kΩ
Input Current	10 mA typical (at 24 VDC)	10 mA typical (at 24 VDC)
ON Voltage	10.2 VDC min.	10.2 VDC min.
OFF Voltage	3.0 VDC max.	3.0 VDC max.
ON Delay	15 ms max.	15 ms max.
OFF Delay	15 ms max.	15 ms max.
No. of Inputs	16 (8 inputs/common, 2 circuits)	32 (8 inputs/common, 4 circuits)
Internal Current Consumption	10 mA, 5 VDC max.	200 mA, 5 VDC max.
Weight	450 grams max.	500 grams max.
Circuit Configuration		
Terminal Connections		
Dimensions	A-shape	A-shape

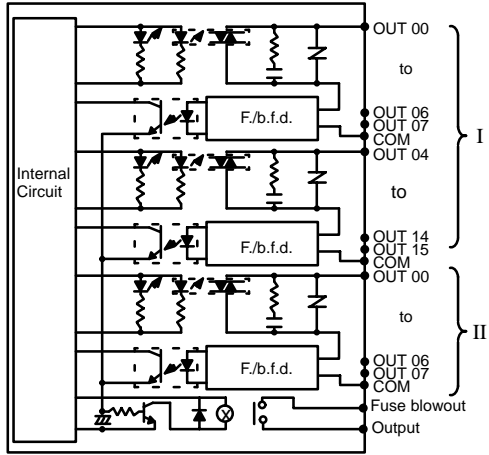
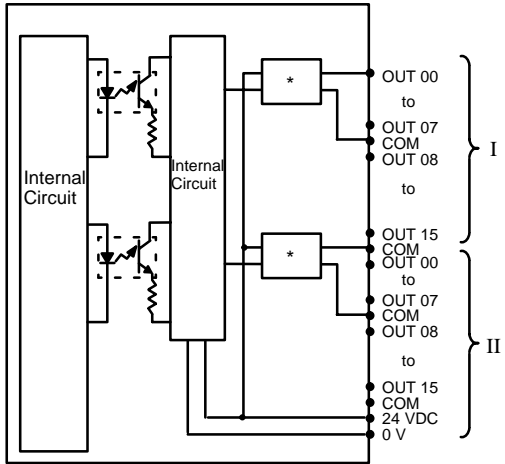
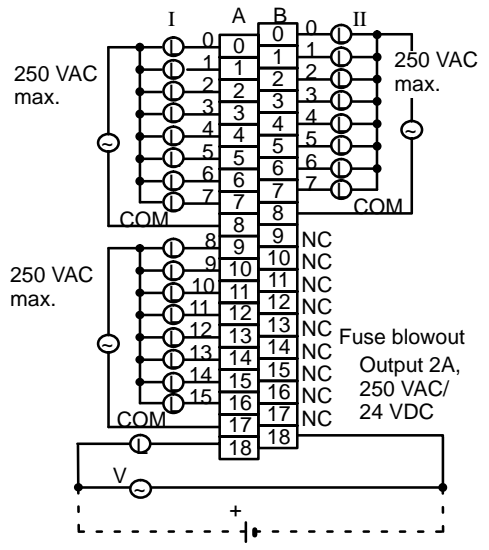
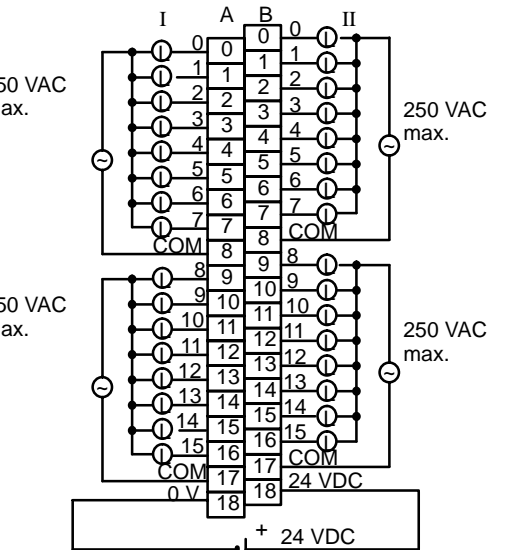
### TTL Input Units

Item	C500-ID501CN
Input Voltage	5 VDC $\pm$ 10%
Input Impedance	1 k $\Omega$
Input Current	3.5 mA typical (at 24 VDC)
ON Voltage	3 VDC min.
OFF Voltage	1 VDC max.
ON Delay	1.5 ms max.
OFF Delay	1.5 ms max.
No. of Inputs	32 (8 inputs/common, 4 circuits)
Internal Current Consumption	200 mA, 5 VDC max.
Weight	450 grams max.
Circuit Configuration	
Terminal Connections	 <p data-bbox="635 1438 906 1465">Use a sinking TTL buffer.</p> <p data-bbox="635 1486 896 1514">(TTL/LS-TTL/CMOS buffer)</p> 
Dimensions	E-shape, with no 4-terminal block

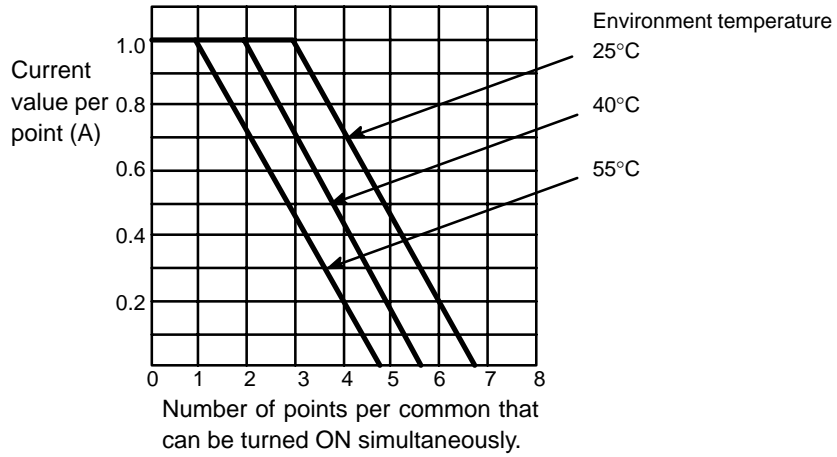
### Triac Output Units

Item	3G2A5-OA121	3G2A5-OA222
Max. Switching Capacity	1 A, 132 VAC, 50/60 Hz (4 A/common, 5 A/Unit)	1 A, 250 VAC, 50/60 Hz (4 A/common, 5 A/Unit)
Min. Switching Capacity	10 mA (resistive load) , 10 VAC 40 mA (inductive load), 10 VAC	10 mA (resistive load), 10 VAC 40 mA (inductive load), 10 VAC
Leakage Current	3 mA (100 VAC) max.	3 mA max. at 100 VAC 6 mA max. at 200 VAC
Residual Voltage	1.2 V max.	1.2 V max.
ON Delay	1 ms max.	1 ms max.
OFF Delay	1/2 of load frequency max.	1/2 of load frequency max.
No. of Outputs	16 (8 outputs/common, 2 circuits)	16 (8 outputs/common, 2 circuits)
Internal Current Consumption	300 mA, 5 VDC max.	300 mA, 5 VDC max.
Fuse Capacity	5 A, 250 V (two fuses)	5 A, 250 V (two fuses)
Weight	500 grams max.	500 grams max.
Circuit Configuration	 <p>The fuse is 5 A, 250 V and 6.35 mm dia. x 32 mm.</p>	 <p>The fuse is 5 A, 250 V; 6.35 mm dia. x 32 mm.</p>
Terminal Connections		
Dimensions	A-shape	A-shape

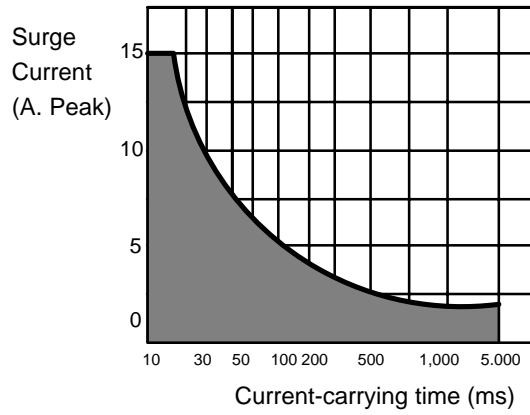
### Triac Output Units (Continued)

Item	3G2A5-OA223	C500-OA225
Max. Switching Capacity	1 A, 250 VAC, 50/60 Hz (4 A/common, 5 A/Unit)	1 A, 250 VAC, 50/60 Hz (4 A/common, 5 A/Unit)
Min. Switching Capacity	10 mA (resistive load) , 10 VAC 40 mA (inductive load), 10 VAC	10 mA (resistive load) , 10 VAC 40 mA (inductive load), 10 VAC
Leakage Current	3 mA (100 VAC) max., 6 mA (200 VAC) max.	2 mA (100 VAC) max., 5 mA (200 VAC) max.
Residual Voltage	1.2 V max.	1.6 V max.
ON Delay	1 ms max.	1 ms max.
OFF Delay	1/2 of load frequency max.	1/2 of load frequency max.
No. of Outputs	24 (8 outputs/common, 3 circuits)	32 (8 outputs/common, 4 circuits)
Internal Current Consumption	450 mA, 5 VDC max.	200 mA, 5 VDC max.
Fuse Capacity	5 A, 250 V (three fuses)	Not provided
Power for External Supply	---	320 mA, 5 VDC ±10% max.
Weight	600 grams max.	600 grams max.
Circuit Configuration	 <p>F/b. f. d. Fuse/blown fuse detection Fuse: MF51SH (5 A, 250 V)</p>	 <p>* G3S-201PL 24 VDC</p>
Terminal Connections		
Dimensions	C-shape	C-shape

### Special Considerations for C500-OA225



### Number of Points per Common Turned ON Simultaneously



### Transistor Output Units

Item	3G2A5-OD411	3G2A5-OD412
Max. Switching Capacity	12 to 48 VDC $+10\%/_{-15\%}$ , 1 A (but, 4 A/common, 5 A/Unit)	12 to 48 VDC $+10\%/_{-15\%}$ , 0.3 A (but, 4.8 A/Unit)
Leakage Current	0.1 mA max.	0.1 mA max.
Residual Voltage	1.4 V max.	1.5 V max.
ON Delay	0.2 ms max.	0.2 ms max.
OFF Delay	0.3 ms max.	0.3 ms max.
No. of Outputs	16 (16 outputs/common, 1 circuit)	32 (32 outputs/common, 1 circuit)
Internal Current Consumption	160 mA, 5 VDC max.	230 mA, 5 VDC max.
Fuse Capacity	5 A, 250 V (two fuses)	1 per circuit, 1 total (Cannot be changed by user.)
Power for External Supply	50 mA, 12 to 48 VDC $\pm 10\%$ min.	80 mA, 12 to 48 VDC $\pm 10\%$ min.
Weight	500 grams max.	530 grams max.
Circuit Configuration	<p>* Fuse/fuse blowout detection circuit</p>	
Terminal Connections	<p>Note: Be sure to supply power to B18; otherwise current will leak through the load while the output is OFF. Because the commons are short-circuited internally, they cannot be used separately and must be wired according to the diagram.</p>	<p>Note: Be sure to supply power to B18; otherwise current will leak through the load while the output is OFF. Because the commons are short-circuited internally, they cannot be used separately and must be wired according to the diagram.</p>
Dimensions	A-shape	B-shape

