Cat. No. W167-E1-4A

SYSMAC
Programmable Controllers
C20P/C28P/C40P/C60P

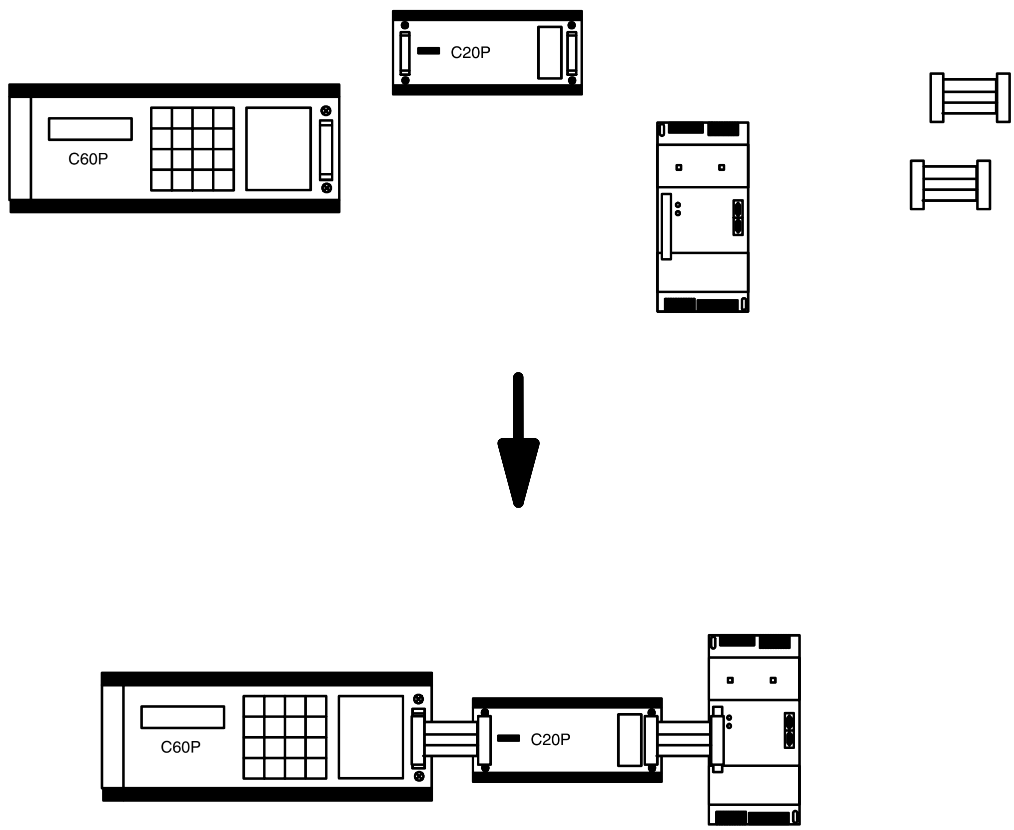
INSTALLATION GUIDE

OMRON

P-type Programmable Controllers

Installation Guide

Revised July 1994



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 the product.

DANGER! Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

Caution Indicates information that, if not heeded, could result in relative serious or minor injury, damage to the product, or faulty operation.

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.

TABLE OF CONTENTS

About this Manual:

This manual has been prepared to provide the information necessary to install, set up, and maintain your C-series P-type Programmable Controller, a low-cost, compact, versatile industrial control system providing up to 148 I/O points. For information regarding system programming and operation, refer to the *Operation Manual*.

Analog I/O Units are also not described in detail in this manual because a separate manual is provided for them (*SYSMAC K-type Analog I/O Units Operation Guide, Cat.No. W122*)

Section 1 describes the basic Units that can be used to build a K-type PC, explains how the Units can be combined, and provides example system configurations.

Section 2 covers actual system installation and wiring, including switch settings.

Section 3 provides information on maintaining your PC in good working condition.

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.

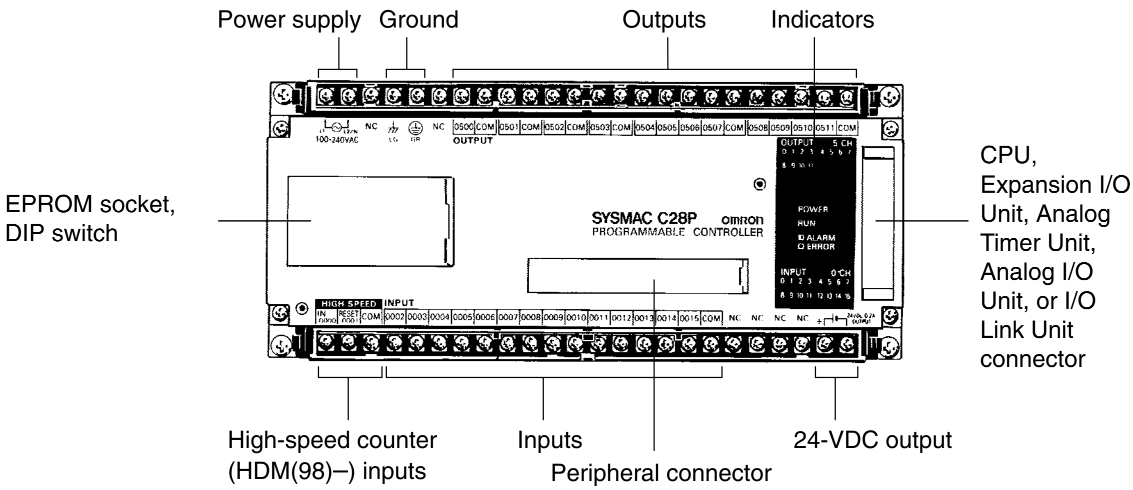
SECTION 1
Introduction

1-1 Nomenclature

This section gives the names and functions of the various components of P-type PCs and the basic Units with which they can be combined in a System.

1-1-1 CPUs

In the diagram below, the C28P is shown as a representative model. Refer to *Appendix A Standard Models* for your model's exact specifications.

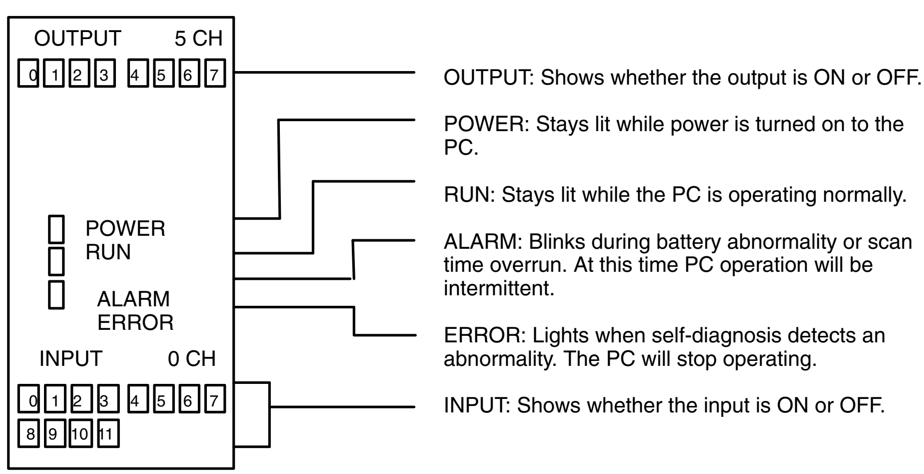


High-speed Counter

When the high-speed counter (HDM(98)) is not being used, the two high-speed counter input terminals can be used as normal DC input terminals. Their ON/OFF response time, however, will be shorter (0.15 ms max.). Regardless of whether or not the high-speed counter command is being used, DIP switch pins 7 and 8 must be off whenever the hardware reset is not being used.

Indicators

The diagram below shows the functions of the various indicators, taking the C20P as an example.

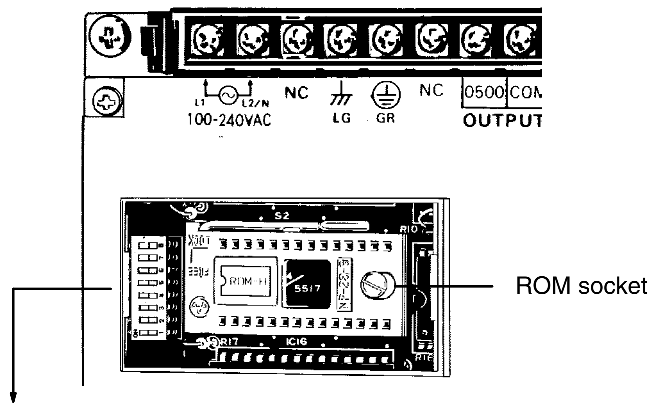


Memory

Each of the C-series P-type PCs is provided with a built-in RAM (random-access memory), as well as a ROM (read-only memory) chip socket. Either may be used with ease. It is recommended to use the RAM for programming and, when the program is completed, to save it in a ROM chip for protection. The memory capacity in either case is 1,194 addresses.

ROM Socket and DIP Switch

Beneath the cover are the DIP switch and the socket where an EPROM chip may be installed. For details, see *2-8-1 Setting the CPU DIP Switch* and *2-8-2 EPROM Installation*. Only DIP switch pins 1 and 2 are on when the CPU is delivered.

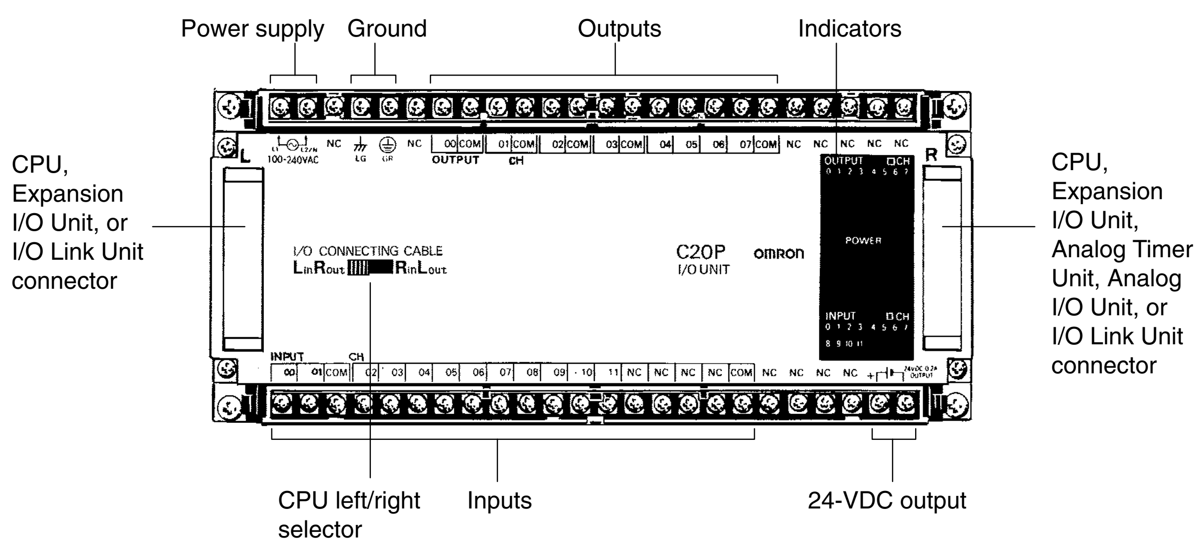


8 7	Turn ON to use hardware reset (0001). Turn OFF if FUN 61 is not used.
6	Turn ON for English display.
5	Turn ON to inhibit ALARM indicator.
4, 3	ROM: ON (RAM: OFF)
2, 1	RAM: ON (ROM: OFF)

CAUTION: In case of battery failure, data stored in the RAM, the DM area, the HR area, etc., will not be preserved.

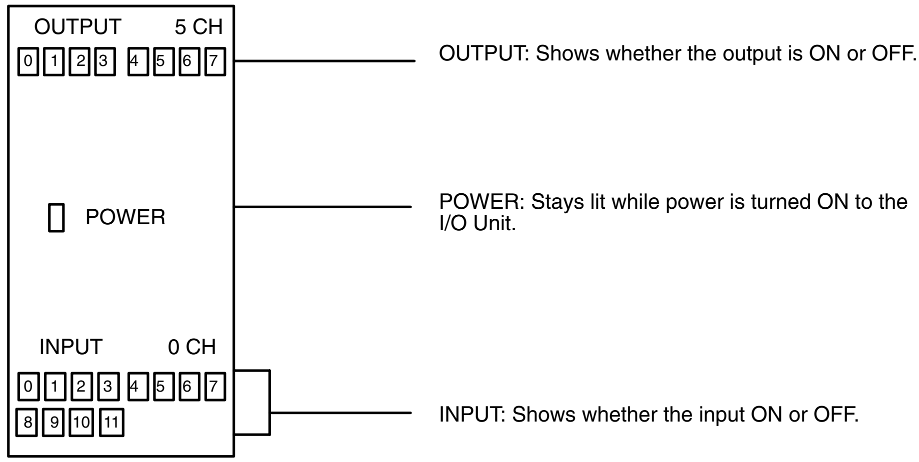
1-1-2 Expansion I/O Units

In the diagram below, the C20P is shown as a representative model. Refer to *Appendix A Standard Models* for your model's exact specifications.



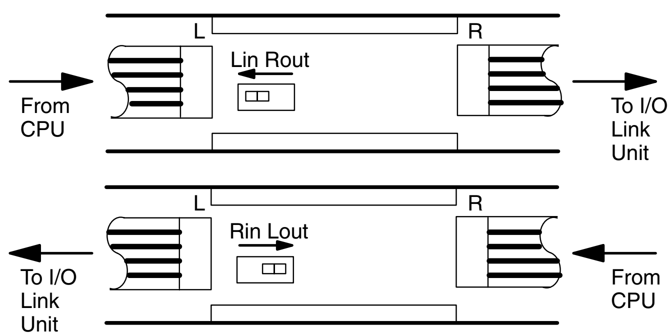
Indicators

The following diagram shows the functions of the various indicators, taking the C20P as an example.



CPU Left/Right Selector

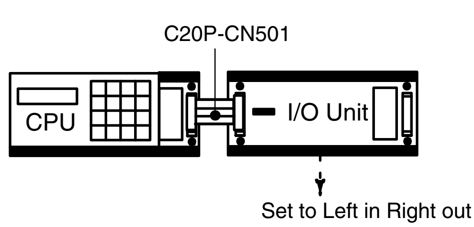
The C20P, C28P, C40P, and C60P Expansion I/O Units all have CPU left/right selector switches. The C16P and C4K do not. For those models which have the switch, care must be taken to set it so that it corresponds with the direction of the I/O Connecting Cable. If the switch is set in the wrong direction, the System will operate as if the I/O Unit were not there. Set the switch so that the CPU connector side (Left or Right) is “in,” as shown in the following diagram. Do not change the switch setting after power has been turned ON, as this will cause the I/O bus to malfunction.



The following example diagrams show the proper switch settings for horizontal and vertical mounting of Units.

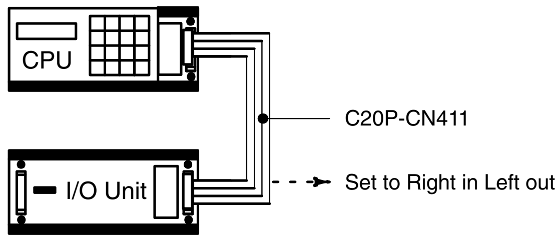
Horizontal Mounting

All Units can be positioned horizontally.



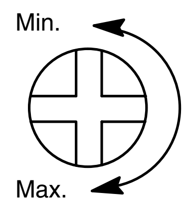
Vertical Mounting

All Units except the C16P and C4K can be positioned vertically.

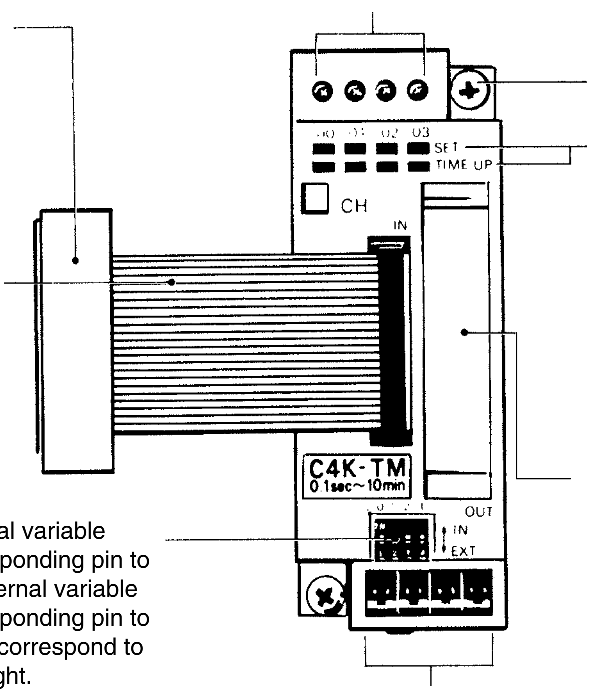


1-1-3 Analog Timer Unit

Internal variable resistors
These variable resistors are used to set the timers and, from left to right, correspond to T0 to T3. The settings of these resistors are effective only when the corresponding IN/EXT selector is set to IN. To set or adjust the time, use the screwdriver supplied with the Analog Timer Unit. Turn the variable resistor shafts clockwise to increase the time value.



CPU connector
Install and connect the Expansion I/O Unit and the CPU horizontally; otherwise the Analog Timer Unit cannot be connected to the CPU.



Two M4 mounting screws (self-rising pressure plate)

Indicators
The SET indicators in the top row light while timer values are being set. The TIME UP indicators in the bottom row light when the corresponding timer contact (T0 to T3) turns ON. Numbers 00 to 03 correspond to T0 to T3.

I/O Connecting Cable
C4K-CN502
One cable is supplied with the Analog Timer Unit

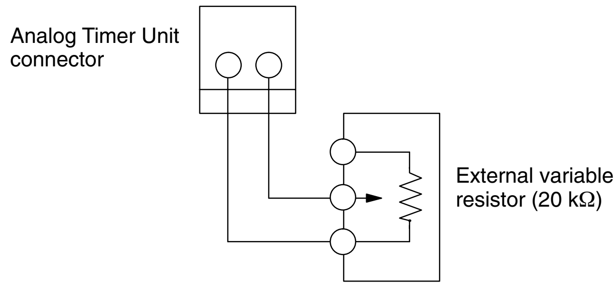
This connector is not used. Do not remove the cover.

IN/EXT selectors
When using the internal variable resistor, set the corresponding pin to IN; when using an external variable resistor, set the corresponding pin to EXT. These selectors correspond to T0 to T3 from left to right.

External variable resistor connectors
When using external variable resistors to set the timers, connect the resistors to these connectors. The corresponding IN/EXT selector must be set to the EXT position. These connectors correspond to T0 to T3 from left to right. Use 20 kΩ external variable resistors. A Connecting Cable with a 2-m lead is available for a variable resistor (C4K-CN223).

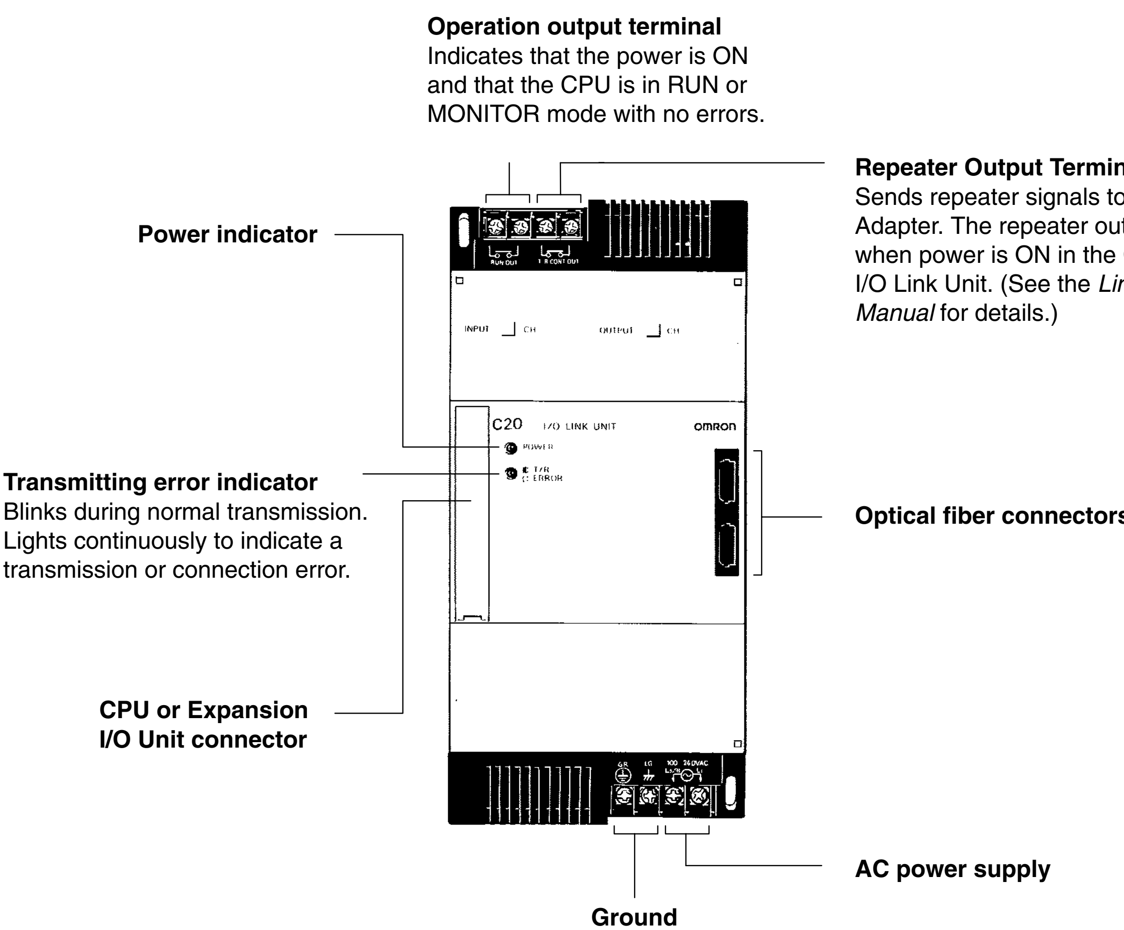
External Variable Resistor

The contactor employs solderless terminals and must be wired as shown below, using AWG 22 to 28 lead wires.



1-1-4 I/O Link Units

The I/O Link Unit must be used as a Remote I/O Slave, and must be used with a Remote I/O Master. Refer to the *Remote I/O Unit Operation Guide* for details.



1-2 System Configuration

Depending on your control requirements, you can combine various Units for a total number of I/O points ranging anywhere from 20 to 148.

A P-type PC consists of a CPU Unit plus one or more of the following Units: Expansion I/O Units, Analog Timer Units, Analog I/O Units, or an I/O Link Unit. All of these Units are connected in series with the CPU Unit at one end. An I/O Link Unit, if included, must be on the other end (meaning only one I/O Link Unit can be used) and an Analog Timer Unit cannot be used with. The rest of the Units can be in any order desired. The Units from which P-type PCs can be built are shown below.

Unit type	Name	Words occupied	Inputs provided	Outputs provided
CPU	C20P	2	12 points	8 points
	C28P	2	16 points	12 points
	C40P	4	24 points	16 points
	C60P	4	32 points	24 points
Expansion I/O Unit	C4K	2	4 input points or 4 output points	
	C20P	2	12 points	8 points
	C28P	2	16 points	12 points
	C40P	4	24 points	16 points
	C60P	4	32 points	24 points
Special I/O Units	Analog Timer Unit	2	4 timer inputs	
	C4K Analog Input Unit	2	4 analog inputs	
	C1K Analog Input Unit	2	1 analog input	
	Analog Output Unit	2	1 analog output	
	I/O Link Unit	2	16 input and 16 output bits	

When determining which configuration to use, another factor to consider is the ease with which I/O points can be assigned. In order to make the process as simple as possible, it is recommended that a CPU be used which has more I/O points than the largest Expansion I/O Unit. For example, rather than combining a C20P CPU with a C20P Expansion I/O Unit, it would be preferable to use a C40P CPU. Similarly, combining a C60P CPU with a C40 Expansion I/O Unit would be better than using a C40P CPU and a C60P Expansion I/O Unit.

The tables on the following pages show the possible configurations for a P-type PC. Although the tables branch to show the various possibilities at any one point, there can be no branching in the actual PC connections. You can choose either branch at any point and go as far as required, i.e., you can break off at any point to create a smaller PC System.When implementing a system there is a physical restriction on the total cable length allowable. The sum of the lengths of all cables in the system must be limited to less than 1.2 meters.

The tables also show I/O word allocations for the Units in the systems and which words will be input words and which words will be output words. All of these are determined by the position of the Unit in the configuration except for the C4P and C16P Expansion I/O Units, in which case the model of the Unit determines whether the words are input or output.

The symbols used in the table represent the following:

C20P/C28P	
Input	Output

C20P or C28P CPU Unit

C40P/C60P			
Input	Output	Input	Output

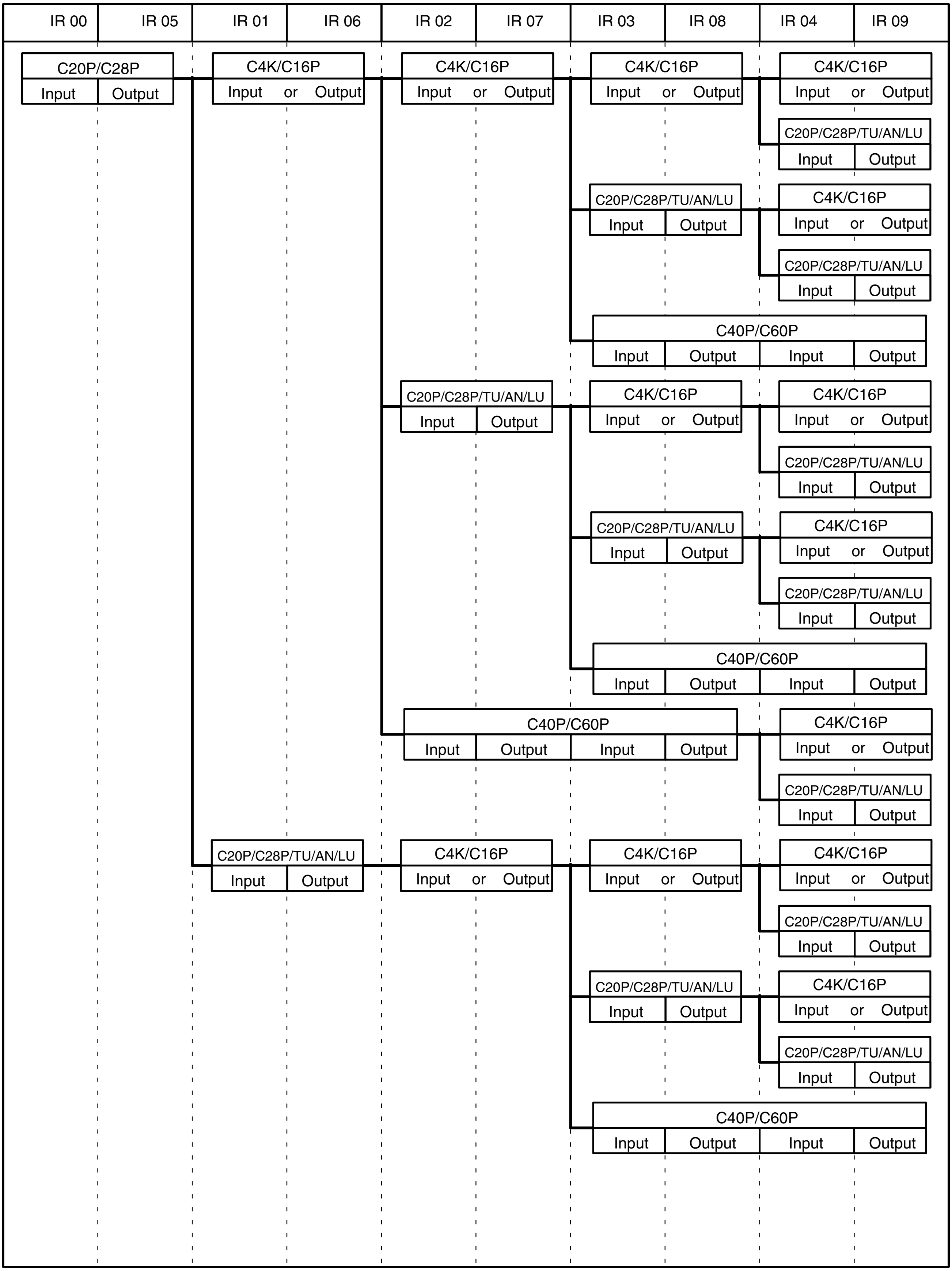
C40P or C60P CPU or Expansion I/O Unit

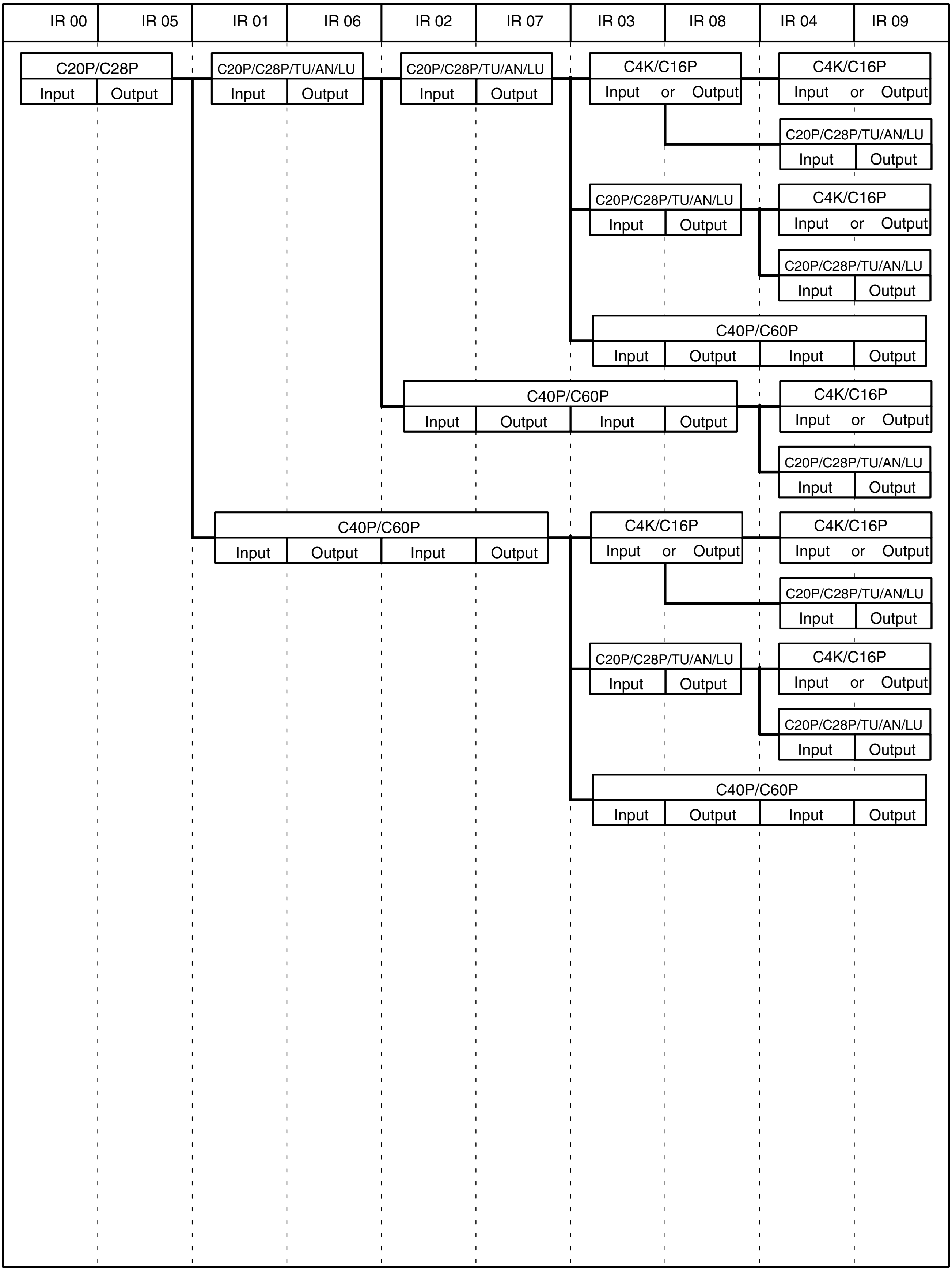
C4K/C16P
Input or Output

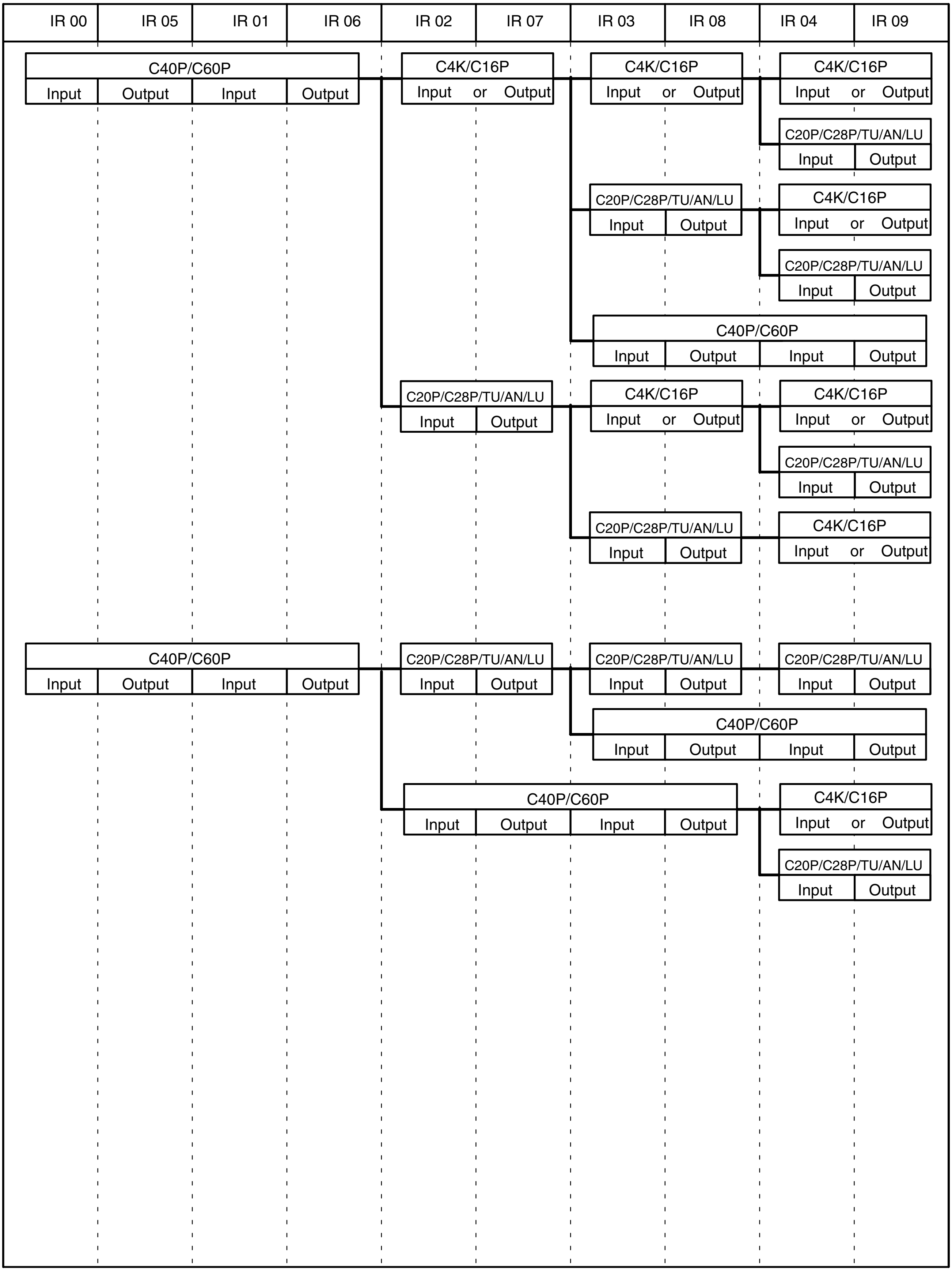
C4K or C16P Expansion I/O Unit

C20P/C28P/TU/AN/LU	
Input	Output

C20P Expansion I/O Unit, C28P Expansion I/O Unit, Analog Timer Unit, Analog I/O Unit, or I/O Link Unit