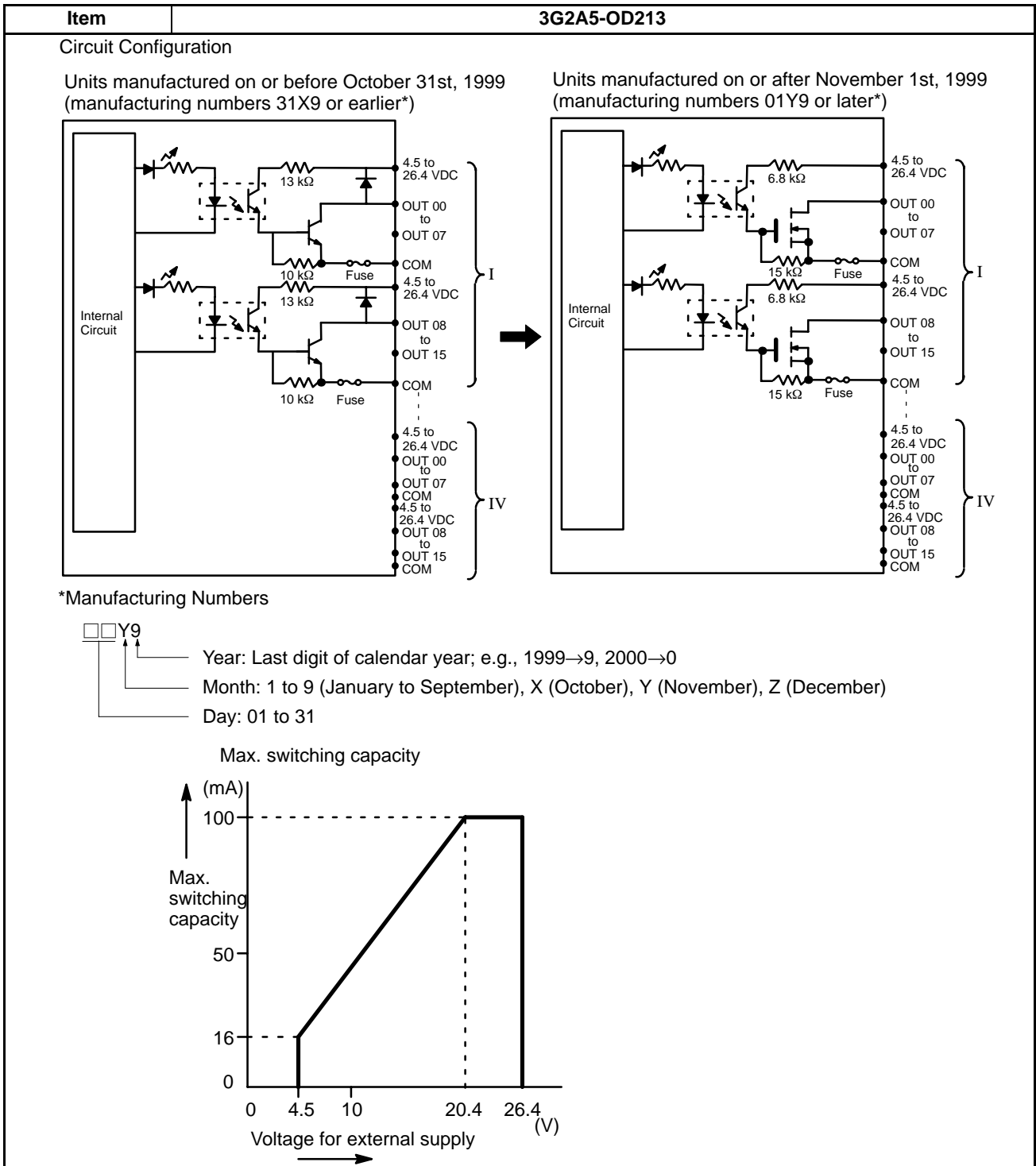


### Transistor Output Units (Continued)

Item	3G2A5-OD414
Max. Switching Capacity	12 to 48 VDC +10%/-15%, 0.3 A (but, 2.4 A/common; 4.8 A/Unit)
Leakage Current	0.1 mA max.
Residual Voltage	1.5 V max.
ON Delay	0.2 ms max.
OFF Delay	0.3 ms max.
No. of Outputs	32 (16 outputs/common, 2 circuits)
Internal Current Consumption	230 mA, 5 VDC max.
Fuse Capacity	Not provided
Power for External Supply	80 mA, 12 to 48 VDC ±10% min.
Weight	530 grams max.
Circuit Configuration	
Terminal Connections	<p>Supply power to A18 and B18. Without power supplied to A18 and B18, leakage current will cause a malfunction at the load.</p>
Dimensions	B-shape

**Transistor Output Units (Continued)**

Item	3G2A5-OD213
Max. Switching Capacity	16 mA/4.5 V to 100 mA/26.4 VDC (See chart below.) (but, 800 mA/common, 6.4 A/Unit)
Leakage Current	0.1 mA max.
Residual Voltage	0.4 V max.
ON Delay	0.2 ms max.
OFF Delay	0.3 ms max.
No. of Outputs	64 (8 outputs/common, 8 circuits)
Internal Current Consumption	460 mA, 5 VDC max. (140 mA + (5 mA x no. of ON points))
Fuse	1 per circuit, 8 total (Cannot be changed by user.)
Power for External Supply	170 mA, 26.4 VDC min. (2.6 mA x no. of ON points)
Weight	550 grams max.



Item	3G2A5-OD213
Terminal Connections	<p style="text-align: right;">4.5 to 26.4 VDC</p> <p style="text-align: right;">When wiring output circuits, be sure to use the correct polarity for the external power supplies. Wiring with incorrect polarity may result in erroneous operation of the load.</p>
Dimensions	D-shape

### Transistor Output Units (Continued)

Item	3G2A5-OD215	C500-OD217
Max. Switching Capacity	24 VDC ±10%, 50 mA/point	12 to 24 VDC +10%/−15%, 1 A (but, 4 A/common, 5 A/Unit)
Leakage Current	---	0.1 mA max.
Residual Voltage	1.0 V max.	1.4 V max.
ON Delay	0.2 ms max.	0.2 ms max.
OFF Delay	0.3 ms max.	0.3 ms max.
No. of Outputs	16 (independent commons)	16 (8 outputs/common, 2 circuits)
Internal Current Consumption	200 mA, 5 VDC max.	160 mA, 5 VDC max.
Fuse Capacity	Not provided	5 A, 250 V (two fuses)
Power for External Supply	---	50 mA, 12 to 24 VDC ±10% min.
Weight	530 grams max.	500 grams max.
Circuit Configuration		
Terminal Connections		<p>Note: Be sure to connect Power Supplies to 18 and 19.</p>
Dimensions	B-shape	A-shape

### Transistor Output Units (Continued)

Item	C500-OD218	C500-OD219
Max. Switching Capacity	12 to 24 VDC +10%/-15%, 0.3 A (but, 2.4 A/common, 4.8 A/Unit)	12 to 24 VDC +10%/-15%, 2.1 A (but, 8 A/common, 16 A/Unit)
Leakage Current	0.1 mA max.	0.1 mA max.
Residual Voltage	1.5 V max.	0.7 V max.
ON Delay	0.2 ms max.	0.2 ms max.
OFF Delay	0.3 ms max.	0.4 ms max.
No. of Outputs	32 (16 outputs/common, 2 circuits)	16 (8 outputs/common, 2 circuits)
Internal Current Consumption	230 mA, 5 VDC max.	160 mA, 5 VDC max.
Fuse Capacity	1 per circuit, 2 total (Cannot be changed by user.)	10 A, 250 V (two fuses)
Power for External Supply	80 mA, 12 to 24 VDC ±10% min.	100 mA, 12 to 24 VDC ±10% min.
Weight	530 grams max.	550 grams max.
Circuit Configuration		
Terminal Connections	<p>Note: Be sure to supply power to A18 and B18. A8, A17, B8, and B17 are short-circuited internally, so they cannot be used separately. A8 and B8 do not have to be wired.</p>	<p>Note: Be sure to supply power to 18 and 19.</p>
Dimensions	B-shape	A-shape

### Transistor Output Units (Continued)

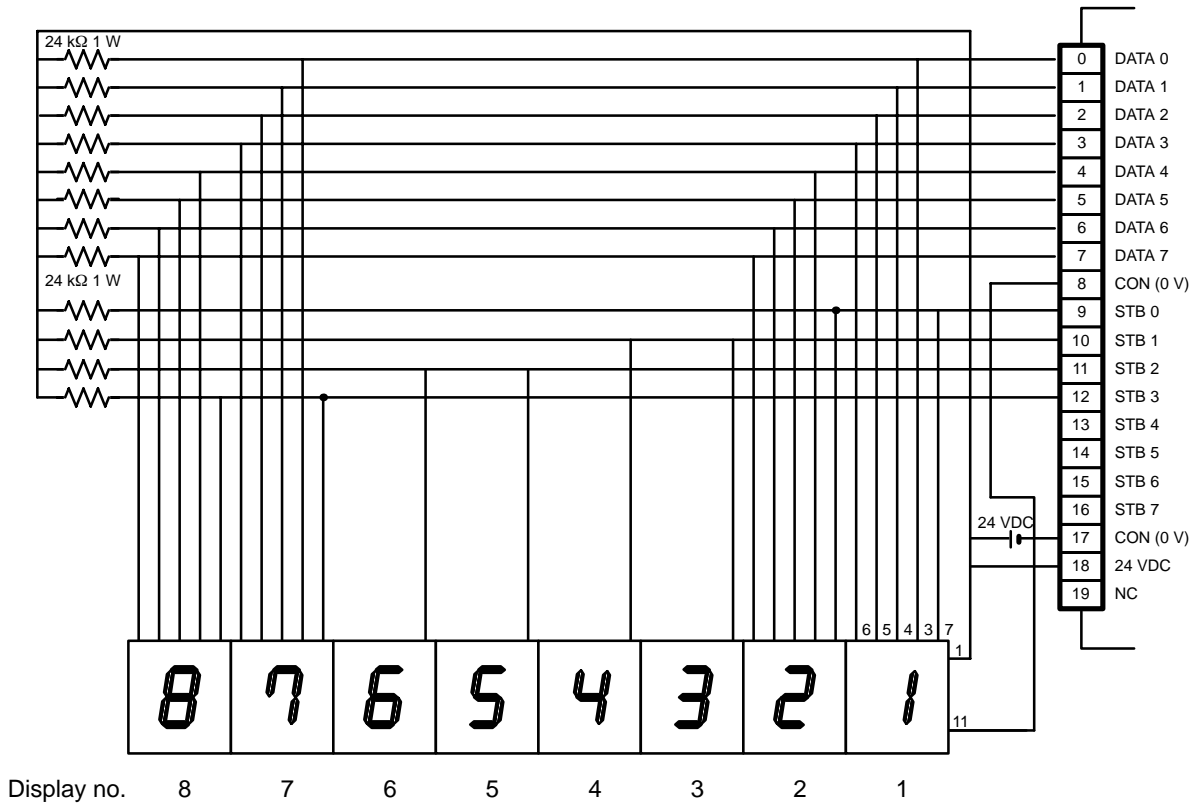
Item	C500-OD415CN
Max. Switching Capacity	12 to 48 VDC $\pm 10\%$ / $-15\%$ , 0.3 A (but, 2.4 A/common, 4.8 A/Unit)
Leakage Current	0.1 mA max.
Residual Voltage	1.5 V max.
ON Delay	0.2 ms max.
OFF Delay	0.3 ms max.
No. of Outputs	32 (16 outputs/common, 2 circuits)
Internal Current Consumption	230 mA, 5 VDC max.
Fuse Capacity	Not provided
Power for External Supply	80 mA, 12 to 48 VDC $\pm 10\%$ min.
Weight	530 grams max.
Circuit Configuration	
Terminal Connections (CNI and CNII)	<p>Note: Power can be supplied to either connector pins A9, B9, A10, and B10 or to terminal block terminals 1 to 4. If power is not supplied, dark current will leak through the load while the output is OFF.</p> <p>The following pins are connected internally:          CNI: A9, B9, and terminal 2;          A10, B10 and terminal 1.          CNII: A9, B9, and terminal 4;          A10, B10 and terminal 3</p>
Dimensions	E-shape