IR 00
IR 05
IR 01
IR 06
IR 02
IR 07
IR 03
IR 08
IR 04
IR 09
C20P/C28P
Input
Output
C4K/C16P
Input or Output
C20P/C28P/TU/AN/LU
C40P/C60P


IR 00
IR 05
IR 01
IR 06
IR 02
IR 07
IR 03
IR 08
IR 04
IR 09
C20P/C28P
Input
Output
C20P/C28P/TU/AN/LU
C4K/C16P
Input or Output
C40P/C60P


IR 00
IR 05
IR 01
IR 06
IR 02
IR 07
IR 03
IR 08
IR 04
IR 09
C40P/C60P
Input
Output
Input
Output
C4K/C16P
Input or Output
C4K/C16P
Input or Output
C4K/C16P
Input or Output
C20P/C28P/TU/AN/LU
Input
Output
C20P/C28P/TU/AN/LU
Input
Output
C4K/C16P
Input or Output
C20P/C28P/TU/AN/LU
Input
Output
C40P/C60P
Input
Output
Input
Output
C20P/C28P/TU/AN/LU
Input
Output
C4K/C16P
Input or Output
C4K/C16P
Input or Output
C20P/C28P/TU/AN/LU
Input
Output
C20P/C28P/TU/AN/LU
Input
Output
C4K/C16P
Input or Output
C40P/C60P
Input
Output
Input
Output
C20P/C28P/TU/AN/LU
Input
Output
C20P/C28P/TU/AN/LU
Input
Output
C20P/C28P/TU/AN/LU
Input
Output
C40P/C60P
Input
Output
Input
Output
C40P/C60P
Input
Output
Input
Output
C4K/C16P
Input or Output
C20P/C28P/TU/AN/LU
Input
Output

SECTION 2
System Installation and Wiring

2-1 General

This section explains how to install and set up your Control System, with specifics on the proper environment, actual mounting, applicable cable, wiring, and switch settings.

2-2 Installation Environment

Although the P-type Programmable Controller is quite durable, the following conditions must be observed in order for your System to operate at its highest level of reliability.

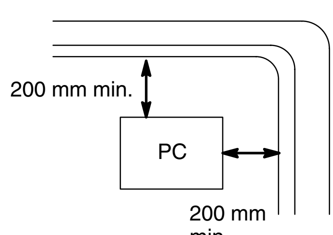
Ambient temperature	Operating: 0° to 55°C* Storage: –20° to 65°C
Humidity	35% to 45% (without condensation)
Atmosphere	Must be free from the following: • Corrosive gases • Abrupt temperature changes • Direct sunlight • Concentration of dust, salt, iron particles • Splatter from water, oil, other chemicals
Vibration and shock	Must not receive direct impact or vibration

*The ambient operating temperature for the Programming Console is 0° to 45°.

Caution In low humidity conditions, excessive static electricity of over 8 kV can damage internal components such as ICs. Before touching the PC, be sure to first touch a grounded metallic object to discharge any static electricity buildup.

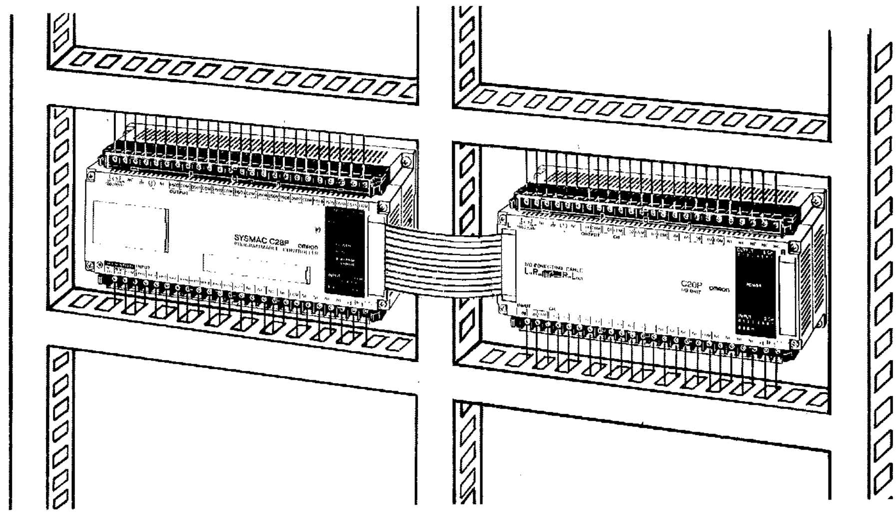
Noise Prevention

Use twisted-pair cables with cross-sectional areas of at least 2 mm^2/conductor (AGW 14) to prevent noise. Avoid mounting the PC close to high-power equipment, and be sure to mount it at least 200 mm away from power lines. Wherever possible, use wiring ducts to contain and protect the PC wiring. The I/O wiring should not be placed in the same duct with the power line or other wiring. Standard wiring conduits are sufficient as long as the I/O wiring and power lines are kept separate.

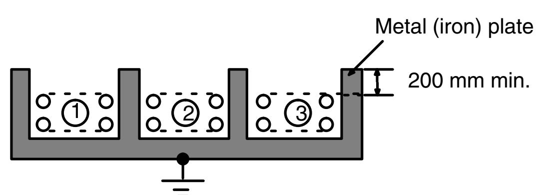


Duct Work

When CPUs and Expansion I/O Units are mounted horizontally, be sure that no ducts or wiring passes between them. The diagram shows an example of unacceptable mounting.

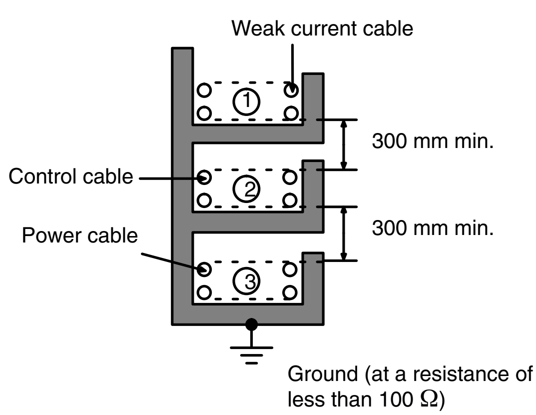


If the controlled system requires either 10 A at 400 V max. or 20 A at 220 V max. power cables, and if the conduits are run parallel to each other, a minimum distance of 300 mm must be provided between the I/O lines and the power cable. If the I/O lines and the power cables must be placed in the same duct at the point of connection to the equipment, be sure to screen them with a grounded metal plate.



Grounding (at a ground resistance of less than 100 Ω)

1 PC I/O circuit
2 PC power circuit
3 General control circuit/Power circuit

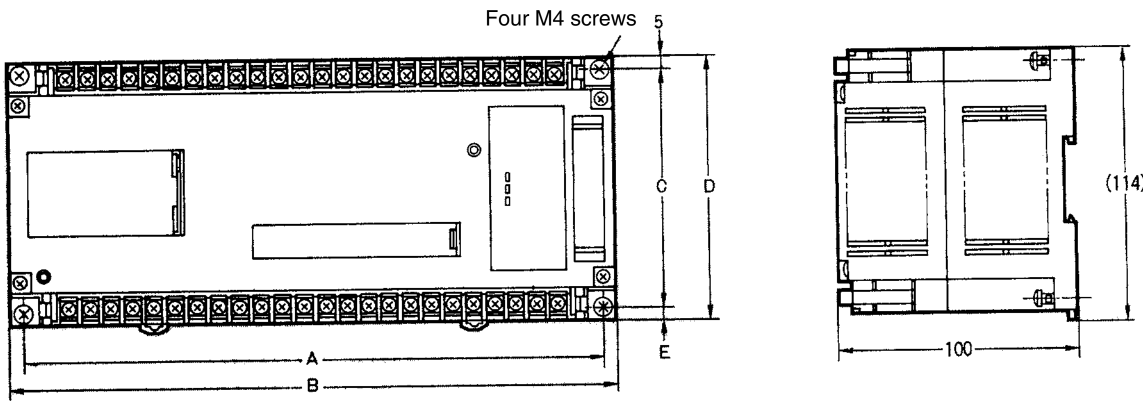


2-3 Dimensions and Installation

This section gives dimensions and other information necessary for mounting the CPUs, Expansion I/O Units, Analog Timer Units, and I/O Link Units. All measurements are in mm.

CPUs

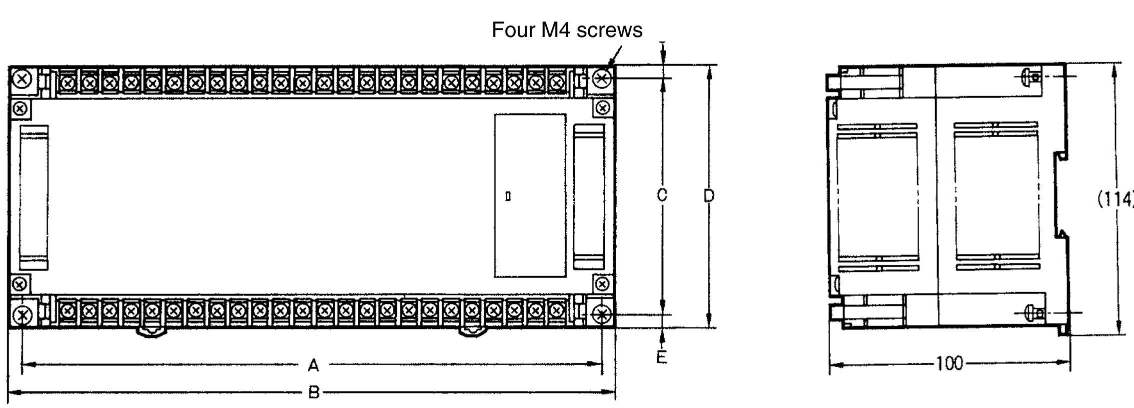
The C20P is shown below. Dimensions for all Units are given in the table.



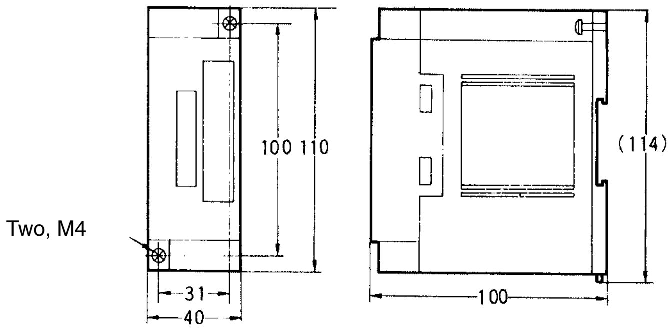
Model	A	B	C	D	E
C20P	240	250	100	110	5
C28P	240	250	100	110	5
C40P	290	300	100	110	5
C60P	340	350	120	140	15

Expansion I/O Units

The C20P is shown below. Dimensions for all Units are given in the table.

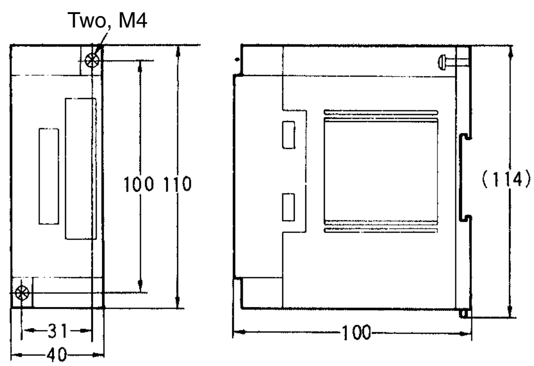


C4K

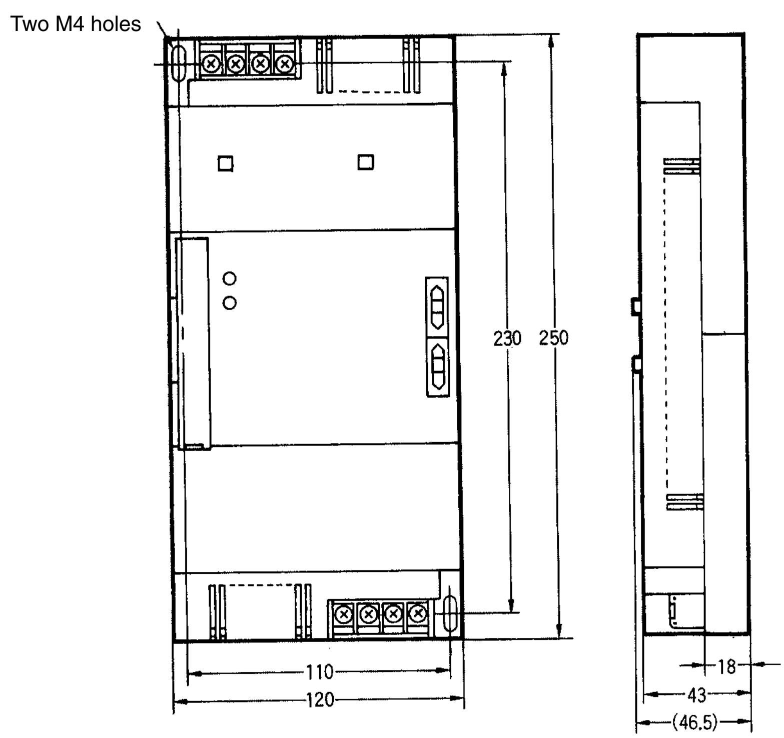


Model	A	B	C	D	E
C16P	145	155	100	110	5
C20P	240	250	100	110	5
C28P	240	250	100	110	5
C40P	290	300	100	110	5
C60P	340	350	120	140	15

Analog Timer Units C4K-TM



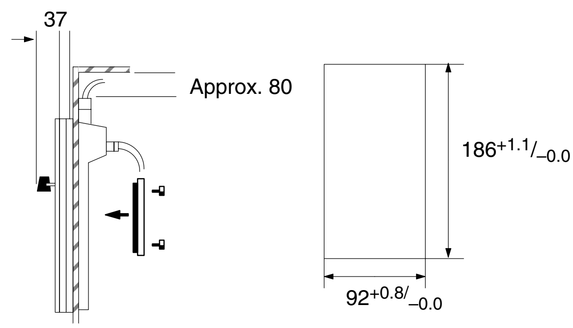
I/O Link Units C20-LK011(-P)



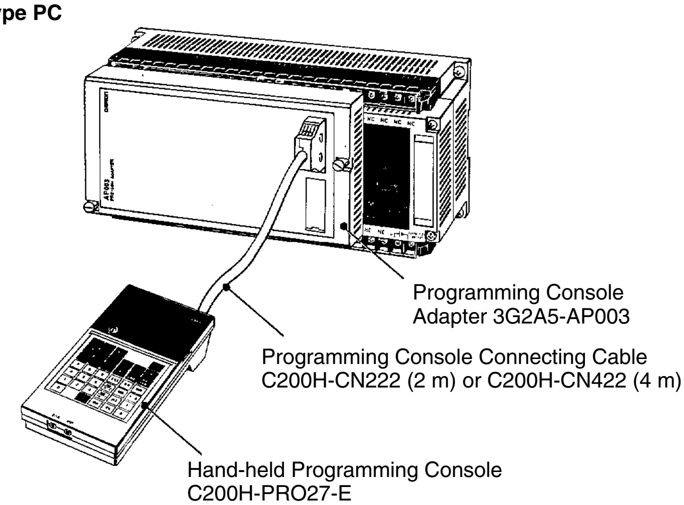
Programming Console

The Hand-held Programming Console can be mounted to a panel if desired. To do so, the Programming Console Mounting Bracket (C200H-ATT01, sold separately) is required. Mounting dimensions and connections are shown below. Only one connector should be used at any one time. When connecting the Programming Console, press in firmly until you hear it click into place.