### Transistor Output Units (Continued)

Item	3G2A5-OD211 (dynamic)	3G2A5-OD212 (PNP)
Max. Switching Capacity	24 VDC +10%/-15%	12 to 24 VDC +10%/-15%, 0.3 A (but, 2.4 A/common, 4.8 A/Unit)
Leakage Current	0.1 mA max.	0.1 mA max.
Residual Voltage	1.5 V max.	1.5 V max.
ON Delay	0.2 ms max.	0.2 ms max.
OFF Delay	0.3 ms max.	0.3 ms max.
No. of Outputs	64 (dynamic)	32 (16 outputs/common, 2 circuits)
Internal Current Consumption	300 mA, 5 VDC max.	230 mA, 5 VDC max.
Fuses	Not provided.	1 per circuit, 2 total (Cannot be changed by user.)
Power for External Supply	50 mA, 24 VDC ±10% min.	50 mA, 12 to 24 VDC ±10% min.
Weight	450 grams max.	530 grams max.
Circuit Configuration	<p>DATA: Positive logic output STB: Negative logic output</p>	
Terminal Connections	<p>Terminal Connections</p>	<p>Note: A8 and A17 are connected internally, as are B8 and B17; they cannot be used independently. Wire according to the diagram to prevent insufficient current flow.</p>
Dimensions	A-shape	B-shape



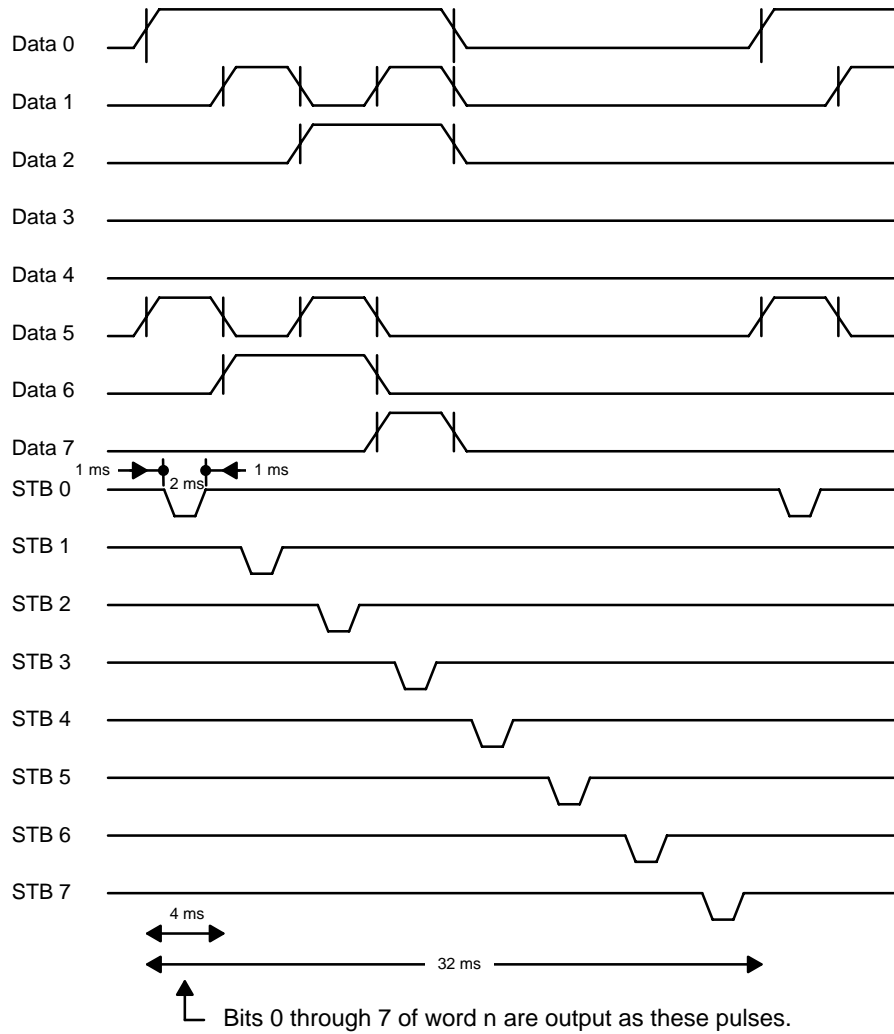
### Wiring Dynamic Outputs (3G2A5-OD211)



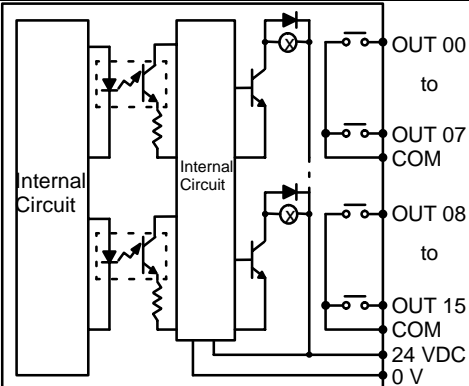
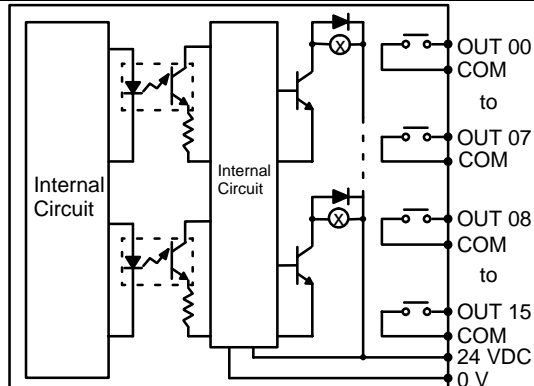
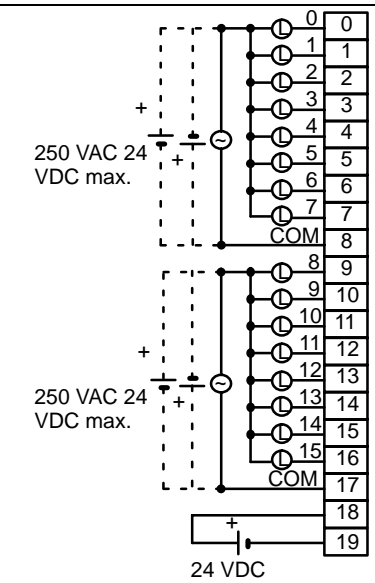
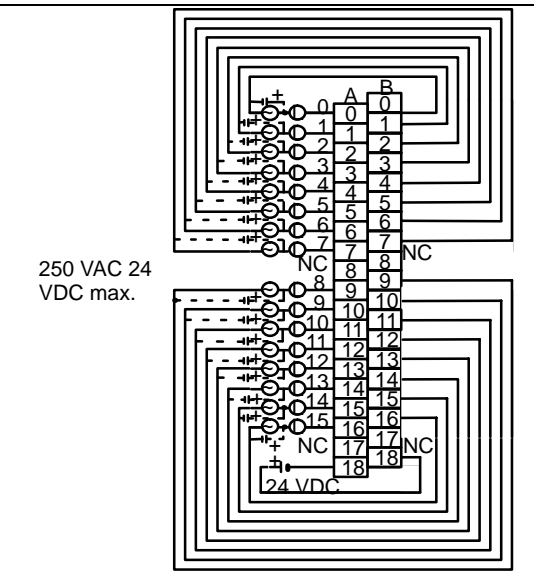
Point Number	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Data Number	07	06	05	04	03	02	01	00	07	06	05	04	03	02	01	00
Word n	Display no. 4				Display no. 3				Display no. 2				Display no. 1			
	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1
	STB 1								STB 0							
Word n + 1	Display no. 8				Display no. 7				Display no. 6				Display no. 5			
	1	0	0	0	0	1	1	1	0	1	1	0	0	1	0	1
	STB 3								STB 2							

**Note** Because the DC Input Unit is operated on an extremely small current, make sure there is adequate distance between the DC Input Unit wires and high-tension equipment or power lines. If this cannot be avoided, use shielded cables when wiring the DC Input Unit. Be sure to keep the total length of the wires less than 10 m.

# Timing



### Contact Output Units

Item	3G2A5-OC221	3G2A5-OC223
Max. Switching Capacity	2 A, 250 VAC ( $\cos\phi= 1$ ), 0.5 A, 250 VAC ( $\cos\phi= 0.4$ ) 2 A, 24 VDC (but, 8 A/common,16 A/Unit)	2 A, 250 VAC ( $\cos\phi= 1$ ), 0.5 A, 250 VAC ( $\cos\phi= 0.4$ ), 2 A, 24 VDC (but, 32 A/Unit)
Min. Switching Capacity	10 mA, 5 VDC	10 mA, 5 VDC
Power for External Supply	Voltage: 24 VDC $\pm 10\%$ Current: 10 mA/point, 160 mA/Unit	Voltage: 24 VDC $\pm 10\%$ Current: 10 mA/point, 160 mA/Unit
Relay	G6B-114P-FD-US-M (24 VDC) w/socket	G6B-114P-FD-US-M (24 VDC) w/socket
Service Life of Relay	Electrical: 300,000 operations (resistive load) 100,000 operations (inductive load) Mechanical: 50,000,000 operations	Electrical: 300,000 operations (resistive load) 100,000 operations (inductive load) Mechanical: 50,000,000 operations
ON Delay	15 ms max.	15 ms max.
OFF Delay	15 ms max.	15 ms max.
No. of Outputs	16 (8 outputs/common, 2 circuits)	16 (independent commons)
Internal Current Consumption	100 mA, 5 VDC max.	100 mA, 5 VDC max.
Weight	450 grams max.	450 grams max.
Circuit Configuration	 <p>Relays are mounted on sockets and are replaceable.</p>	 <p>Relays are mounted on sockets and are replaceable.</p>
Terminal Connections		
Dimensions	A-shape	B-shape

### Contact Output Units (Continued)

Item	3G2A5-OC224
Max. Switching Capacity	2 A, 250 VAC ( $\cos\phi= 1$ ), 0.5 A, 250 VAC ( $\cos\phi= 0.4$ ) 2 A, 24 VDC (8 A/common, 32 A/Unit)
Min. Switching Capacity	10 mA, 5 VDC
Power for External Supply	Voltage: 24 VDC $\pm 10\%$ Current: 10 mA/point, 320 mA/Unit
Relay	G6B-114P-FD-US-M (24 VDC) w/socket
Service Life of Relay	Electrical: 300,000 operations (resistive load) 100,000 operations (inductive load) Mechanical: 50,000,000 operations
ON Delay	15 ms max.
OFF Delay	15 ms max.
No. of Outputs	32 (8 outputs/common, 4 circuits)
Internal Current Consumption	200 mA, 5 VDC max.
Weight	600 grams max.
Circuit Configuration	
Terminal Connections	
Dimensions	C-shape

# TTL Output Unit

Item	C500-OD501CN
Max. Switching Capacity	5 VDC $\pm$ 10% 35 mA/point
Leakage Current	0.1 mA max.
Residual Voltage	0.4 V max.
ON Delay	0.2 ms max.
OFF Delay	0.3 ms max.
No. of Outputs	32 (8 outputs/common, 4 circuits)
Internal Current Consumption	250 mA, 5 VDC max.
Fuse Capacity	Not provided
Power for External Supply	32 mA, 5 VDC $\pm$ 10% min.
Weight	450 grams max.
Circuit Configuration	
Terminal Connections	<p>Because the output data is negative logic, the terminal output goes low when the output bit is ON (1).</p>
Dimensions	E-shape

# DC Input/Transistor Output Unit

C500-MD211CN			
Output (CNI, word n)		Input (CNII, word n+1)	
Max. Switching Capacity	12 to 24 VDC $+10\%$ / $-15\%$ , 0.3 A (but, 2.4 A/common, 4.8 A/Unit)	Input Voltage	12 to 24 VDC $+10\%$ / $-15\%$
Leakage Current	0.1 mA max.	Input Impedance	2.2 $\Omega$
Residual Voltage	1.5 V max.	Input Current	10 mA typical (at 24 VDC)
Fuses	1 per circuit, 2 total (Cannot be changed by user.)	ON Voltage	10.2 VDC min.
Power for External Supply	80 mA, 12 to 24 VDC $\pm 10\%$ max.	OFF Voltage	3.0 VDC max.
ON Delay	0.2 ms max.	ON Delay	1.5 ms max.
OFF Delay	0.3 ms max.	OFF Delay	1.5 ms max.
No. of Outputs	16 (8 outputs/common, 2 circuits)	No. of Inputs	16 (8 inputs/common, 2 circuits)
Internal Current Consumption	260 mA, 5 VDC max.		
Weight	520 grams max.		
Circuit Configuration			
Terminal Connections			
Dimensions	E-shape		