C200H-PRO27-E Panel Mounting **Panel Cutout (DIN 43700)**



P-type PC



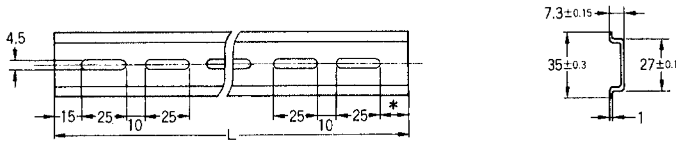
The other Programming Consoles are normally connected directly to the CPU and held in place with two mounting screw.

Caution Never run a Programming Console Connecting Cable past high-power lines or other sources of electrical noise, as these will prevent correct operation. Also, never leave the PC operating in RUN mode when the Programming Console is connected via Connecting Cable, as noise entering through the cable could also cause malfunctions in operation.

Note
1. Always keep the unused connector covered.
2. Do not attach a key holder to the switch key; it will interfere with operation.
3. The key cannot be removed in PROGRAM mode.
4. Use the switch on the upper right side of the Programming Console to adjust the volume of the beeper.
5. The 3G2C6-CN122 (1 m) and 3G2C7-CN5111 (50 cm) Connecting Cables are available to connect the 3G2A5-PRO13-E and 3G2A6-PRO15-E Programming Consoles. The Programming Console Adapter is not required for these.
6. For operational information, refer to your PC's *Operation Manual.*

DIN Rails

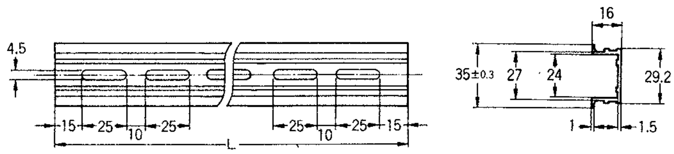
PFP-50N/PFP-100N



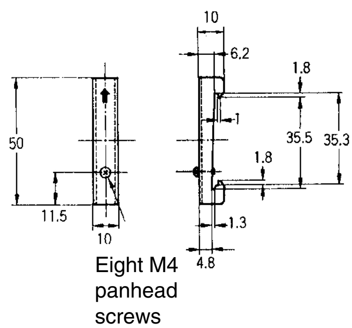
Model	L	*
PFP-50N	50 cm	5
PFP-100N	1 m	15
PFP-100N2	1 m	—

Use the PFP-100N2 for the C60P. If the PFP-50N or PFP-100N are used, the Unit will be slanted.

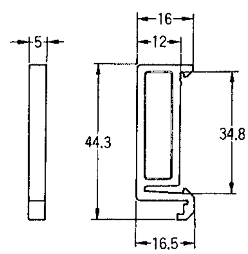
PFP-100N2



Endplate PFP-M



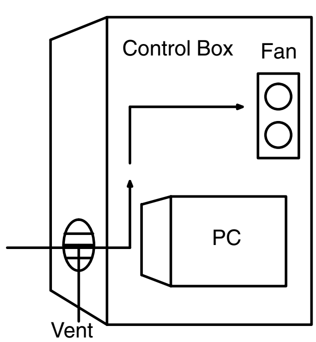
Spacer PFP-S



Mounting

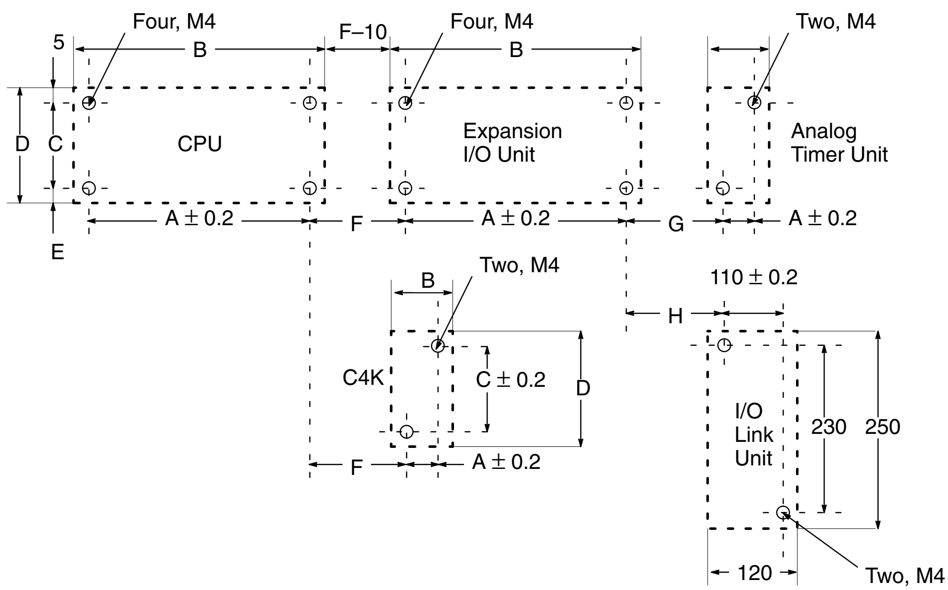
A CPU and Expansion I/O Unit may be mounted either vertically or horizontally in relation to each other but the orientation of each unit itself must remain horizontal as described by the following mounting diagrams. If mounting the units vertically, position the CPU above the Expansion I/O Unit; if mounting horizontally, position the CPU to the left.

When installing the CPUs, Expansion I/O Units, and I/O Link Units, allow sufficient space between the Units for cooling. Models taking a 100 to 240-VAC power supply require a minimum cooling space of 10 mm between Units. Avoid mounting any units in warm areas or over a heat source of any kind.In addition, if the CPU is installed in a control box, allow sufficient space for maintenance and ventilation. It may be necessary to install a ventilation fan in the control box to maintain the required ambient temperature as indicated in *Appendix B Specifications*.

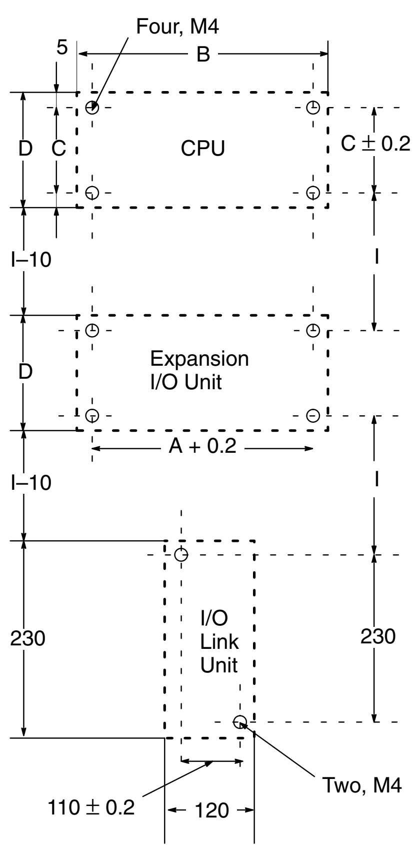


Another factor to consider is the I/O wiring (see *2-6 I/O Wiring*). If the CPU and/or Expansion I/O Units are mounted vertically, a minimum of 70 mm open space is required for ease of I/O wiring. The spacing of the mounting holes, for both vertical and horizontal mounting is as shown below.

Horizontal Mounting



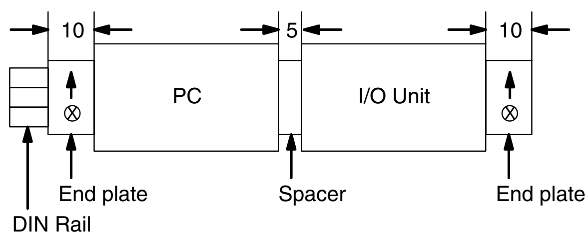
Vertical Mounting



Model		A±0.2	B	C±0.2	D	E
CPU	C20P	240	250	100	110	5
	C28P	240	250	100	110	5
I/O Unit	C40P	290	300	100	110	5
	C60P	340	350	120	140	15
I/O Unit	C16P	145	155	100	110	5
	C4K	31	40	100	110	5
Analog Timer Unit	C4K -TM	31	40	100	110	5

F	G	H	I
15 to 40	15 to 35	20 to 40	80 to 130

Attach End Plates (PFP-M) to both ends (as shown below) when connecting CPUs, Expansion I/O Units, or Analog Timer Units to a DIN Rail. It is also recommended that a Spacer (PFP-S) be installed between a CPU and Expansion I/O Unit when they are mounted horizontally.



Mounting screws are included with CPUs, Expansion I/O Units, and Analog Timer Units. They must be purchased separately for I/O Link Units.

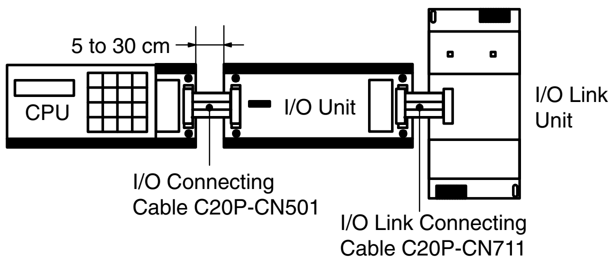
2-4 I/O Connecting Cable

Applicable connecting cable will vary according to which Units are connected and whether they are mounted horizontally or vertically. All Expansion I/O Units except the C16P and C4K use C20P-CN501 cable (5 cm) for horizontal mounting and C20P-CN411 cable (40 cm) for vertical mounting. The C16P and C4K cannot be mounted vertically. The C16P can use either of the above-mentioned cables for horizontal mounting. The C4K can use only C4K-CN502 cable (5 cm). For connecting I/O Link Units, use C20P-CN711 cable (70 cm).

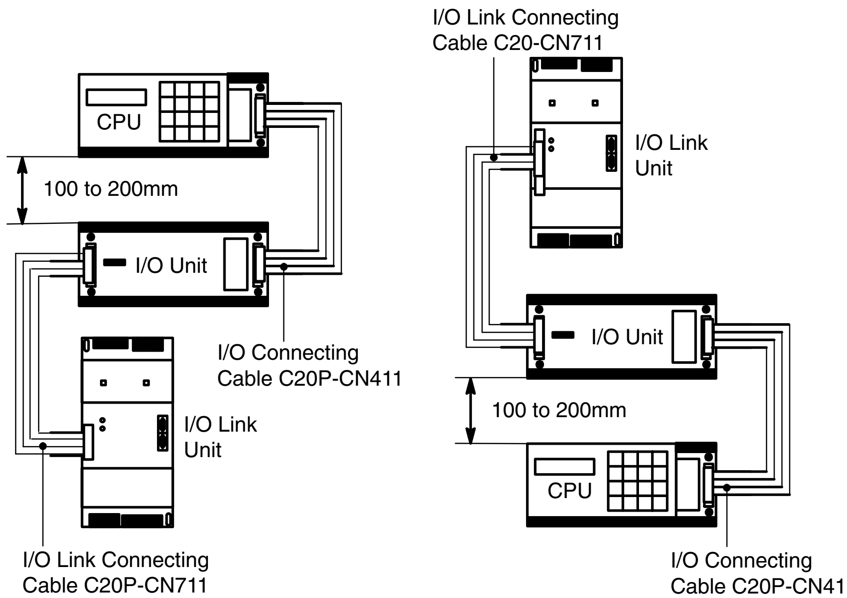
Caution Always be sure to use only the cable that is included with the Unit. Using the wrong cable (such as the C20 I/O Connecting Cable or I/O Link Connecting Cable) for connecting Expansion I/O Units can cause serious damage to the Units.

The following diagrams illustrate the appropriate cables for connecting CPUs, Expansion I/O Units, and I/O Link Units either horizontally or vertically.

Horizontal Mounting

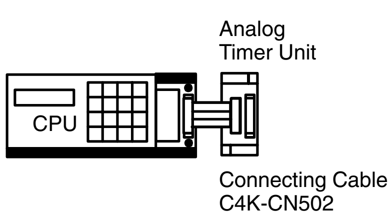


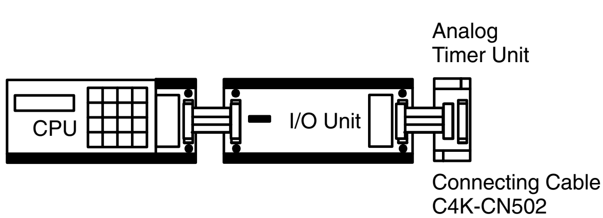
Vertical Mounting



Connecting Analog Timer Units

One Analog Timer Unit can be connected directly to a CPU or to any combination of a CPU and Expansion I/O Units. In either case, as shown in the following diagram, the Units must be mounted horizontally.





Connecting I/O Link Units

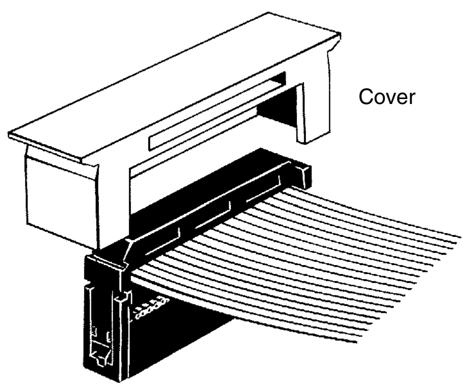
One I/O Link Unit can be connected directly to a CPU or to any combination of a CPU and Expansion I/O Units. It cannot be used in the same PC System with an Analog Timer Unit.

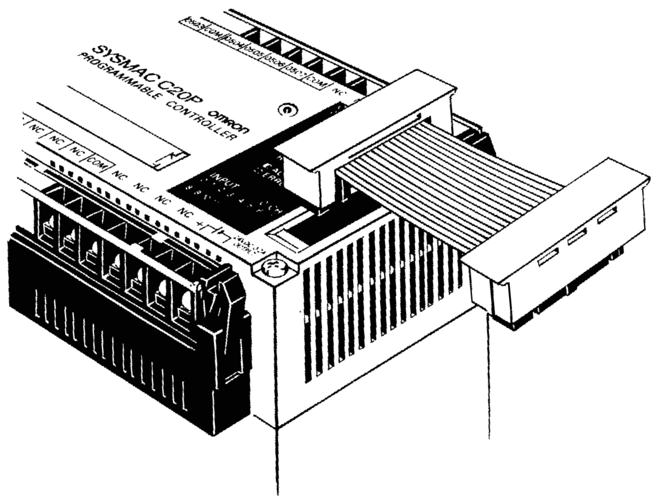
Connection Procedure

Follow these four steps to connect Expansion I/O Unit, Analog Timer, and I/O Link Unit Connecting Cables.

1, 2, 3...

1. Remove the connector cover from the CPU, using a screwdriver if necessary.
2. Insert one of the cable's connectors into the cover. (Once inserted, the connector cannot be removed.)
3. Reinsert the cover/connector combination into the CPU.
4. Repeat this procedure on the other end of the cable.





Optical Fiber Cable

Optical fiber cable can be used for extending transmission distance and reducing noise. There are three types, and the appropriate cable for any given situation will depend on the desired transmission distance and the particular Units which need to be connected.

All-plastic optical fiber cable (APF) is for short-distance transmission (up to 20 m) and can be used only by Units with the suffix "-P" attached. Plastic-clad optical fiber cable (PCF) is for middle-distance transmission (up to 200 m for Units with "-P" and 800 m for Units without "-P"). Crystal optical fiber cable (AGF) is for long-distance transmission (up to 3 km) and can be connected only to certain Link Adapters.

Although laying optical fiber cable does not basically differ from laying wire cable, there are certain precautions which should be observed. For details, refer to the *Optical Remote I/O Systems Manual*.

Link Adapters

Although it is normally possible to connect Units in series, a failure (power failure, disconnection, etc.) in one of the Units will cause all the subsequent Units to cease operating. You can use Link Adapters to prevent this type of situation from occurring. Even if a power failure occurs in a Unit connected to a branch line of a Link Adapter, the Link Adapter will bypass that Unit and continue to transmit signals to the other Units. You can also use Link Adapters for branching and for converting between various types of wire and optical cable. For details on these and other functions of Link Adapters, refer to the *Link Adapter Manual*.

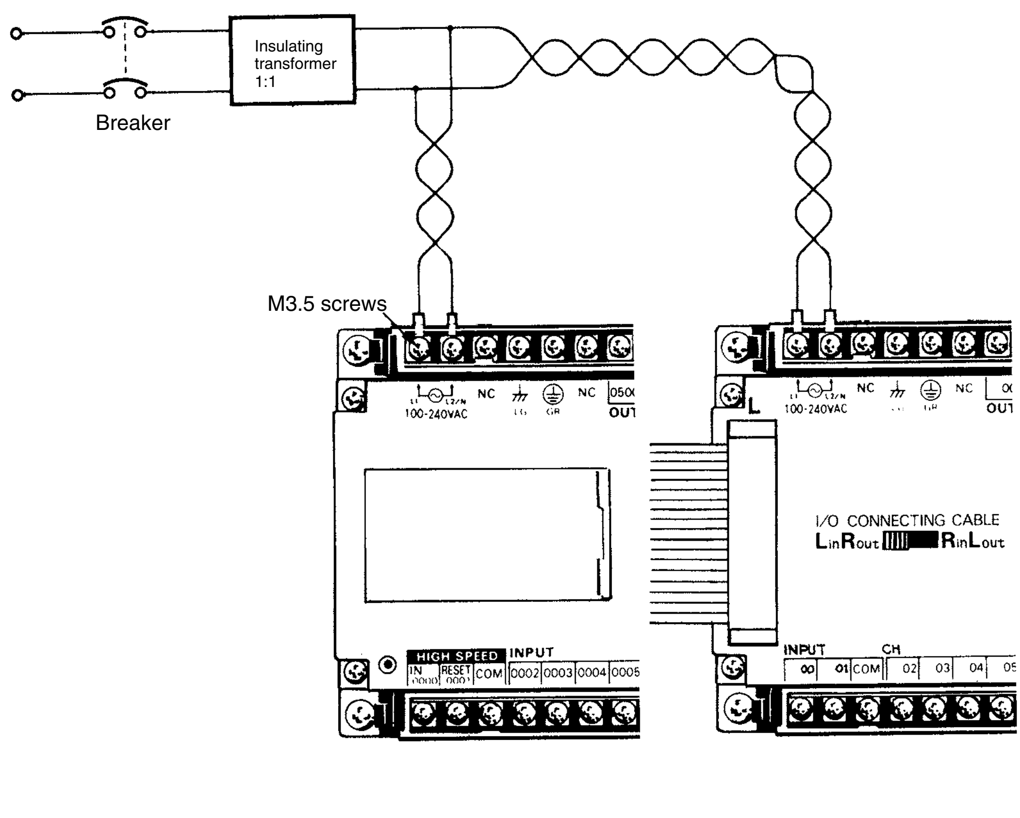
2-5 Wiring CPUs and Expansion I/O Units

Power Supply

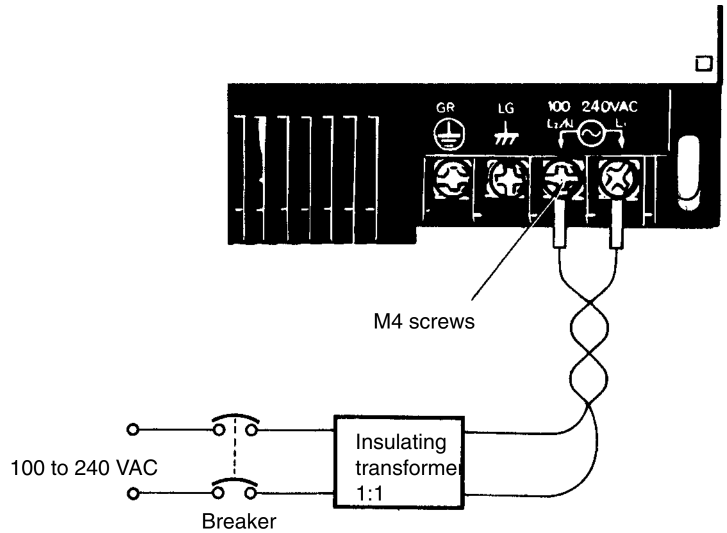
Use a commercially available 24-VDC, 100 to 120-VAC, or 200 to 240-VAC power supply (depending on your model) for the CPU. When an Expansion I/O Unit(s) or an I/O Link Unit is used, the power supply must also be connected to each of these Units. Where possible, use independent power sources for the inputs, the output loads, and the CPU. All of the CPUs and Expansion I/O Units may be connected to the same power source. If a CPU and an Expansion I/O Unit are connected to separate power supplies, then the CPU (as well as the Programming Console, etc.) will not operate unless power is turned on to the Expansion I/O Unit.

Wiring

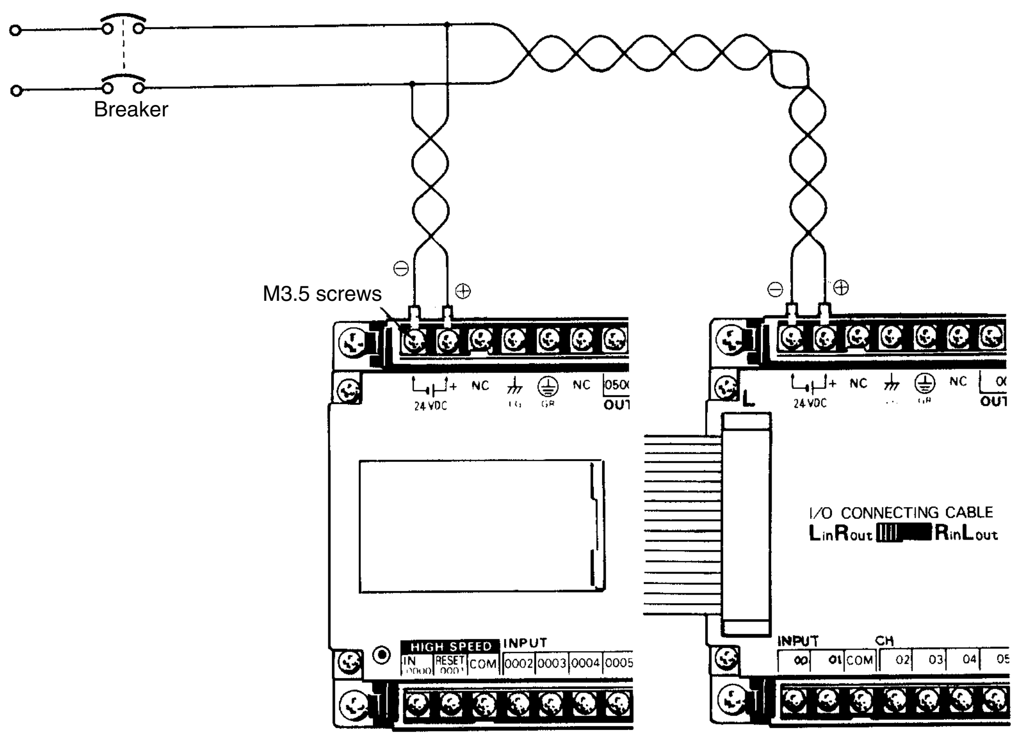
The following diagram illustrates the proper wiring for CPUs and Expansion I/O Units with the suffix "-A." These models use a power supply of 100 to 240 VAC, with an operating voltage range of 85 to 264 VAC. The internal noise-reduction system in these Units is sufficient for general power line noise, but ground noise can be greatly reduced by using a 1:1 insulating transformer. Ground only the primary side of the transformer. To prevent voltage drop, use wires 2 mm^2 or less in cross sectional area, twisting them as shown in the diagram. When power is turned on, the incoming current will be approximately 10 A.



Connect an I/O Link Unit as shown in the following diagram, using M4 terminal screws.



The following diagram illustrates the proper wiring for CPUs and Expansion I/O Units with the suffix "-D." These models use a power supply of 24 VDC with an operating voltage range of 20.6 to 26.4 VDC. Be careful to connect the positive and negative terminals correctly. When power is turned ON, the incoming current will be approximately 30 A.

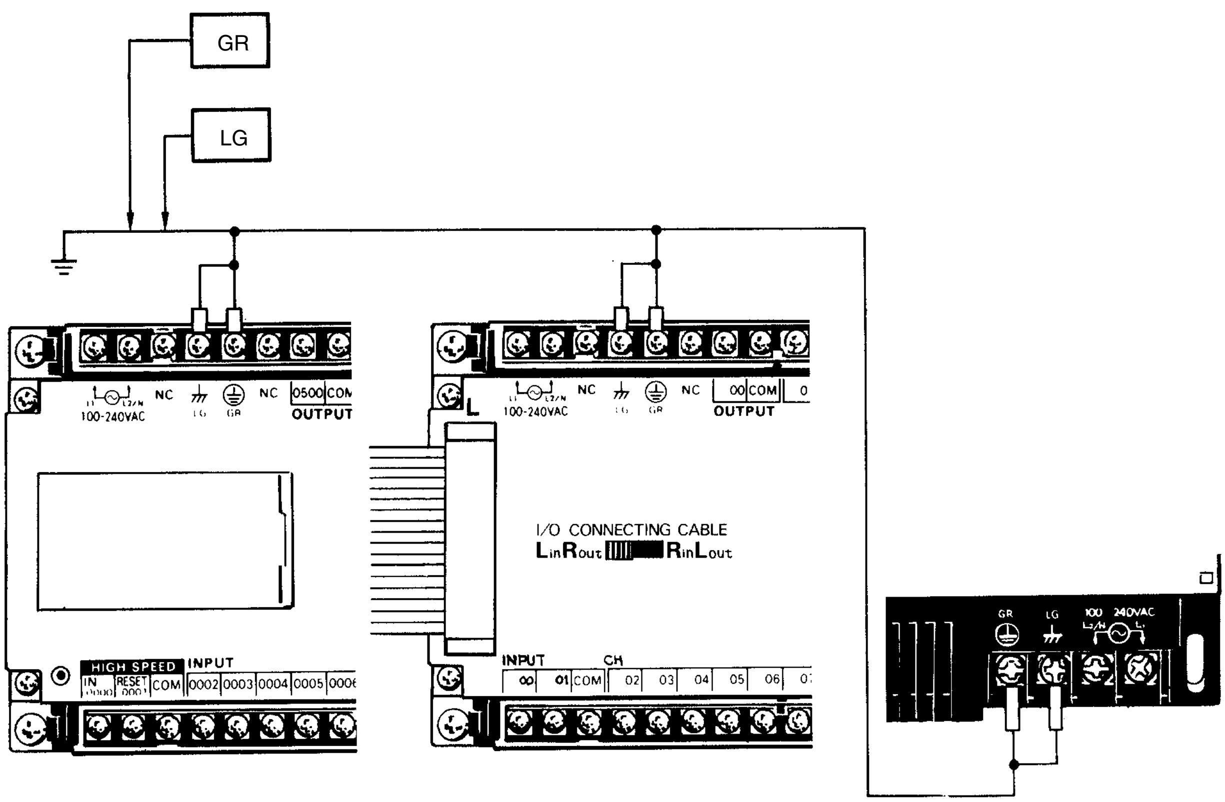


Ground

The Line Ground (LG) terminal is a noise filter neutral terminal which does not normally require grounding. When electrical noise is a problem, however, this terminal should be connected to the GR terminal.

Attach an independent ground-wire with a cross-sectional area of at least 2 mm^2 (AWG 14) to the GR terminal, to avoid electrical shock. Ground resistance must be less than 100 Ω. Do not use a ground-wire longer than 20 m. Care must be taken because ground resistance is affected by the nature of the ground, water content, season, and the amount of time that has elapsed since the wire was laid underground.

CPU operation may be adversely affected if the ground-wire is shared with other equipment, or if grounding is attempted by attaching the ground-wire to the metal superstructure of a building. When either Expansion I/O Units or I/O Link Units are used, they also require grounding at the GR terminal. These may all be included on the same ground.



2-6 I/O Wiring

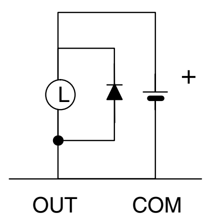
This section shows I/O wiring diagrams for representative models of all the CPUs, Expansion I/O Units, and I/O Link Units covered in this manual. It also gives connection examples for the sensors and switches which can be connected as input devices.

2-6-1 Unit Wiring Diagrams

The following items are all available for use as outputs. Do not mix them within the same common circuit.

Output	Load Power Supply
Relay	Up to 250 VAC/24 VDC
Transistor	5 to 24 VDC
Triac	100 to 120/200 to 240 VAC

When using transistor outputs, connect the common line (COM) to the load power supply negative side. For an induction load, connect the diode to the load in parallel, as shown in the diagram, such that the cathode is on the positive side of the power supply.



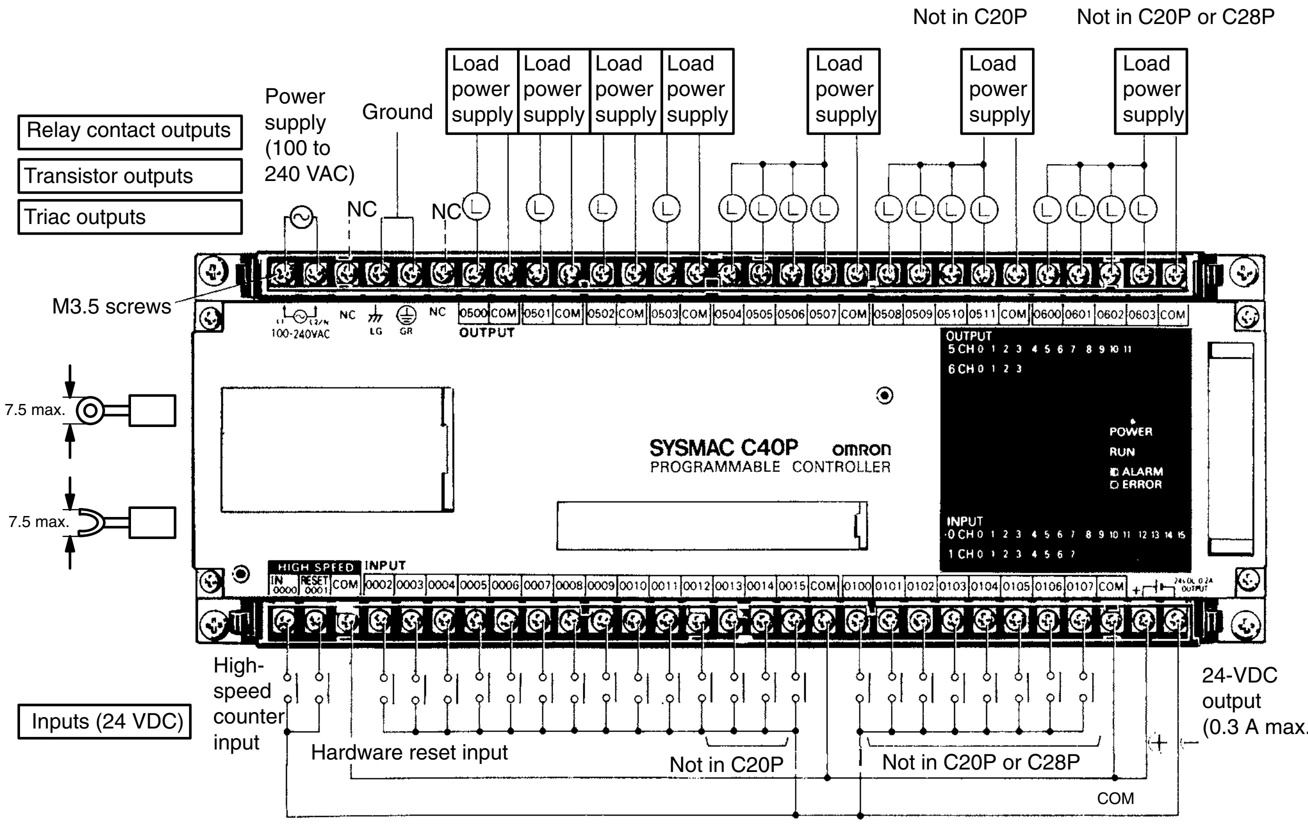
When using the high-speed counter (HDM(98)) instruction, wire input 0000 as the high-speed counter input and input 0001 as the hardware reset input. If the HDM(98) is not used, inputs 0000 and 0001 may be used as general input terminals. Their response time (0.15 ms), however, will be shorter than the other inputs.

Do not connect the NC terminals to anything. The DC inputs in the following I/O wiring diagrams are NPN (positive common). Reverse the polarity if PNP (negative common) is used.

In the diagrams, representative models are sometimes used to cover several models with similar wiring. In such cases, the type of Unit (i.e., CPU C60P) is listed first, followed by the suffix of the applicable model number. A space left blank (□) in the model number indicates that any of several numbers could be inserted there.

CPU C20P, C28P, C40P (CD□-A)

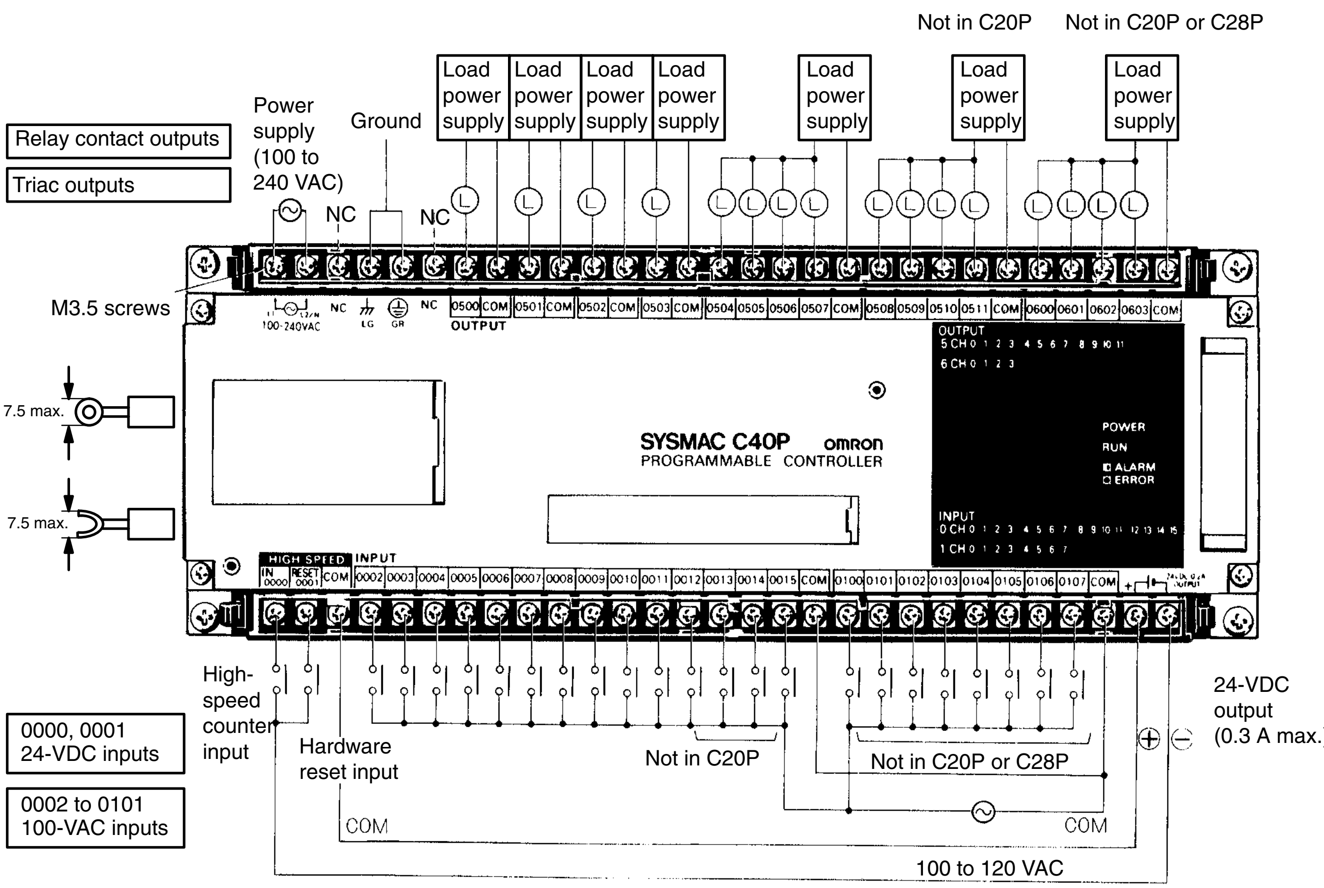
The inputs can use the Unit's 24-VDC power supply output. If the maximum output current of 0.3 A is not sufficient a separate DC power supply must be used.