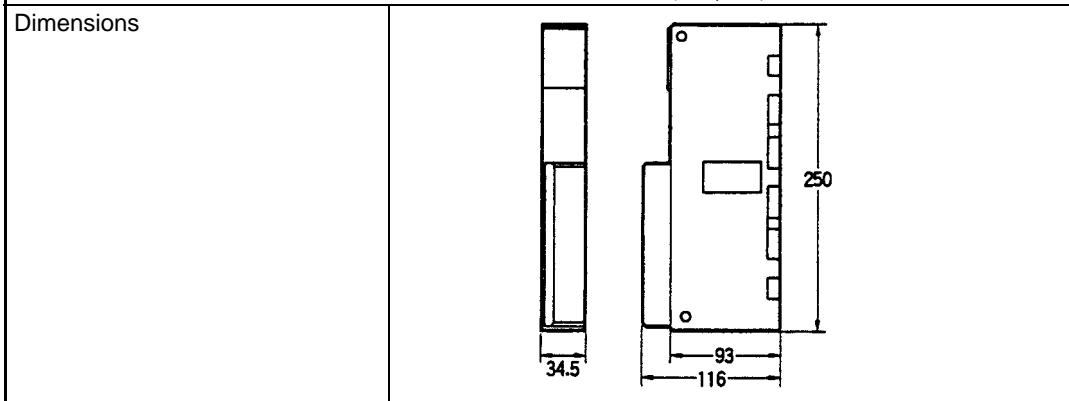
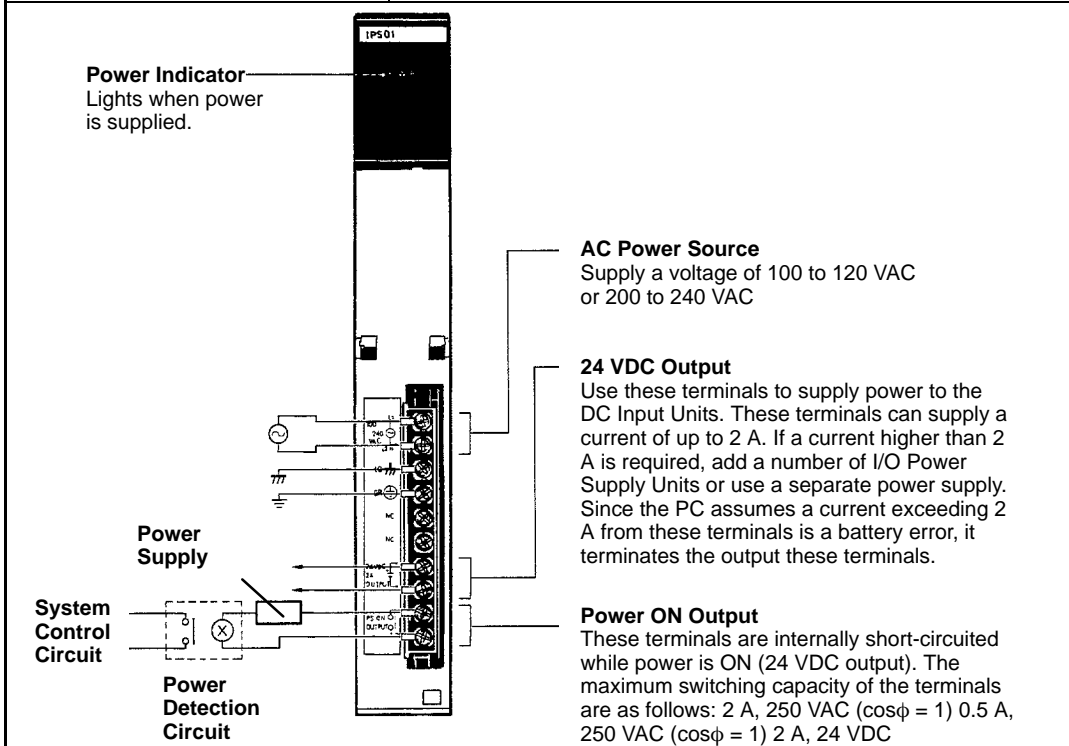
### Dummy I/O Unit

Item	3G2A5-DUM01								
Selection Function	Unit designation: input/output Point designation: 16/32/64 points								
Internal Current Consumption	35 mA, 5 VDC max.								
Power for External Supply	30 mA, 24 VDC $\pm$ 10% min.								
Weight	450 grams max.								
Terminal Connections	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>Short-circuit: input</p> <p>Open: output</p> </div> </div> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Point designation</th> <th>Terminal connection</th> </tr> </thead> <tbody> <tr> <td>16 points</td> <td>Open 3,4, and 5</td> </tr> <tr> <td>32 points</td> <td>Short 3 and 4. Open 5.</td> </tr> <tr> <td>64 points</td> <td>Short 4 and 5. Open 3.</td> </tr> </tbody> </table>	Point designation	Terminal connection	16 points	Open 3,4, and 5	32 points	Short 3 and 4. Open 5.	64 points	Short 4 and 5. Open 3.
Point designation	Terminal connection								
16 points	Open 3,4, and 5								
32 points	Short 3 and 4. Open 5.								
64 points	Short 4 and 5. Open 3.								
Dimensions	A-shape								

**Note** Power is supplied to the Dummy I/O Unit from the 24 VDC output terminal of the Power Supply Unit mounted on the same Rack as the Dummy I/O Unit. Be sure to supply power to the Dummy I/O Unit before supplying power to the CPU. If power is supplied to the Dummy I/O Unit after power is supplied to the CPU, the Dummy I/O Unit is assumed to have only 16 I/O points, and may result in an I/O Verification Error or an I/O Setting Error.

### I/O Power Supply Unit

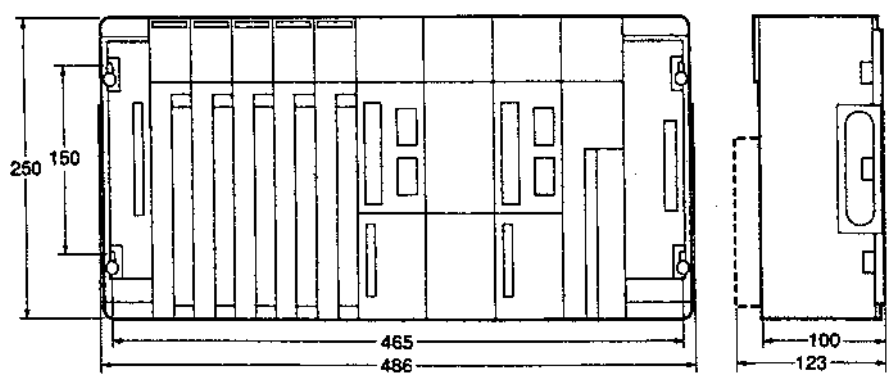
Item	CV500-IPS01
Input Voltage	100 through 120 VAC/200 through 240 VAC 50/60 Hz
Allowable Input Voltage Range	85 to 132 VAC/170 to 264 VAC
Input Current	160 VA max.
Output Capacity	2 A, 24 VDC
Dimensions	34.5 x 250 x 116 mm (WxHxD)
Weight	700 grams max.





## Dimensions

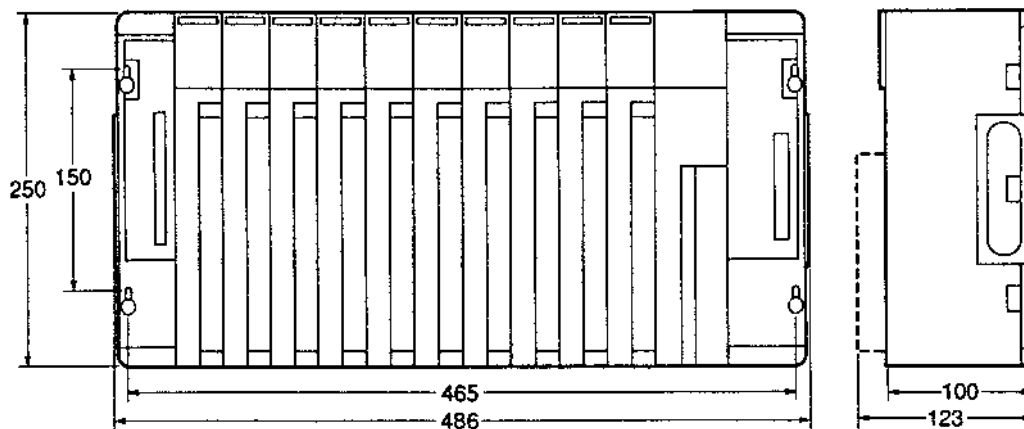
### CPU Racks



**Note** 1.The above diagram shows the CPU Rack with the Power Supply Unit and I/O Control Unit removed. Remove these Units when mounting or disconnecting the CPU Rack.

2.The Power Supply Unit is shown with its dimensions when mounted.

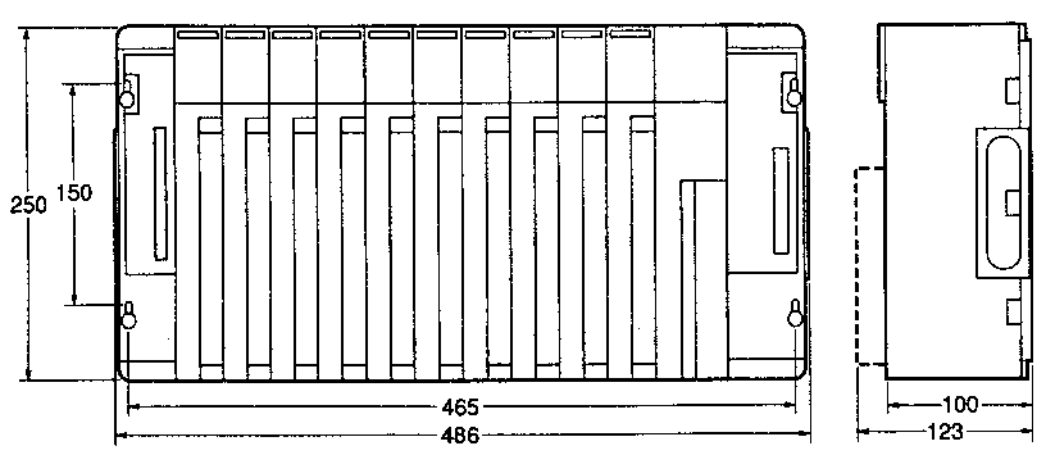
### Expansion CPU Racks



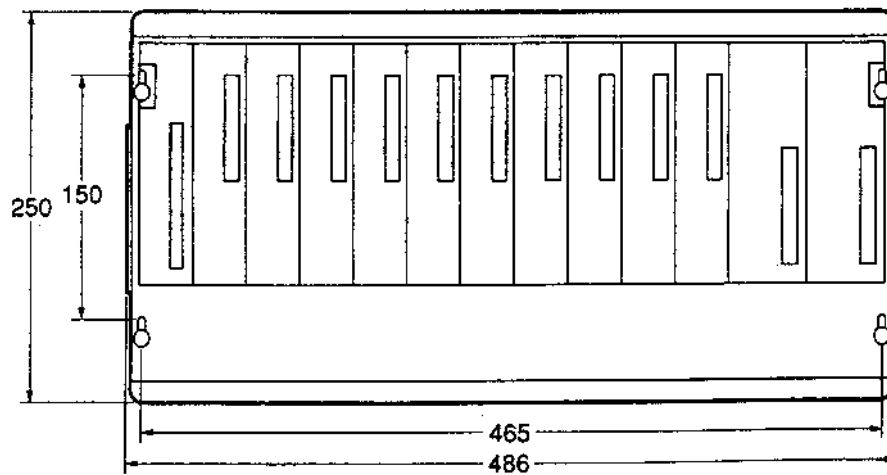
**Note** 1.The above diagram shows the Expansion CPU Rack with the Power Supply Unit and I/O Interface Unit removed. Remove these Units when mounting or disconnecting the CPU Rack.

2.The Power Supply Unit is shown with its dimensions when mounted.

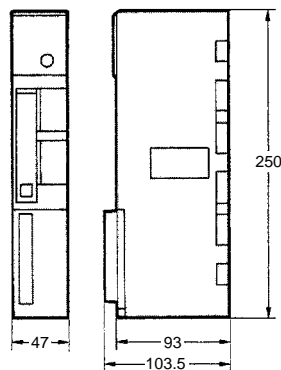
### Expansion I/O Racks



### Expansion I/O Rack Backplane

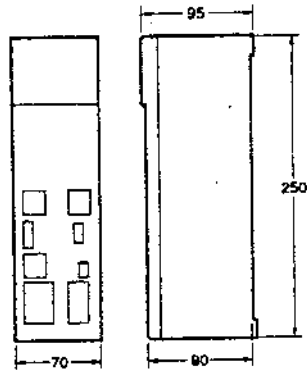


### CPU Unit CVM1D-CPU21



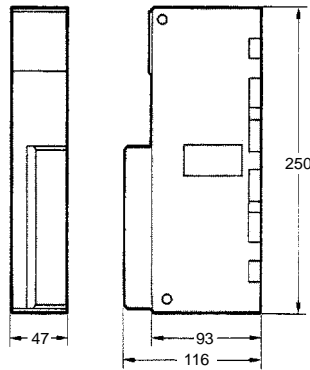
### Duplex Unit

CVM1D-DPL01



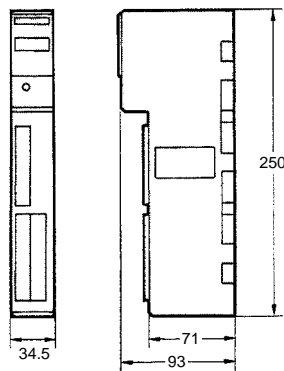
### Power Supply Units

CVM1D-PA208/212



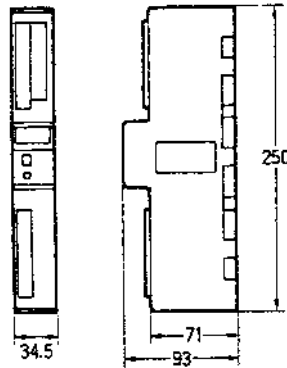
### I/O Control Units

CV500-IC101/IC201/IC301



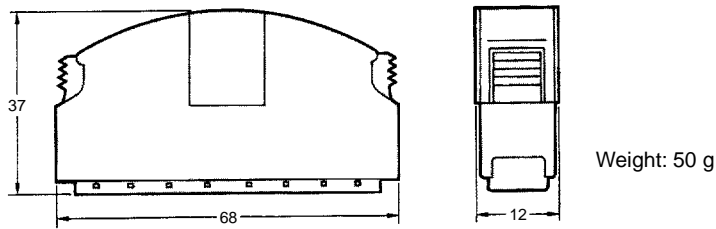
### I/O Interface Units

CV500-II101/II201



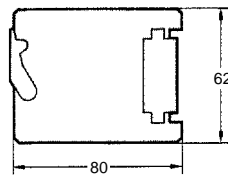
### Terminating Resistance Unit

CV500-TER01



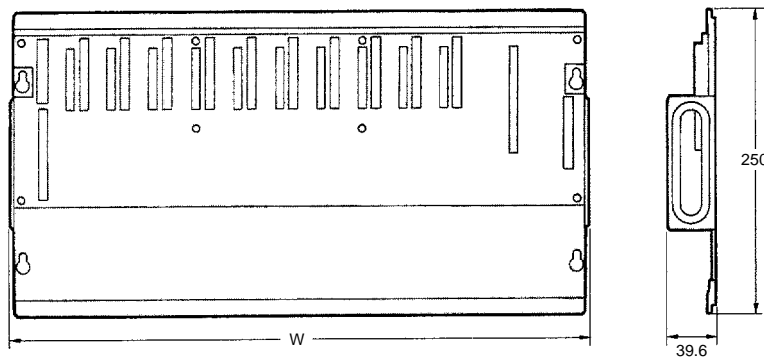
### Expansion Data Memory Units (EM Units)

CV500-DM641/DM151/DM251



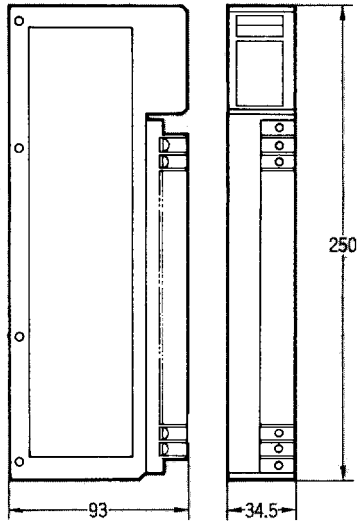
### Backplanes

CVM1D-BC051/BI101/BI102

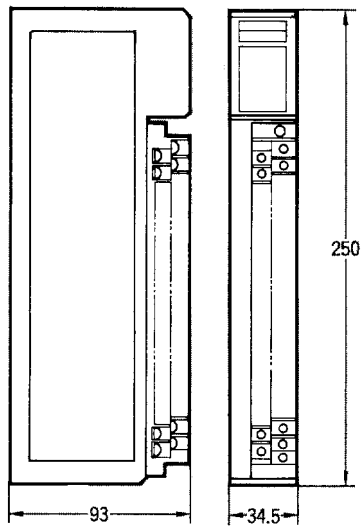


Model	W
CVM1D-BC051 (CPU Rack)	486
CVM1D-BI101 (Expansion CPU Rack)	
CVM1D-BI102 (Expansion I/O Rack)	

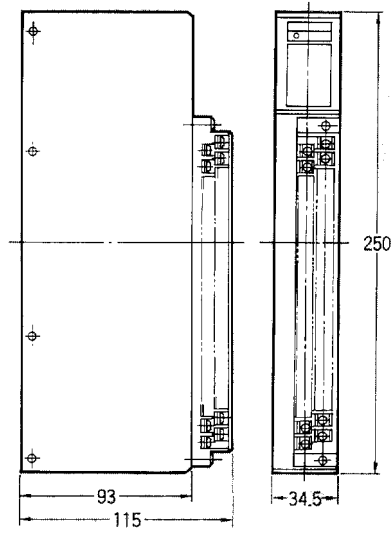
### Type-A I/O Units



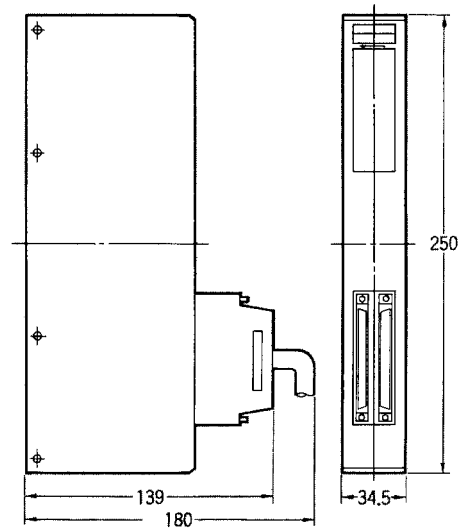
### Type-B I/O Units



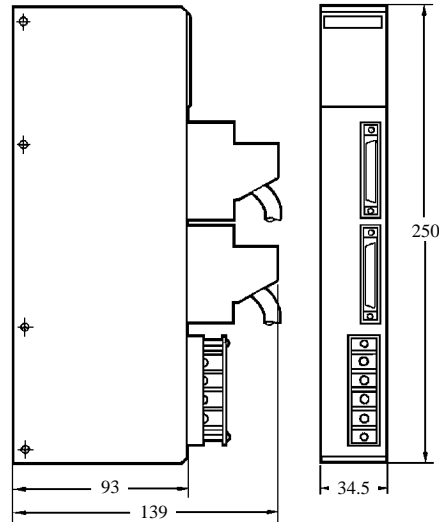
### Type-C I/O Units



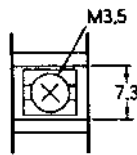
### Type-D I/O Units



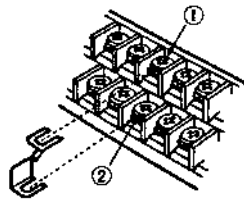
### Type-E I/O Units



### Terminal Block Dimensions (Common to A, B, C)



**Note** Use the common short-circuit implement (PTC-38S) provided with the type-C Unit to connect terminals (1) and (2) in the following diagram. The current capacity is 5 A.



### Weights

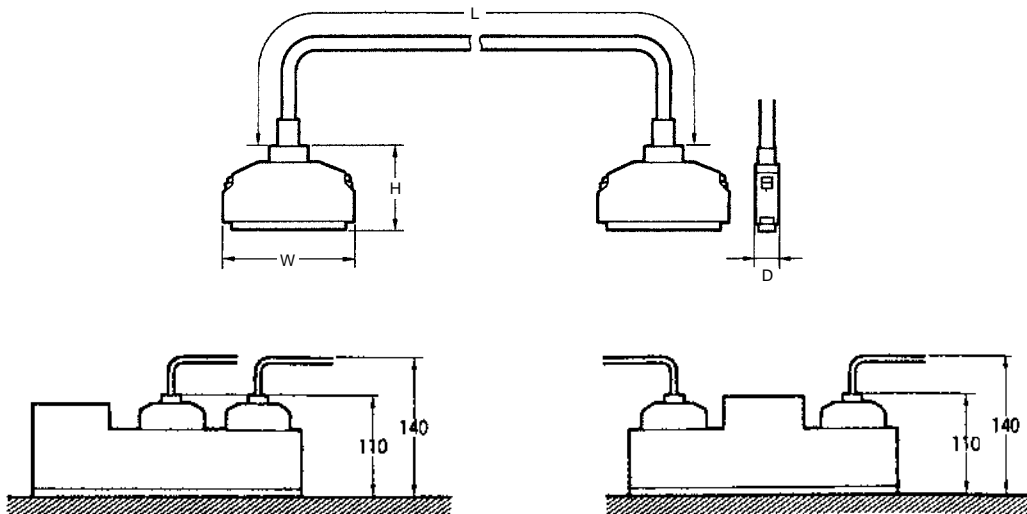
Model	Weight (gram)
CVM1D-CPU21	700
CVM1D-DPL01	550
CV500-PA208/212	900
CV500-IC101/201	380
CV500-IC301	270
CV500-II101/201	400
CVM1D-BC051, CVM1D-BI101/102	1,900
CV500-DM641/151/251	40

### Connecting Cables

Cable name	Model	Cable length (L)	Weight	Connector dimensions (W x H x D)
CPU Bus Cable (for connecting Expansion CPU Rack)	CV500-CN311	0.3 m	110 g	60 x 42 x 12 mm
	CV500-CN611	0.6 m	150 g	
I/O Cable (for connecting CPU Rack, Expansion CPU Rack, or Expansion I/O Rack)	CV500-CN312	0.3 m	140 g	68 x 45 x 12 mm
	CV500-CN612	0.6 m	180 g	
	CV500-CN122	1 m	240 g	
	CV500-CN222	2 m	380 g	
	CV500-CN332	3 m	520 g	
	CV500-CN522	5 m	800 g	
	CV500-CN132	10 m	1.6 kg	
	CV500-CN232	20 m	3.0 kg	
	CV500-CN332	30 m	4.4 kg	
	CV500-CN432	40 m	5.8 kg	
	CV500-CN532	50 m	7.2 kg	