NC: Do not connect the NC terminals to anything.

CPU C20P, C28P, C40P (CA□-A)

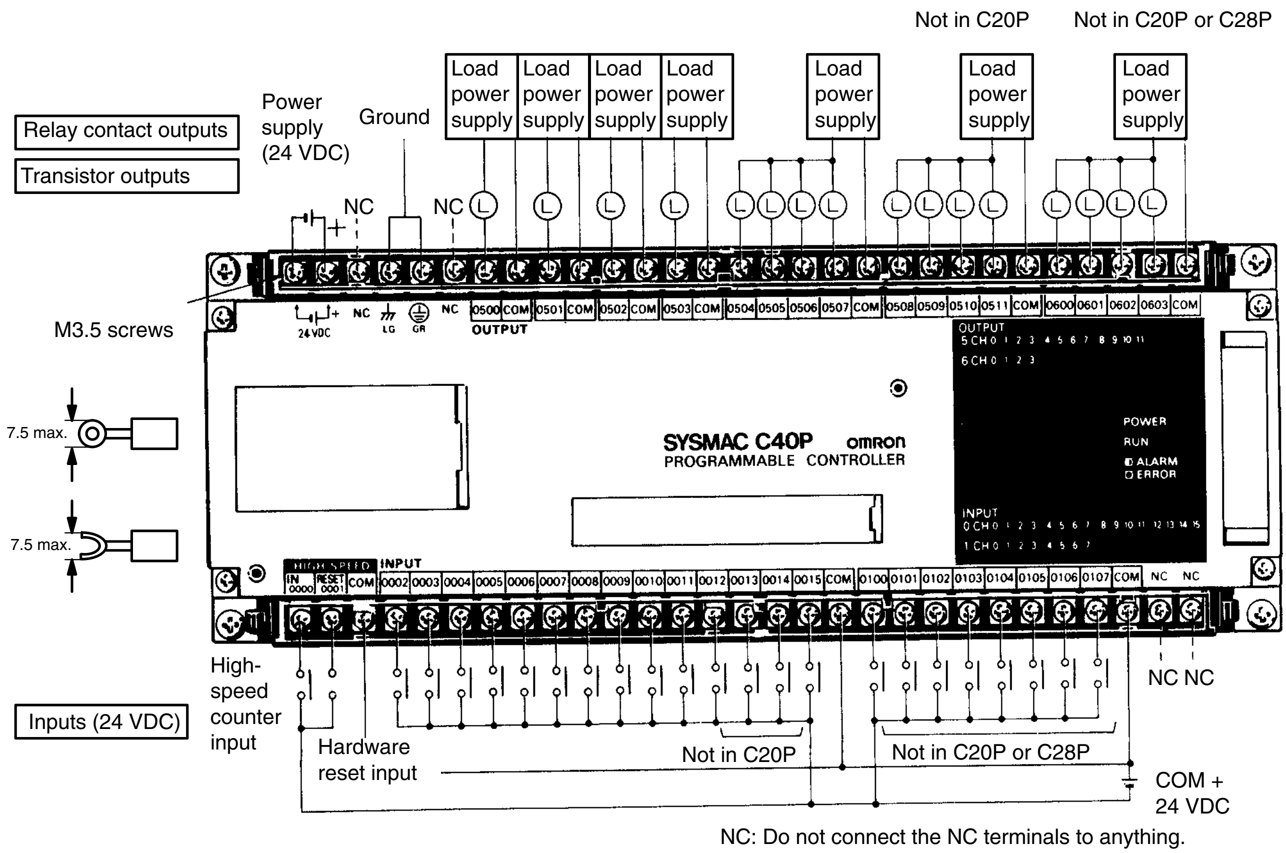
Inputs 0000 and 0001 can use the Unit's 24-VDC power supply output. If the maximum output current of 0.3 A is not sufficient a separate DC power supply must be used. Inputs 0002 to 0107 take a 100-VAC power supply.



NC: Do not connect the NC terminals to anything.

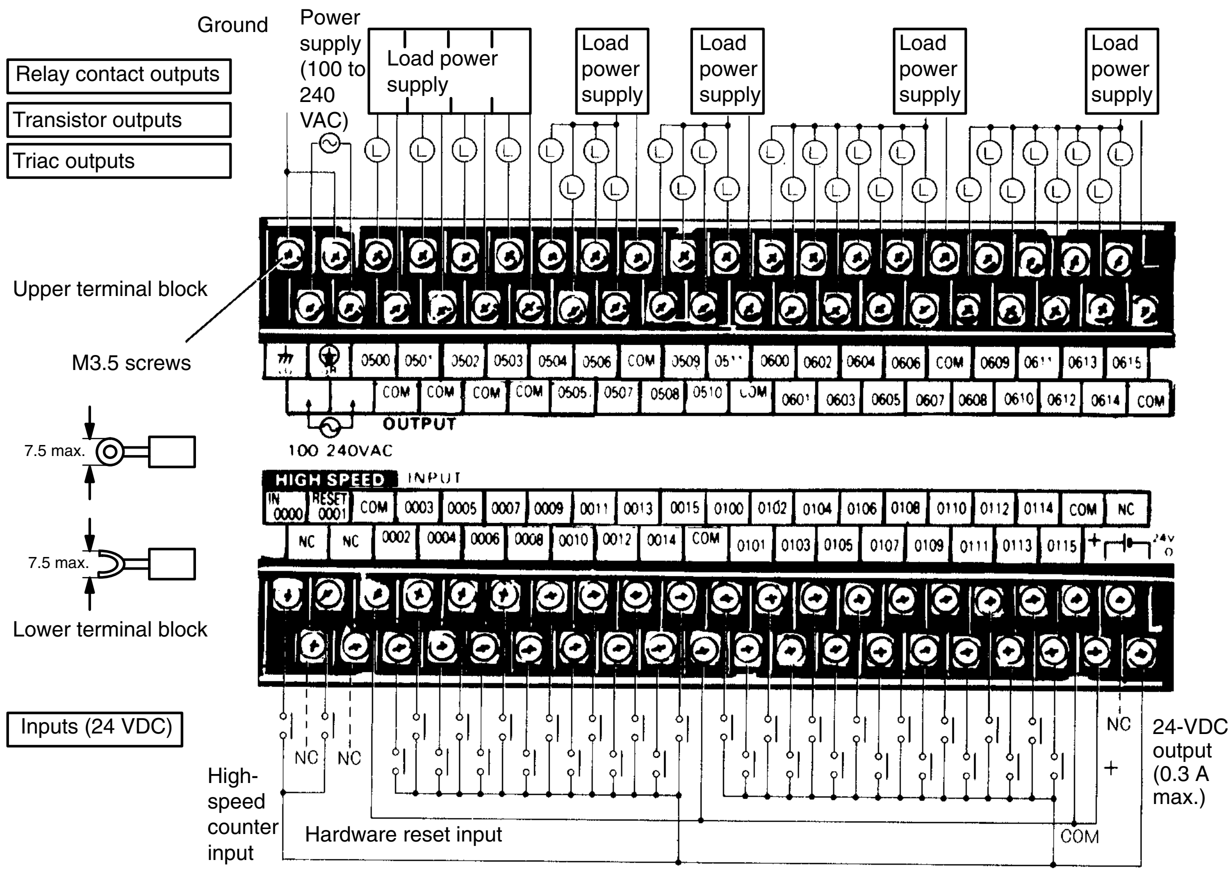
CPU C20P, C28P, C40P (CD□-D)

A separate power supply must be used for the DC inputs.



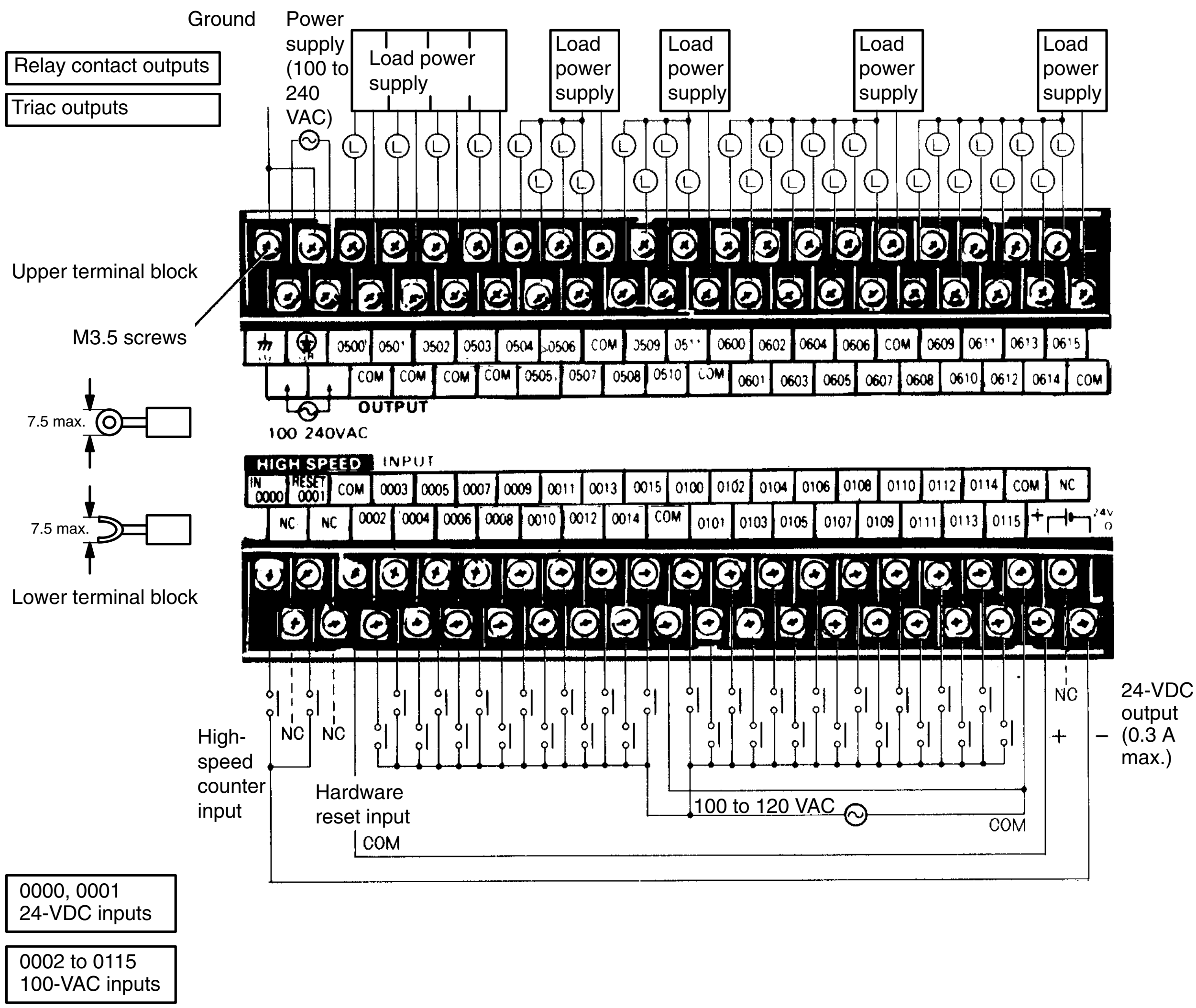
CPU C60P (CD□-A)

The inputs can use the Unit's 24-VDC power supply output. If the maximum output current of 0.3 A is not sufficient, however, a separate DC power supply must be used.



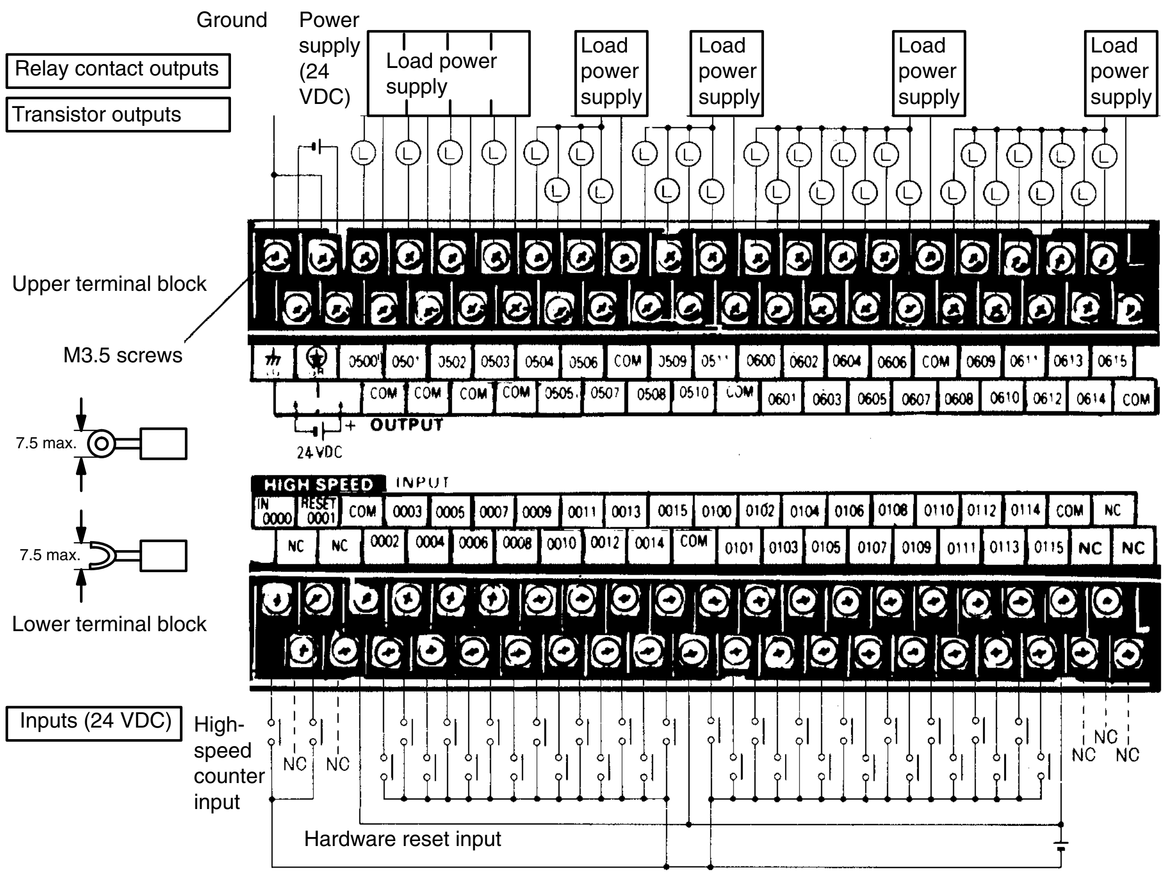
CPU C60P (CA□-A)

Inputs 0000 and 0001 can use the Unit's 24-VDC power supply output. If the maximum output current of 0.3 A is not sufficient, however, a separate DC power supply must be used. Inputs 0002 to 0115 take a 100-VAC power supply.