**Note** Do not put the Connecting Cables in the same duct with power lines or I/O wiring.

### Cable Dimensions





# Glossary

<b>address</b>	A number used to identify the location of data or programming instructions in memory or to identify the location of a network or a unit in a network.
<b>advanced instruction</b>	An instruction input with a function code that handles data processing operations within ladder diagrams, as opposed to a basic instruction, which makes up the fundamental portion of a ladder diagram.
<b>AGF</b>	All-glass optical fiber cable; also known as crystal optical fiber cable.
<b>allocation</b>	The process by which the PC assigns certain bits or words in memory for various functions. This includes pairing I/O bits to I/O points on Units.
<b>analog</b>	Something that represents or can process a continuous range of values as opposed to values that can be represented in distinct increments. Something that represents or can process values represented in distinct increments is called digital.
<b>Analog I/O Unit</b>	I/O Units that convert I/O between analog and digital values. An Analog Input Unit converts an analog input to a digital value for processing by the PC. An Analog Output Unit converts a digital value to an analog output.
<b>AND</b>	A logic operation whereby the result is true if and only if both premises are true. In ladder-diagram programming the premises are usually ON/OFF states of bits or the logical combination of such states called execution conditions.
<b>APF</b>	An acronym for all-plastic optical fiber cable.
<b>area</b>	See <i>data area</i> and <i>memory area</i> .
<b>area prefix</b>	A one or two letter prefix used to identify a memory area in the PC. All memory areas except the CIO area require prefixes to identify addresses in them.
<b>ASCII</b>	Short for American Standard Code for Information Interchange. ASCII is used to code characters for output to printers and other external devices.
<b>asynchronous execution</b>	Execution of programs and servicing operations in which program execution and servicing are not synchronized with each other.
<b>Auxiliary Area</b>	A PC data area allocated to flags and control bits.
<b>auxiliary bit</b>	A bit in the Auxiliary Area.
<b>Backplane</b>	A base to which Units are mounted to form a Rack. Backplanes provide a series of connectors for these Units along with buses to connect them to the CPU and other Units and wiring to connect them to the Power Supply Unit. Backplanes also provide connectors used to connect them to other Backplanes.
<b>back-up</b>	A copy made of existing data to ensure that the data will not be lost even if the original data is corrupted or erased.
<b>BASIC</b>	A common programming language. BASIC Units are programmed in BASIC.
<b>basic instruction</b>	A fundamental instruction used in a ladder diagram. See <i>advanced instruction</i> .

<b>BASIC Unit</b>	A CPU Bus Unit used to run programs in BASIC.
<b>baud rate</b>	The data transmission speed between two devices in a system measured in bits per second.
<b>BCD</b>	Short for binary-coded decimal.
<b>binary</b>	A number system where all numbers are expressed in base 2, i.e., numbers are written using only 0's and 1's. Each group of four binary bits is equivalent to one hexadecimal digit. Binary data in memory is thus often expressed in hexadecimal for convenience.
<b>binary-coded decimal</b>	A system used to represent numbers so that every four binary bits is numerically equivalent to one decimal digit.
<b>bit</b>	The smallest piece of information that can be represented on a computer. A bit has the value of either zero or one, corresponding to the electrical signals ON and OFF. A bit represents one binary digit. Some bits at particular addresses are allocated to special purposes, such as holding the status of input from external devices, while other bits are available for general use in programming.
<b>bit address</b>	The location in memory where a bit of data is stored. A bit address specifies the data area and word that is being addressed as well as the number of the bit within the word.
<b>branch line</b>	A communications line leading from a Link Adapter to any Link Unit not designated as a terminator in a Link System. See <i>main line</i> .
<b>buffer</b>	A temporary storage space for data in a computerized device.
<b>building-block PC</b>	A PC that is constructed from individual components, or "building blocks." With building-block PCs, there is no one Unit that is independently identifiable as a PC. The PC is rather a functional assembly of Units.
<b>bus</b>	A communications path used to pass data between any of the Units connected to it.
<b>bus link</b>	A data link that passed data between two Units across a bus.
<b>byte</b>	A unit of data equivalent to 8 bits, i.e., half a word.
<b>central processing unit</b>	A device that is capable of storing programs and data, and executing the instructions contained in the programs. In a PC System, the central processing unit executes the program, processes I/O signals, communicates with external devices, etc.
<b>channel</b>	See <i>word</i> .
<b>character code</b>	A numeric (usually binary) code used to represent an alphanumeric character.
<b>checksum</b>	A sum transmitted with a data pack in communications. The checksum can be recalculated from the received data to confirm that the data in the transmission has not been corrupted.
<b>CIO Area</b>	A memory area used to control I/O and to store and manipulate data. CIO Area addresses do not require prefixes.
<b>communications cable</b>	Cable used to transfer data between components of a control system and conforming to the RS-232C or RS-422 standards.

<b>constant</b>	An input for an operand in which the actual numeric value is specified. Constants can be input for certain operands in place of memory area addresses. Some operands must be input as constants.
<b>control bit</b>	A bit in a memory area that is set either through the program or via a Programming Device to achieve a specific purpose, e.g., a Restart Bit is turned ON and OFF to restart a Unit.
<b>control signal</b>	A signal sent from the PC to effect the operation of the controlled system.
<b>Control System</b>	All of the hardware and software components used to control other devices. A Control System includes the PC System, the PC programs, and all I/O devices that are used to control or obtain feedback from the controlled system.
<b>controlled system</b>	The devices that are being controlled by a PC System.
<b>Converting Link Adapter</b>	A Link Adapter used to convert between different types of optical fiber cable, different types of wire cable, or between optical fiber cable and wire cable. Such conversion is necessary to connect Units that use different forms of communication.
<b>CPU</b>	See <i>central processing unit</i> .
<b>CPU Backplane</b>	A Backplane used to create a CPU Rack.
<b>CPU Bus Unit</b>	A special Unit used with CV-series or CVM1/CVM1D PCs that mounts to the CPU bus. This connection to the CPU bus enables special data links, data transfers, and processing.
<b>CPU Rack</b>	The main Rack in a building-block PC, the CPU Rack contains the CPU, a Power Supply, and other Units. The CPU Rack, along with the Expansion CPU Rack, provides both an I/O bus and a CPU bus.
<b>crystal optical fiber cable</b>	See <i>AGF</i> .
<b>C-series PC</b>	Any of the following PCs: C2000H, C1000H, C500, C200H, C40H, C28H, C20H, C60K, C60P, C40K, C40P, C28K, C28P, C20K, C20P, C120, or C20.
<b>CV Support Software</b>	A programming package run on an IBM PC/AT or compatible to serve as a Programming Device for CV-series or CVM1/CVM1D PCs.
<b>CV-series PC</b>	Any of the following PCs: CV500, CV1000, or CV2000
<b>CVSS</b>	See <i>CV Support Software</i> .
<b>cycle</b>	One unit of processing performed by the CPU, including SFC/ladder program execution, peripheral servicing, I/O refreshing, etc. The cycle is called the scan with C-series PCs.
<b>cycle time</b>	The time required to complete one cycle of CPU processing.
<b>data area</b>	An area in the PC's memory that is designed to hold a specific type of data.
<b>data link</b>	An automatic data transmission operation that allows PCs or Units within PC to pass data back and forth via common data areas.
<b>data register</b>	A storage location in memory used to hold data. In CV-series or CVM1/CVM1D PCs, data registers are used with or without index registers to hold data used in indirect addressing.

<b>data transfer</b>	Moving data from one memory location to another, either within the same device or between different devices connected via a communications line or network.
<b>debug</b>	A process by which a draft program is corrected until it operates as intended. Debugging includes both the removal of syntax errors, as well as the fine-tuning of timing and coordination of control operations.
<b>decimal</b>	A number system where numbers are expressed to the base 10. In a PC all data is ultimately stored in binary form, four binary bits are often used to represent one decimal digit, via a system called binary-coded decimal.
<b>decrement</b>	Decreasing a numeric value, usually by 1.
<b>default</b>	A value automatically set by the PC when the user does not specifically set another value. Many devices will assume such default conditions upon the application of power.
<b>destination</b>	The location where an instruction places the data on which it is operating, as opposed to the location from which data is taken for use in the instruction. The location from which data is taken is called the source.
<b>digit</b>	A unit of storage in memory that consists of four bits.
<b>DIN track</b>	A rail designed to fit into grooves on various devices to allow the devices to be quickly and easily mounted to it.
<b>DIP switch</b>	Dual in-line package switch, an array of pins in a signal package that is mounted to a circuit board and is used to set operating parameters.
<b>distributed control</b>	A automation concept in which control of each portion of an automated system is located near the devices actually being controlled, i.e., control is decentralized and 'distributed' over the system. Distributed control is a concept basic to PC Systems.
<b>DM Area</b>	A data area used to hold only word data. Words in the DM area cannot be accessed bit by bit.
<b>DM word</b>	A word in the DM Area.
<b>downloading</b>	The process of transferring a program or data from a higher-level or host computer to a lower-level or slave computer. If a Programming Device is involved, the Programming Device is considered the host computer.
<b>Dummy I/O Unit</b>	An I/O Unit that has no functional capabilities but that can be mounted to a slot on a Rack so that words can be allocated to that slot. Dummy I/O Units can be used to avoid changing operand addresses in programs by reserving words for a slot for future use or by filling a slot vacated by a Unit to which words have already been allocated.
<b>duplex system</b>	A system where a second CPU Unit and Power Supply Unit are ready to take over control if the main Units fail.
<b>EEPROM</b>	Electrically erasable programmable read-only memory; a type of ROM in which stored data can be erased and reprogrammed. This is accomplished using a special control lead connected to the EEPROM chip and can be done without having to remove the EEPROM chip from the device in which it is mounted.
<b>electrical noise</b>	Random variations of one or more electrical characteristics such as voltage, current, and data, which might interfere with the normal operation of a device.

<b>EM Area</b>	Extended Data Memory Area; an area that can be optionally added to certain PCs to enable greater data storage. Functionally, the EM Area operates like the DM Area. Area addresses are prefixed with E and only words can be accessed. The EM Area is separated into multiple banks.
<b>EM card</b>	A card mounted inside certain PCs to added an EM Area.
<b>EPROM</b>	Erasable programmable read-only memory; a type of ROM in which stored data can be erased, by ultraviolet light or other means, and reprogrammed.
<b>error code</b>	A numeric code generated to indicate that an error exists, and something about the nature of the error. Some error codes are generated by the system; others are defined in the program by the operator.
<b>event processing</b>	Processing that is performed in response to an event, e.g., an interrupt signal.
<b>Expansion CPU Backplane</b>	A Backplane used to create an Expansion CPU Rack.
<b>Expansion CPU Rack</b>	A Rack connected to the CPU Rack to increase the virtual size of the CPU Rack. Units that may be mounted to the CPU Backplane may also be mounted to the Expansion CPU Backplane.
<b>Expansion Data Memory Unit</b>	A card mounted inside certain PCs to added an EM Area.
<b>Expansion I/O Backplane</b>	A Backplane used to create an Expansion I/O Rack.
<b>Expansion I/O Rack</b>	A Rack used to increase the I/O capacity of a PC. In CV-series or CVM1/CVM1D PC, either one Expansion I/O Rack can be connected directly to the CPU or Expansion CPU Rack or multiple Expansion I/O Racks can be connected by using an I/O Control and I/O Interface Units.
<b>FA</b>	Factory automation.
<b>factory computer</b>	A general-purpose computer, usually quite similar to a business computer, that is used in automated factory control.
<b>fatal error</b>	An error that stops PC operation and requires correction before operation can continue.
<b>FINS</b>	See <i>CV-mode</i> .
<b>flag</b>	A dedicated bit in memory that is set by the system to indicate some type of operating status. Some flags, such as the carry flag, can also be set by the operator or via the program.
<b>force reset</b>	The process of forcibly turning OFF a bit via a programming device. Bits are usually turned OFF as a result of program execution.
<b>force set</b>	The process of forcibly turning ON a bit via a programming device. Bits are usually turned ON as a result of program execution.
<b>frame checksum</b>	The results of exclusive ORing all data within a specified calculation range. The frame checksum can be calculated on both the sending and receiving end of a data transfer to confirm that data was transmitted correctly.
<b>GPC</b>	An acronym for Graphic Programming Console.
<b>Graphic Programming Console</b>	A programming device with advanced programming and debugging capabilities to facilitate PC operation. A Graphic Programming Console is provided with a