CPU C60P (CD□-D)

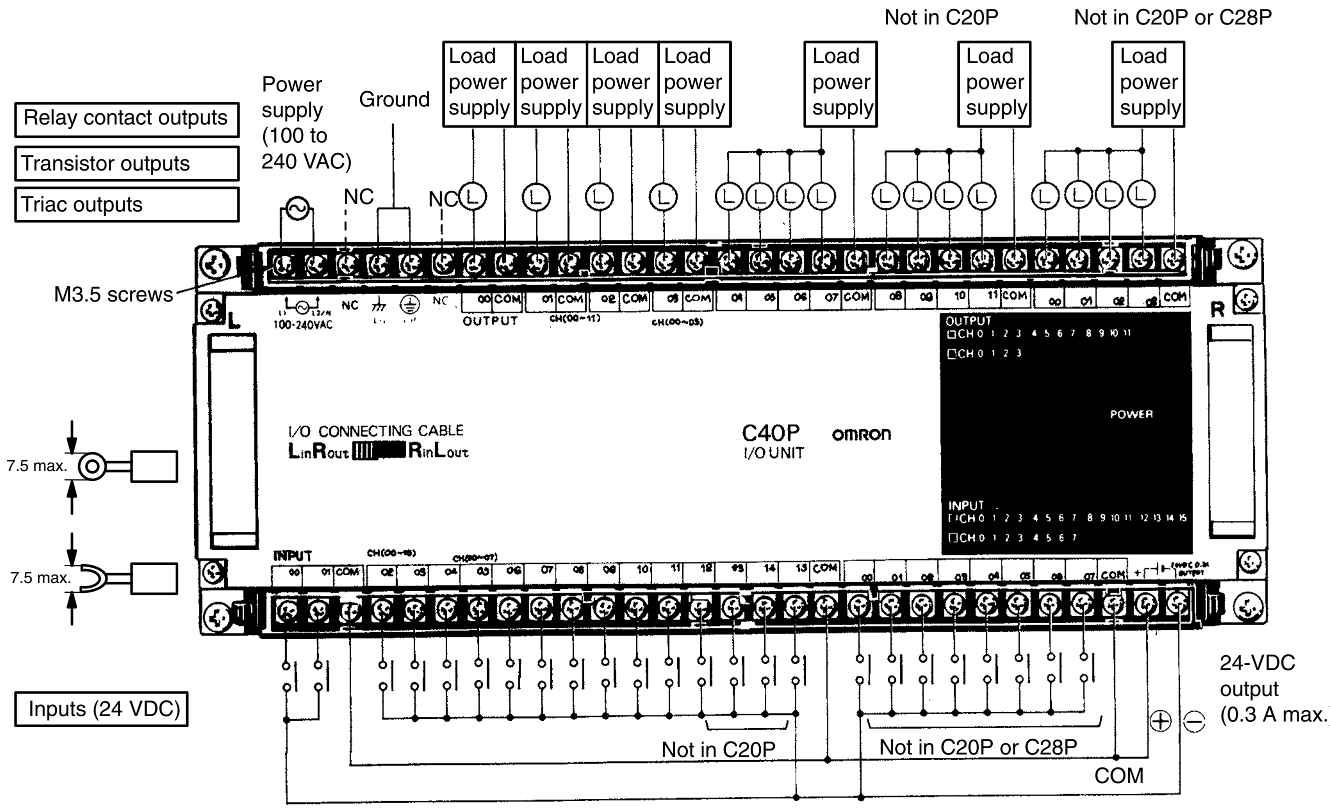
A separate power supply must be used for the DC inputs.



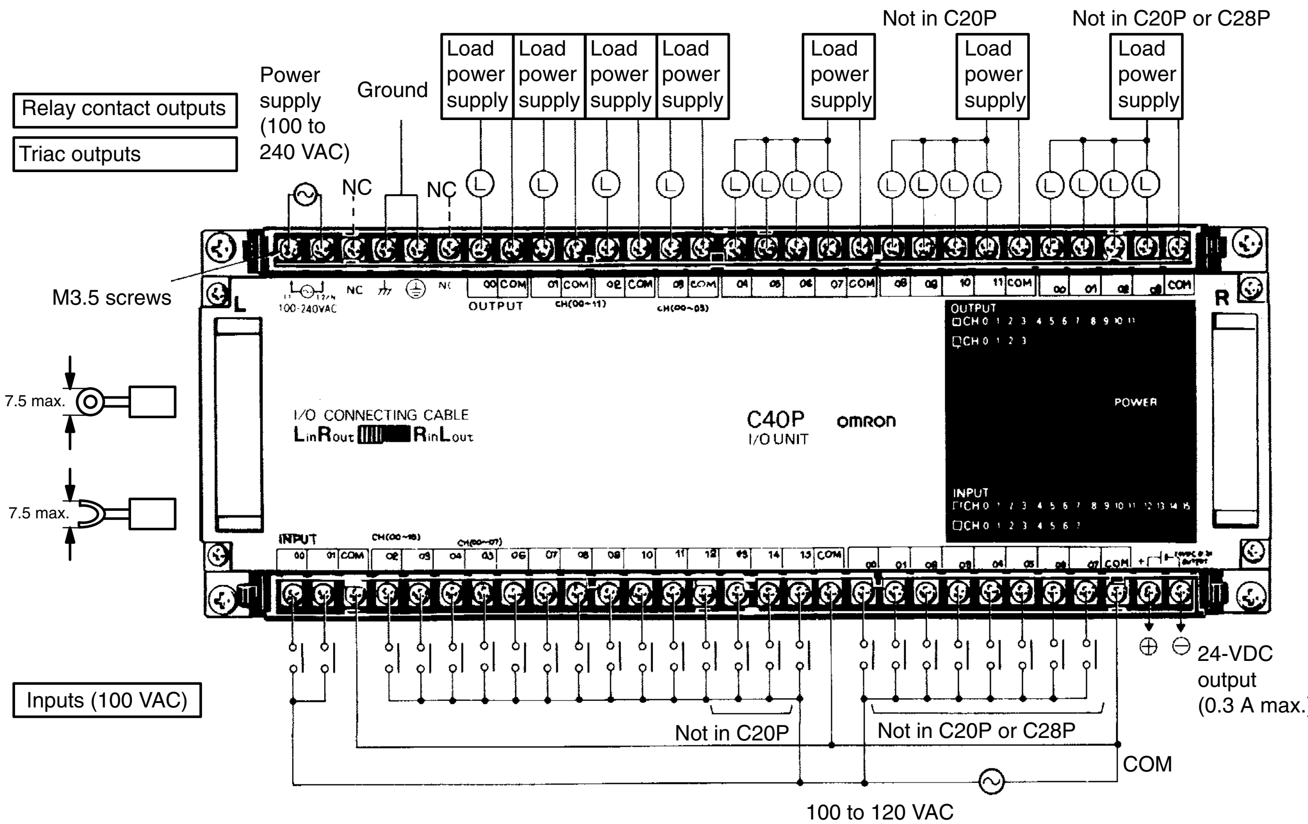
Do not connect the NC terminals to anything.

I/O Unit C20P/C28P/C40P (ED□-A)

The inputs can use the Unit's 24-VDC power supply output. If the maximum output current of 0.3 A is not sufficient, however, a separate DC power supply must be used.

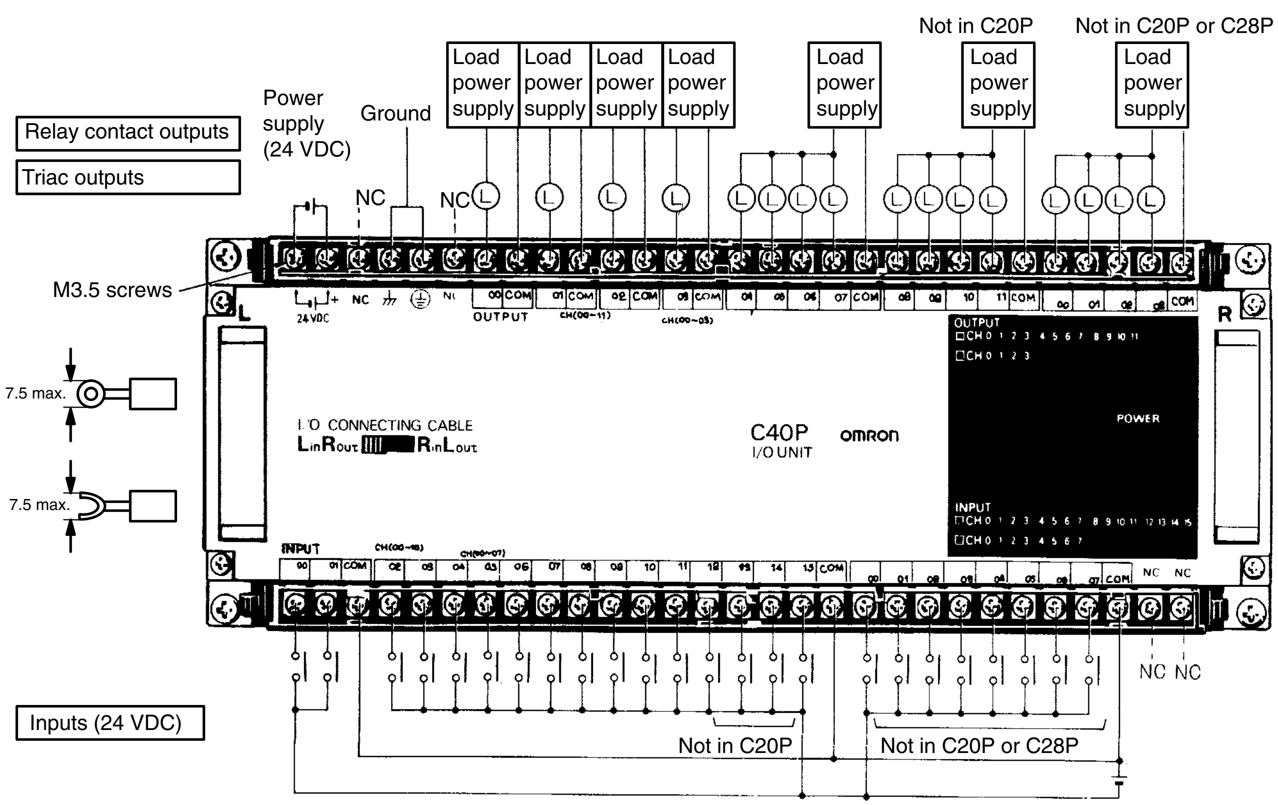


I/O Unit C20P/C28P/C40P (EA□-A)



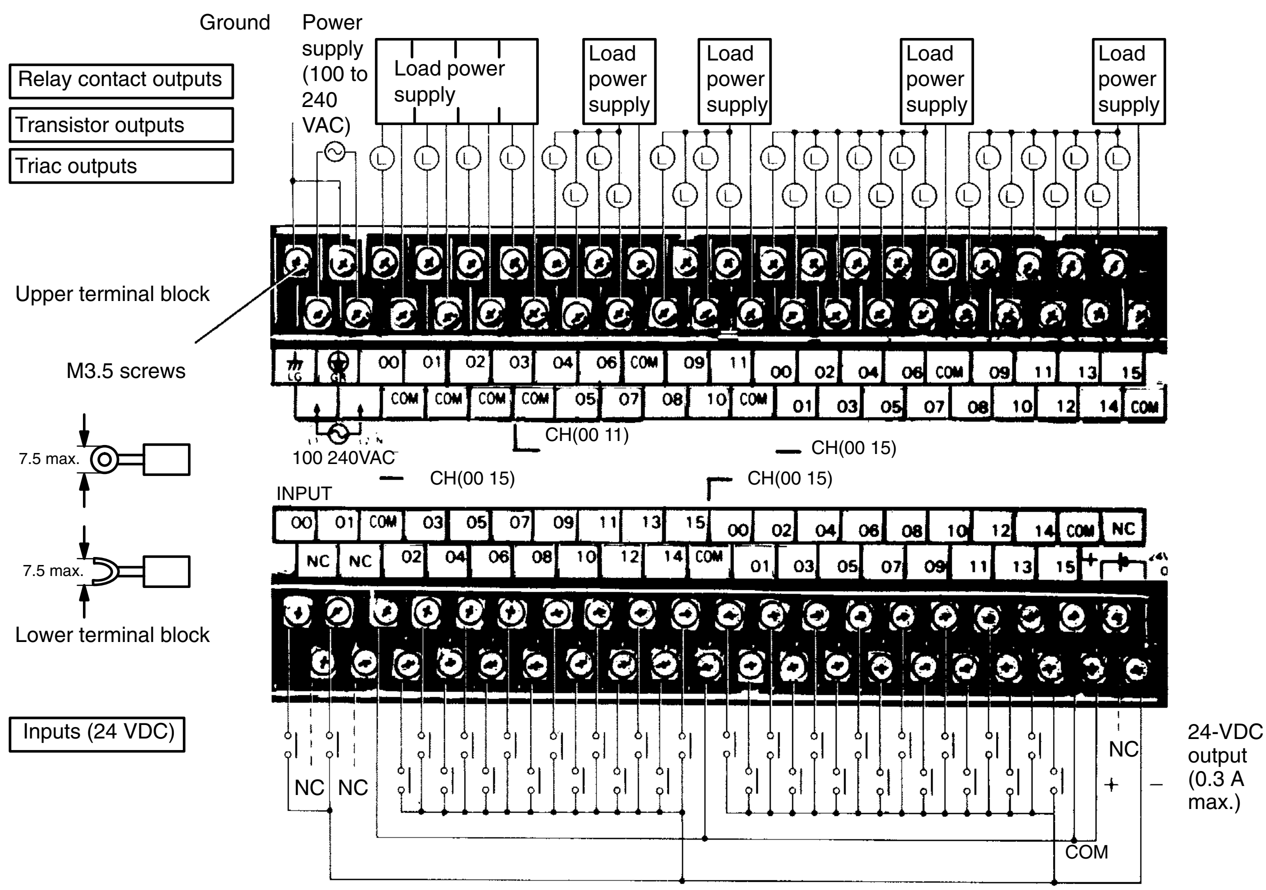
I/O Unit C20P/C28P/C40P (ED□-D)

A separate power supply must be used for the DC inputs.

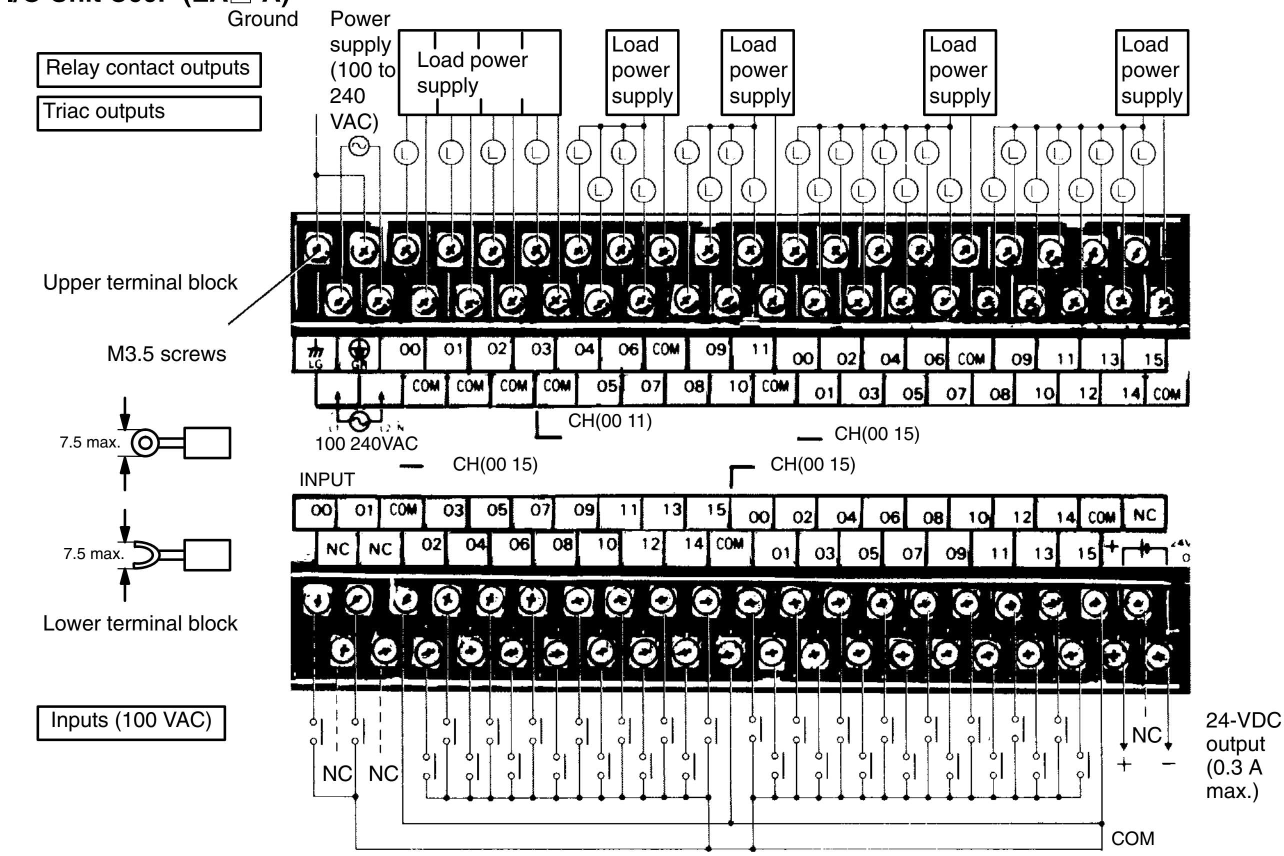


I/O Unit C60P (ED□-A)