	large display onto which ladder-diagram programs can be written directly in ladder-diagram symbols for input into the PC without conversion to mnemonic form.
<b>hexadecimal</b>	A number system where all numbers are expressed to the base 16. In a PC all data is ultimately stored in binary form, however, displays and inputs on Programming Devices are often expressed in hexadecimal to simplify operation. Each group of four binary bits is numerically equivalent to one hexadecimal digit.
<b>host interface</b>	An interface that allows communications with a host computer.
<b>Host Link System</b>	A system with one or more host computers connected to one or more PCs via Host Link Units or host interfaces so that the host computer can be used to transfer data to and from the PC(s). Host Link Systems enable centralized management and control of PC Systems.
<b>Host Link Unit</b>	An interface used to connect a C-series PC to a host computer in a Host Link System.
<b>H-PCF cable</b>	An acronym for hard plastic-clad optical fiber cable.
<b>I/O allocation</b>	The process by which the PC assigns certain bits in memory for various functions. This includes pairing I/O bits to I/O points on Units.
<b>I/O Block</b>	Either an Input Block or an Output Block. I/O Blocks provide mounting positions for replaceable relays.
<b>I/O Control Unit</b>	A Unit mounted to the CPU Rack to monitor and control I/O points on Expansion CPU Racks or Expansion I/O Racks.
<b>I/O delay</b>	The delay in time from when a signal is sent to an output to when the status of the output is actually in effect or the delay in time from when the status of an input changes until the signal indicating the change in the status is received.
<b>I/O device</b>	A device connected to the I/O terminals on I/O Units, Special I/O Units, etc. I/O devices may be either part of the Control System, if they function to help control other devices, or they may be part of the controlled system.
<b>I/O Interface Unit</b>	A Unit mounted to an Expansion CPU Rack or Expansion I/O Rack to interface the Rack to the CPU Rack.
<b>I/O point</b>	The place at which an input signal enters the PC System, or at which an output signal leaves the PC System. In physical terms, I/O points correspond to terminals or connector pins on a Unit; in terms of programming, an I/O points correspond to I/O bits in the IR area.
<b>I/O refreshing</b>	The process of updating output status sent to external devices so that it agrees with the status of output bits held in memory and of updating input bits in memory so that they agree with the status of inputs from external devices.
<b>I/O response time</b>	The time required for an output signal to be sent from the PC in response to an input signal received from an external device.
<b>I/O Terminal</b>	A Remote I/O Unit connected in a Wired Remote I/O System to provide a limited number of I/O points at one location. There are several types of I/O Terminals.
<b>I/O Unit</b>	The most basic type of Unit mounted to a Backplane. I/O Units include Input Units and Output Units, each of which is available in a range of specifications. I/O Units do not include Special I/O Units, Link Units, etc.

<b>I/O verification error</b>	A error generated by a disagreement between the Units registered in the I/O table and the Units actually mounted to the PC.
<b>I/O word</b>	A word in the CIO area that is allocated to a Unit in the PC System and is used to hold I/O status for that Unit.
<b>IBM PC/AT or compatible</b>	A computer that has similar architecture to, that is logically compatible with, and that can run software designed for an IBM PC/AT computer.
<b>initialize</b>	Part of the startup process whereby some memory areas are cleared, system setup is checked, and default values are set.
<b>input</b>	The signal coming from an external device into the PC. The term input is often used abstractly or collectively to refer to incoming signals.
<b>input bit</b>	A bit in the CIO area that is allocated to hold the status of an input.
<b>Input Block</b>	A Unit used in combination with a Remote Interface to create an I/O Terminal. An Input Block provides mounting positions for replaceable relays. Each relay can be selected according to specific input requirements.
<b>input device</b>	An external device that sends signals into the PC System.
<b>input point</b>	The point at which an input enters the PC System. Input points correspond physically to terminals or connector pins.
<b>input signal</b>	A change in the status of a connection entering the PC. Generally an input signal is said to exist when, for example, a connection point goes from low to high voltage or from a nonconductive to a conductive state.
<b>Input Terminal</b>	An I/O Terminal that provides input points.
<b>instruction</b>	A direction given in the program that tells the PC of the action to be carried out, and the data to be used in carrying out the action. Instructions can be used to simply turn a bit ON or OFF, or they can perform much more complex actions, such as converting and/or transferring large blocks of data.
<b>interface</b>	An interface is the conceptual boundary between systems or devices and usually involves changes in the way the communicated data is represented. Interface devices such as NSBs perform operations like changing the coding, format, or speed of the data.
<b>interrupt (signal)</b>	A signal that stops normal program execution and causes a subroutine to be run or other processing to take place.
<b>Interrupt Input Unit</b>	A Rack-mounting Unit used to input external interrupts into a PC System.
<b>IOIF</b>	An acronym for I/O Interface Unit.
<b>IOM (Area)</b>	A collective memory area containing all of the memory areas that can be accessed by bit, including timer and counter Completion Flags. The IOM Area includes all memory area memory addresses between 0000 and 0FFF.
<b>JIS</b>	An acronym for Japanese Industrial Standards.
<b>jump</b>	A type of programming where execution moves directly from one point in a program to another, without sequentially executing any instructions in between.

Jumps in ladder diagrams are usually conditional on an execution condition; jumps in SFC programs are conditional on the step status and transition condition status before the jump.

<b>least-significant (bit/word)</b>	See <i>rightmost (bit/word)</i> .
<b>LED</b>	Acronym for light-emitting diode; a device used as for indicators or displays.
<b>leftmost (bit/word)</b>	The highest numbered bits of a group of bits, generally of an entire word, or the highest numbered words of a group of words. These bits/words are often called most-significant bits/words.
<b>link</b>	A hardware or software connection formed between two Units. "Link" can refer either to a part of the physical connection between two Units or a software connection created to data existing at another location (i.e., data links).
<b>Link Adapter</b>	A Unit used to connect communications lines, either to branch the lines or to convert between different types of cable. There are two types of Link Adapter: Branching Link Adapters and Converting Link Adapters.
<b>Link System</b>	A system used to connect remote I/O or to connect multiple PCs in a network. Link Systems include the following: SYSMAC BUS Remote I/O Systems, SYSMAC BUS/2 Remote I/O Systems, SYSMAC LINK Systems, Host Link Systems, and SYSMAC NET Link Systems.
<b>Link Unit</b>	Any of the Units used to connect a PC to a Link System. These include Remote I/O Units, SYSMAC LINK Units, and SYSMAC NET Link Units.
<b>linkable slot</b>	A slot on either a Backplane to which a Link Unit can be mounted. Backplanes differ in the slots to which Link Units can be mounted.
<b>load</b>	The processes of copying data either from an external device or from a storage area to an active portion of the system such as a display buffer. Also, an output device connected to the PC is called a load.
<b>main line</b>	In a Link System connected through Branching Link Adapters, the communications cable that runs from the Unit at each end of the System through the Link Adapters.
<b>MCR Unit</b>	Magnetic Card Reader Unit.
<b>megabyte</b>	A unit of storage equal to one million bytes.
<b>memory area</b>	Any of the areas in the PC used to hold data or programs.
<b>most-significant (bit/word)</b>	See <i>leftmost (bit/word)</i> .
<b>nesting</b>	Programming one loop within another loop, programming a call to a subroutine within another subroutine, or programming an IF–ELSE programming section within another IF–ELSE section.
<b>Network Service Board</b>	A device with an interface to connect devices other than PCs to a SYSMAC NET Link System.
<b>Network Service Unit</b>	A Unit that provides two interfaces to connect peripheral devices to a SYSMAC NET Link System.
<b>noise interference</b>	Disturbances in signals caused by electrical noise.



<b>nonfatal error</b>	A hardware or software error that produces a warning but does not stop the PC from operating.
<b>NOT</b>	A logic operation which inverts the status of the operand. For example, AND NOT indicates an AND operation with the opposite of the actual status of the operand bit.
<b>octal</b>	A number system where all numbers are expressed in base 8, i.e., numbers are written using only numerals 0 through 7.
<b>OFF</b>	The status of an input or output when a signal is said not to be present. The OFF state is generally represented by a low voltage or by non-conductivity, but can be defined as the opposite of either.
<b>OFF delay</b>	The delay between the time when a signal is switched OFF (e.g., by an input device or PC) and the time when the signal reaches a state readable as an OFF signal (i.e., as no signal) by a receiving party (e.g., output device or PC).
<b>offset</b>	A positive or negative value added to a base value such as an address to specify a desired value.
<b>ON</b>	The status of an input or output when a signal is said to be present. The ON state is generally represented by a high voltage or by conductivity, but can be defined as the opposite of either.
<b>ON delay</b>	The delay between the time when an ON signal is initiated (e.g., by an input device or PC) and the time when the signal reaches a state readable as an ON signal by a receiving party (e.g., output device or PC).
<b>on-line removal</b>	Removing a Rack-mounted Unit for replacement or maintenance during PC operation.
<b>operand</b>	The values designated as the data to be used for an instruction. An operand can be input as a constant expressing the actual numeric value to be used or as an address to express the location in memory of the data to be used.
<b>operating error</b>	An error that occurs during actual PC operation as opposed to an initialization error, which occurs before actual operations can begin.
<b>optical connector</b>	A connector designed to be connected to an optical fiber cable.
<b>optical fiber cable</b>	Cable made from light conducting filaments used to transmit signals.
<b>OR</b>	A logic operation whereby the result is true if either of two premises is true, or if both are true. In ladder-diagram programming the premises are usually ON/OFF states of bits or the logical combination of such states called execution conditions.
<b>output</b>	The signal sent from the PC to an external device. The term output is often used abstractly or collectively to refer to outgoing signals.
<b>Output Block</b>	A Unit used in combination with a Remote Interface to create an I/O Terminal. An Output Block provides mounting positions for replaceable relays. Each relay can be selected according to specific output requirements.
<b>output device</b>	An external device that receives signals from the PC System.
<b>output point</b>	The point at which an output leaves the PC System. Output points correspond physically to terminals or connector pins.

<b>output signal</b>	A signal being sent to an external device. Generally an output signal is said to exist when, for example, a connection point goes from low to high voltage or from a nonconductive to a conductive state.
<b>Output Terminal</b>	An I/O Terminal that provides output points.
<b>overflow</b>	The state where the capacity of a data storage location has been exceeded.
<b>overwrite</b>	Changing the content of a memory location so that the previous content is lost.
<b>parity</b>	Adjustment of the number of ON bits in a word or other unit of data so that the total is always an even number or always an odd number. Parity is generally used to check the accuracy of data after being transmitted by confirming that the number of ON bits is still even or still odd.
<b>parity check</b>	Checking parity to ensure that transmitted data has not been corrupted.
<b>PC</b>	An acronym for Programmable Controller.
<b>PC configuration</b>	The arrangement and interconnections of the Units that are put together to form a functional PC.
<b>PC System</b>	With building-block PCs, all of the Racks and independent Units connected directly to them up to, but not including the I/O devices. The boundaries of a PC System are the PC and the program in its CPU at the upper end; and the I/O Units, Special I/O Units, Optical I/O Units, Remote Terminals, etc., at the lower end.
<b>PCB</b>	An acronym for printed circuit board.
<b>PCF</b>	An acronym for plastic-clad optical fiber cable.
<b>PC Setup</b>	A group of operating parameters set in the PC from a Programming Device to control PC operation.
<b>Peripheral Device</b>	Devices connected to a PC System to aid in system operation. Peripheral devices include printers, programming devices, external storage media, etc.
<b>peripheral servicing</b>	Processing signals to and from peripheral devices, including refreshing, communications processing, interrupts, etc.
<b>PID Unit</b>	A Unit designed for PID control.
<b>port</b>	A connector on a PC or computer that serves as a connection to an external device.
<b>Power Supply Unit</b>	A Unit that mounts to a Backplane in a Rack PC. It provides power at the voltage required by the other Units on the Rack.
<b>present value</b>	The current value registered in a device at any instant during its operation. Present value is abbreviated as PV. The use of this term is generally restricted to timers and counters.
<b>printed circuit board</b>	A board onto which electrical circuits are printed for mounting into a computer or electrical device.
<b>Printer Interface Unit</b>	A Unit used to interface a printer so that ladder diagrams and other data can be printed out.

<b>Programmable Controller</b>	A computerized device that can accept inputs from external devices and generate outputs to external devices according to a program held in memory. Programmable Controllers are used to automate control of external devices. Although single-unit Programmable Controllers are available, building-block Programmable Controllers are constructed from separate components. Such Programmable Controllers are formed only when enough of these separate components are assembled to form a functional assembly, i.e., there is no one individual Unit called a PC.
<b>Programming Console</b>	The simplest form of programming device available for a PC. Programming Consoles are available both as hand-held models and as CPU-mounting models.
<b>Programming Device</b>	A Peripheral Device used to input a program into a PC or to alter or monitor a program already held in the PC. There are dedicated programming devices, such as Programming Consoles, and there are non-dedicated devices, such as a host computer.
<b>PROM</b>	Programmable read-only memory; a type of ROM into which the program or data may be written after manufacture, by a customer, but which is fixed from that time on.
<b>PROM Writer</b>	A peripheral device used to write programs and other data into a ROM for permanent storage and application.
<b>prompt</b>	A message or symbol that appears on a display to request input from the operator.
<b>protocol</b>	The parameters and procedures that are standardized to enable two devices to communicate or to enable a programmer or operator to communicate with a device.
<b>PV</b>	See <i>present value</i> .
<b>Rack</b>	An assembly that forms a functional unit in a Rack PC System. A Rack consists of a Backplane and the Units mounted to it. These Units include the Power Supply, CPU, and I/O Units. Racks include CPU Racks, Expansion I/O Racks, and I/O Racks. The CPU Rack is the Rack with the CPU mounted to it. An Expansion I/O Rack is an additional Rack that holds extra I/O Units. An I/O Rack is used in the C2000H Duplex System, because there is no room for any I/O Units on the CPU Rack in this System.
<b>rack number</b>	A number assigned to a Rack according to the order that it is connected to the CPU Rack, with the CPU Rack generally being rack number 0.
<b>Rack PC</b>	A PC that is composed of Units mounted to one or more Racks. This configuration is the most flexible, and most large PCs are Rack PCs. A Rack PC is the opposite of a Package-type PC, which has all of the basic I/O, storage, and control functions built into a single package.
<b>RAM</b>	Random access memory; a data storage media. RAM will not retain data when power is disconnected.
<b>RAS</b>	An acronym for reliability, assurance, safety.
<b>refresh</b>	The process of updating output status sent to external devices so that it agrees with the status of output bits held in memory and of updating input bits in memory so that they agree with the status of inputs from external devices.

<b>relay-based control</b>	The forerunner of PCs. In relay-based control, groups of relays are interconnected to form control circuits. In a PC, these are replaced by programmable circuits.
<b>reserved bit</b>	A bit that is not available for user application.
<b>reserved word</b>	A word in memory that is reserved for a special purpose and cannot be accessed by the user.
<b>reset</b>	The process of turning a bit or signal OFF or of changing the present value of a timer or counter to its set value or to zero.
<b>Restart Bit</b>	A bit used to restart a Unit mounted to a PC.
<b>restart continuation</b>	A process which allows memory and program execution status to be maintained so that PC operation can be restarted from the state it was in when operation was stopped by a power interruption.
<b>retrieve</b>	The processes of copying data either from an external device or from a storage area to an active portion of the system such as a display buffer. Also, an output device connected to the PC is called a load.
<b>retry</b>	The process whereby a device will re-transmit data which has resulted in an error message from the receiving device.
<b>rightmost (bit/word)</b>	The lowest numbered bits of a group of bits, generally of an entire word, or the lowest numbered words of a group of words. These bits/words are often called least-significant bits/words.
<b>rising edge</b>	The point where a signal actually changes from an OFF to an ON status.
<b>ROM</b>	Read only memory; a type of digital storage that cannot be written to. A ROM chip is manufactured with its program or data already stored in it and can never be changed. However, the program or data can be read as many times as desired.
<b>RS-232C interface</b>	An industry standard for serial communications.
<b>RS-422 interface</b>	An industry standard for serial communications.
<b>scan</b>	The process used to execute a ladder-diagram program. The program is examined sequentially from start to finish and each instruction is executed in turn based on execution conditions. The scan also includes peripheral processing, I/O refreshing, etc. The scan is called the cycle with CV-series or CVM1/CVM1D PCs.
<b>scan time</b>	The time required for a single scan of a ladder-diagram program.
<b>self diagnosis</b>	A process whereby the system checks its own operation and generates a warning or error if an abnormality is discovered.
<b>series</b>	A wiring method in which Units are wired consecutively in a string. In Link Systems wired through Link Adapters, the Units are still functionally wired in series, even though Units are placed on branch lines.
<b>servicing</b>	The process whereby the PC provides data to or receives data from external devices or remote I/O Units, or otherwise handles data transactions for Link Systems.

<b>set</b>	The process of turning a bit or signal ON.
<b>set value</b>	The value from which a decrementing counter starts counting down or to which an incrementing counter counts up (i.e., the maximum count), or the time from which or for which a timer starts timing. Set value is abbreviated SV.
<b>slot</b>	A position on a Rack (Backplane) to which a Unit can be mounted.
<b>software error</b>	An error that originates in a software program.
<b>software protect</b>	A means of protecting data from being changed that uses software as opposed to a physical switch or other hardware setting.
<b>software switch</b>	See <i>memory switch</i> .
<b>Special I/O Unit</b>	A Unit that is designed for a specific purpose. Special I/O Units include Position Control Units, High-speed Counter Units, Analog I/O Units, etc.
<b>SRAM</b>	Static random access memory; a data storage media.
<b>subroutine</b>	A group of instructions placed separate from the main program and executed only when called from the main program or activated by an interrupt.
<b>SV</b>	Abbreviation for set value.
<b>switching capacity</b>	The maximum voltage/current that a relay can safely switch on and off.
<b>synchronous execution</b>	Execution of programs and servicing operations in which program execution and servicing are synchronized so that all servicing operations are executed each time the programs are executed.
<b>syntax</b>	The form of a program statement (as opposed to its meaning). For example, the two statements, <code>LET A=B+B</code> and <code>LET A=B*2</code> use different syntaxes, but have the same meaning.
<b>syntax error</b>	An error in the way in which a program is written. Syntax errors can include 'spelling' mistakes (i.e., a function code that does not exist), mistakes in specifying operands within acceptable parameters (e.g., specifying read-only bits as a destination), and mistakes in actual application of instructions (e.g., a call to a subroutine that does not exist).
<b>system configuration</b>	The arrangement in which Units in a System are connected. This term refers to the conceptual arrangement and wiring together of all the devices needed to comprise the System. In OMRON terminology, system configuration is used to describe the arrangement and connection of the Units comprising a Control System that includes one or more PCs.
<b>system error</b>	An error generated by the system, as opposed to one resulting from execution of an instruction designed to generate an error.
<b>system error message</b>	An error message generated by the system, as opposed to one resulting from execution of an instruction designed to generate a message.
<b>terminator</b>	The code comprising an asterisk and a carriage return (* CR) which indicates the end of a block of data in communications between devices. Frames within a multi-frame block are separated by delimiters. Also a Unit in a Link System designated as the last Unit on the communications line.

<b>timer</b>	A location in memory accessed through a TC bit and used to time down from the timer's set value. Timers are turned ON and reset according to their execution conditions.
<b>TR Area</b>	A data area used to store execution conditions so that they can be reloaded later for use with other instructions.
<b>TR bit</b>	A bit in the TR Area.
<b>transfer</b>	The process of moving data from one location to another within the PC, or between the PC and external devices. When data is transferred, generally a copy of the data is sent to the destination, i.e., the content of the source of the transfer is not changed.
<b>transmission distance</b>	The distance that a signal can be transmitted.
<b>UM area</b>	The memory area used to hold the active program, i.e., the program that is being currently executed.
<b>Unit</b>	In OMRON PC terminology, the word Unit is capitalized to indicate any product sold for a PC System. Though most of the names of these products end with the word Unit, not all do, e.g., a Remote Terminal is referred to in a collective sense as a Unit. Context generally makes any limitations of this word clear.
<b>unit address</b>	A number used to control network communications. Unit addresses are computed for Units in various ways, e.g., 10 hex is added to the unit number to determine the unit address for a CPU Bus Unit.
<b>unit number</b>	A number assigned to some Link Units, Special I/O Units, and CPU Bus Units to facilitate identification when assigning words or other operating parameters.
<b>uploading</b>	The process of transferring a program or data from a lower-level or slave computer to a higher-level or host computer. If a Programming Device is involved, the Programming Device is considered the host computer.
<b>watchdog timer</b>	A timer within the system that ensures that the scan time stays within specified limits. When limits are reached, either warnings are given or PC operation is stopped depending on the particular limit that is reached.
<b>WDT</b>	See <i>watchdog timer</i> .
<b>wire communications</b>	A communications method in which signals are sent over wire cable. Although noise resistance and transmission distance can sometimes be a problem with wire communications, they are still the cheapest and the most common, and perfectly adequate for many applications.
<b>word</b>	A unit of data storage in memory that consists of 16 bits. All data areas consists of words. Some data areas can be accessed only by words; others, by either words or bits.
<b>word address</b>	The location in memory where a word of data is stored. A word address must specify (sometimes by default) the data area and the number of the word that is being addressed.
<b>word allocation</b>	The process of assigning I/O words and bits in memory to I/O Units and terminals in a PC System to create an I/O Table.
<b>work area</b>	A part of memory containing work words/bits.

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## *Glossary*

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<b>work bit</b>	A bit in a work word.
<b>work word</b>	A word that can be used for data calculation or other manipulation in programming, i.e., a 'work space' in memory. A large portion of the IR area is always reserved for work words. Parts of other areas not required for special purposes may also be used as work words.
<b>write protect switch</b>	A switch used to write-protect the contents of a storage device, e.g., a floppy disk. If the hole on the upper left of a floppy disk is open, the information on this floppy disk cannot be altered.
<b>write-protect</b>	A state in which the contents of a storage device can be read but cannot be altered.

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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.

Cat. No. W350-E1-2  
 Revision code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	January 1999	Original production
2	July 2000	<p><b>Pages xii and xiii:</b> Safety precautions revised.</p> <p><b>Page xiv:</b> "Power Supply Unit" added at top of page.</p> <p><b>Page 9:</b> Corrected to "explicit messages" at bottom center of diagram.</p> <p><b>Page 13:</b> I/O Interface Unit added in to places.</p> <p><b>Page 21:</b> Model numbers corrected to "CV."</p> <p><b>Page 23:</b> Addition at bottom of page.</p> <p><b>Pages 24 and 25:</b> Model numbers corrected.</p> <p><b>Page 27:</b> Tables entries corrected for SYSMAC BUS Remote I/O Master.</p> <p><b>Pages 37 and 109:</b> Life corrected to "2 years"</p> <p><b>Page 64:</b> "Max." removed at top of page.</p> <p><b>Page 65:</b> Note changed.</p> <p><b>Page 69:</b> New section added.</p> <p><b>Page 73:</b> "Maximum" removed above top diagram.</p> <p><b>Pages 122 and 124:</b> Information added on isolating Backplanes.</p> <p><b>Page 135:</b> Spacer added to <i>Optional</i> table.</p> <p><b>Page 137:</b> JIS specifications changed in top table and note change under top table.</p> <p><b>Page 156:</b> Circuit configuration diagram corrected.</p>