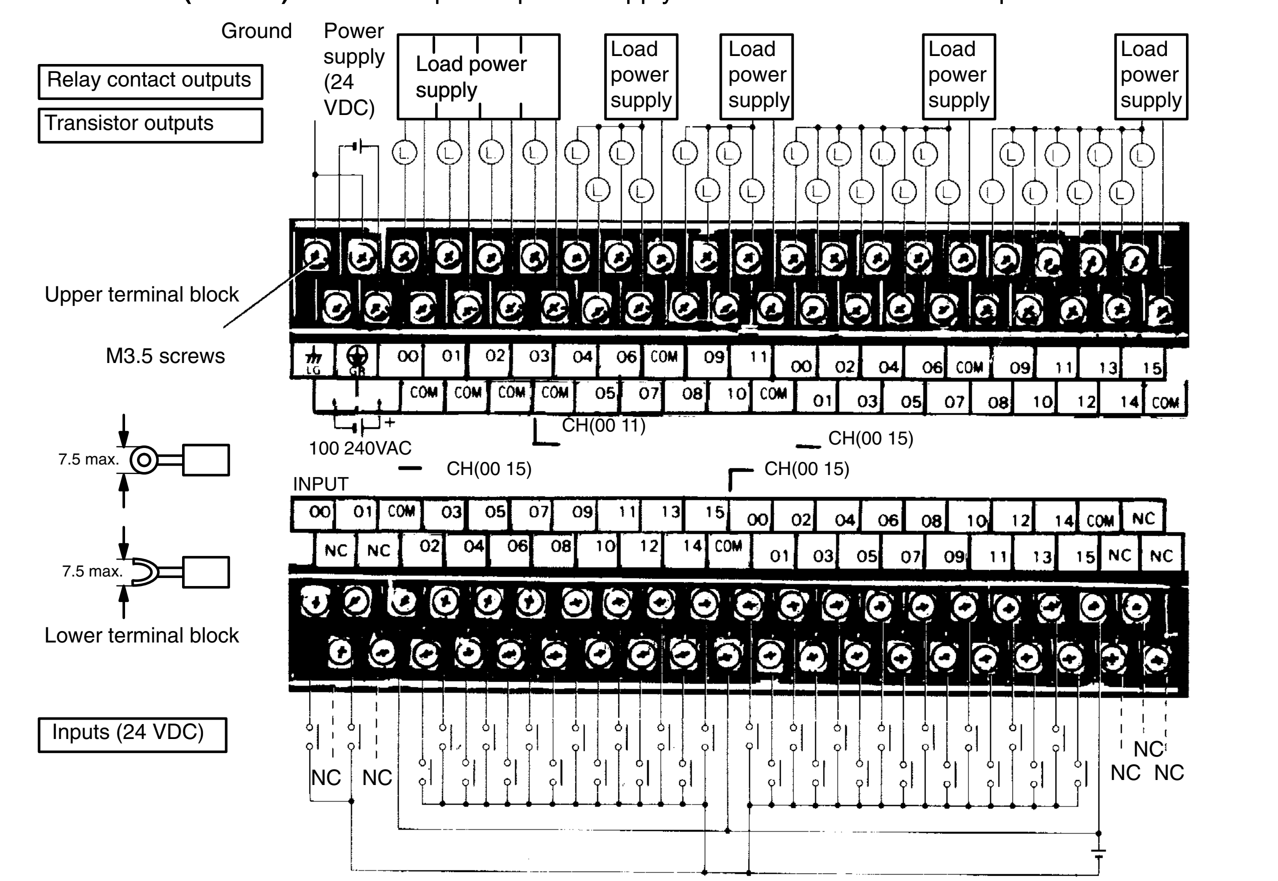
The inputs can use the Unit's 24-VDC power supply output. If the maximum output current of 0.3 A is not sufficient, however, a separate DC power supply must be used.



I/O Unit C60P (EA□-A)



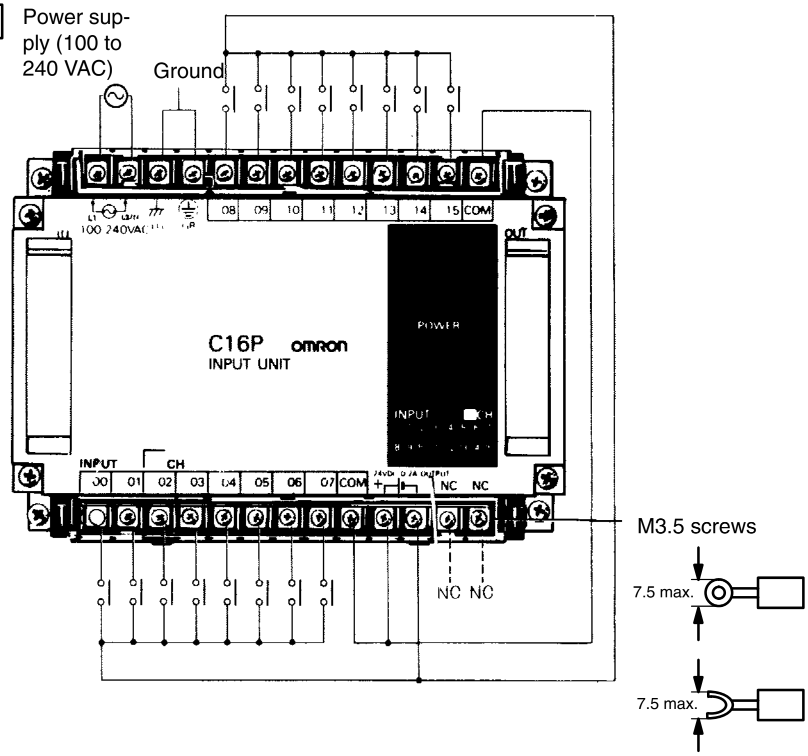
I/O Unit C60P (ED□-D) A separate power supply must be used for the DC inputs.



I/O Unit C16P-ID-A

The inputs can use the Unit's 24-VDC power supply output. If the maximum output current of 0.2 A is not sufficient, however, a separate DC power supply must be used.

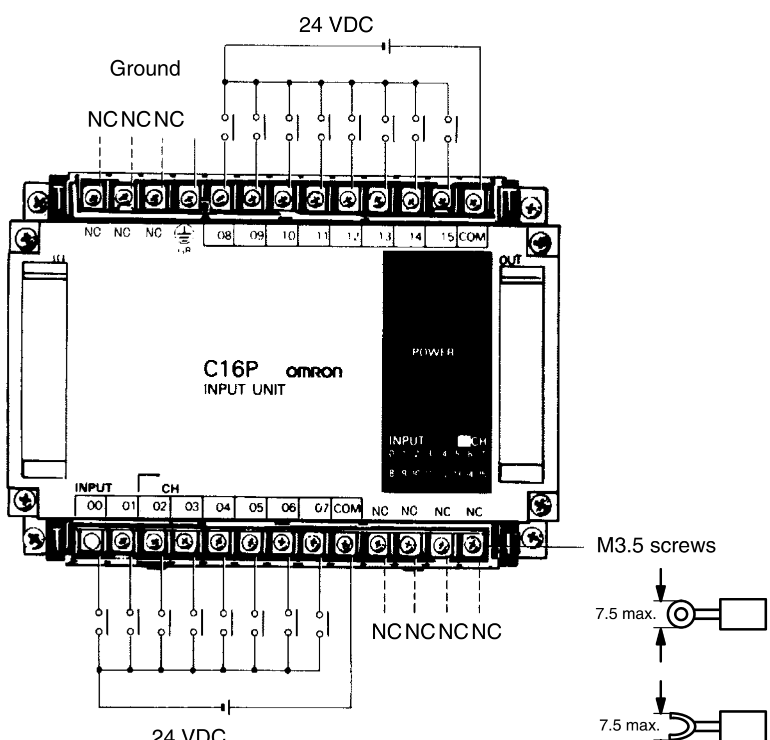
Inputs (24 VDC)



Input Unit C16P-ID

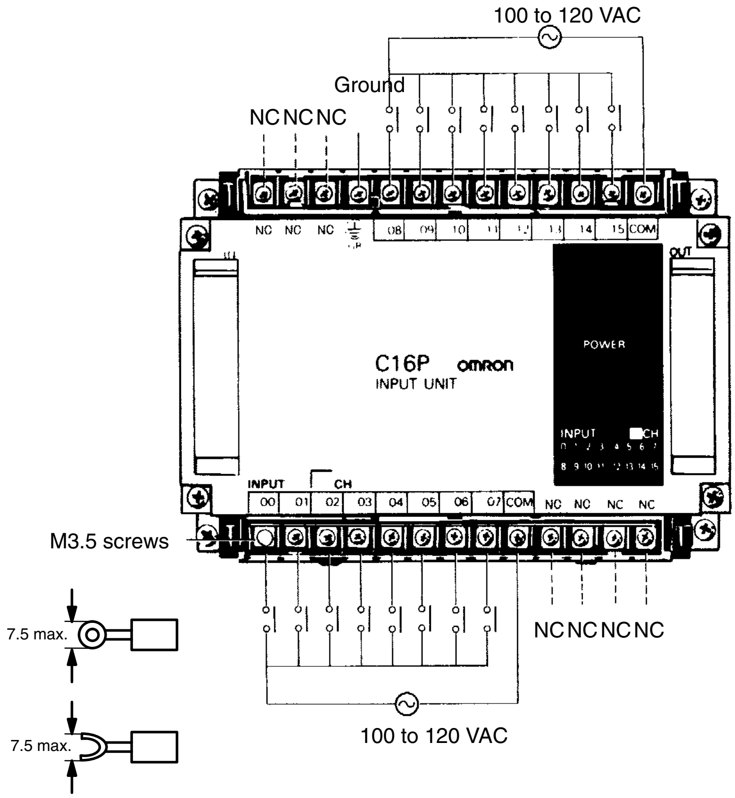
A separate power supply must be used for the DC inputs.

Inputs (24 VDC)

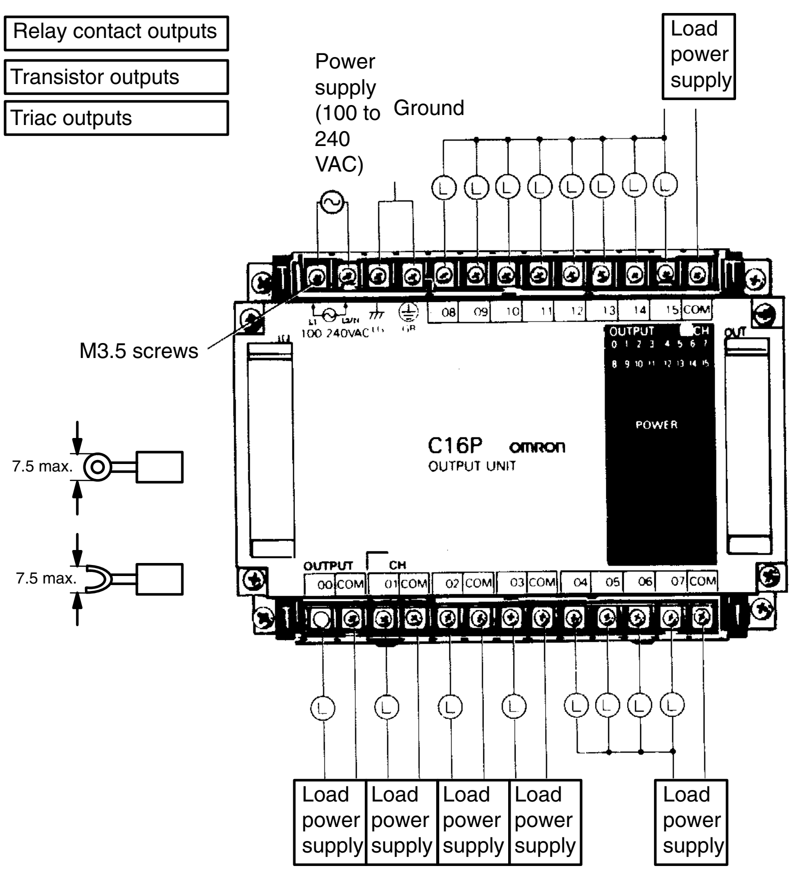


Input Unit C16P-IA

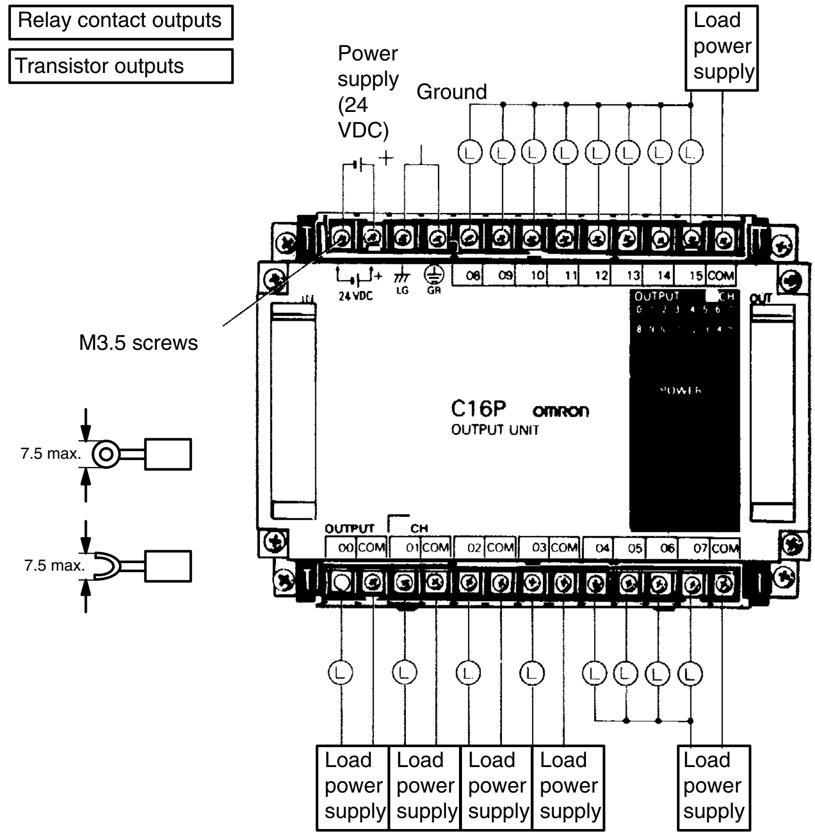
Inputs (100 VAC)



Output Unit C16P-O□-A

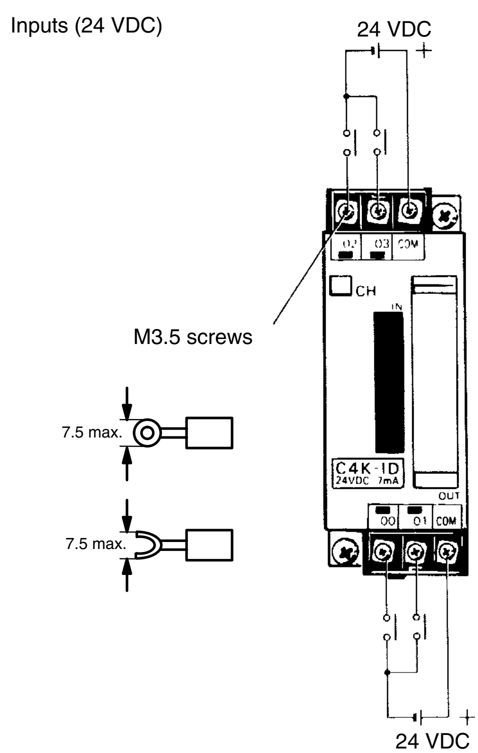


Output Unit C16P-O□-D

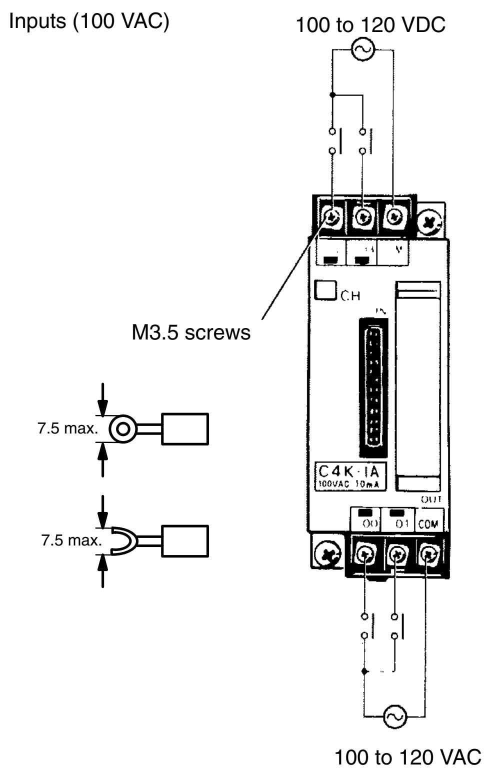


Input Unit C4K-ID

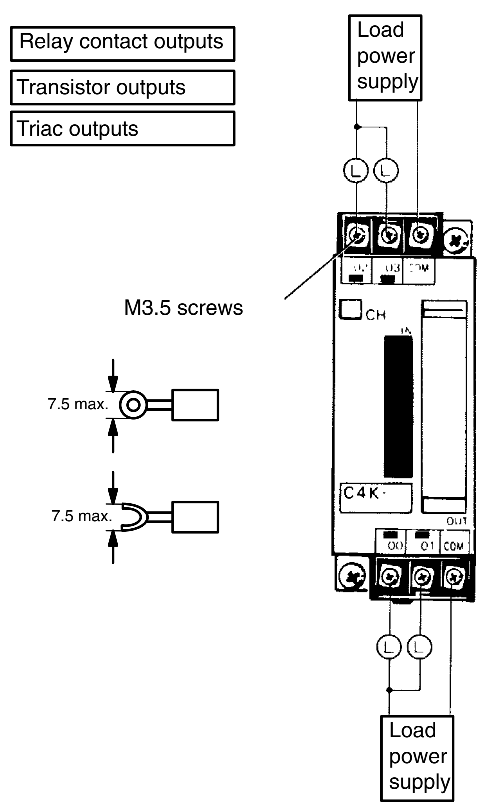
The C4K-ID can use the 24-VDC output from the CPU if the current (0.3 A) is sufficient. If this is not sufficient, a separate DC power source must be used.



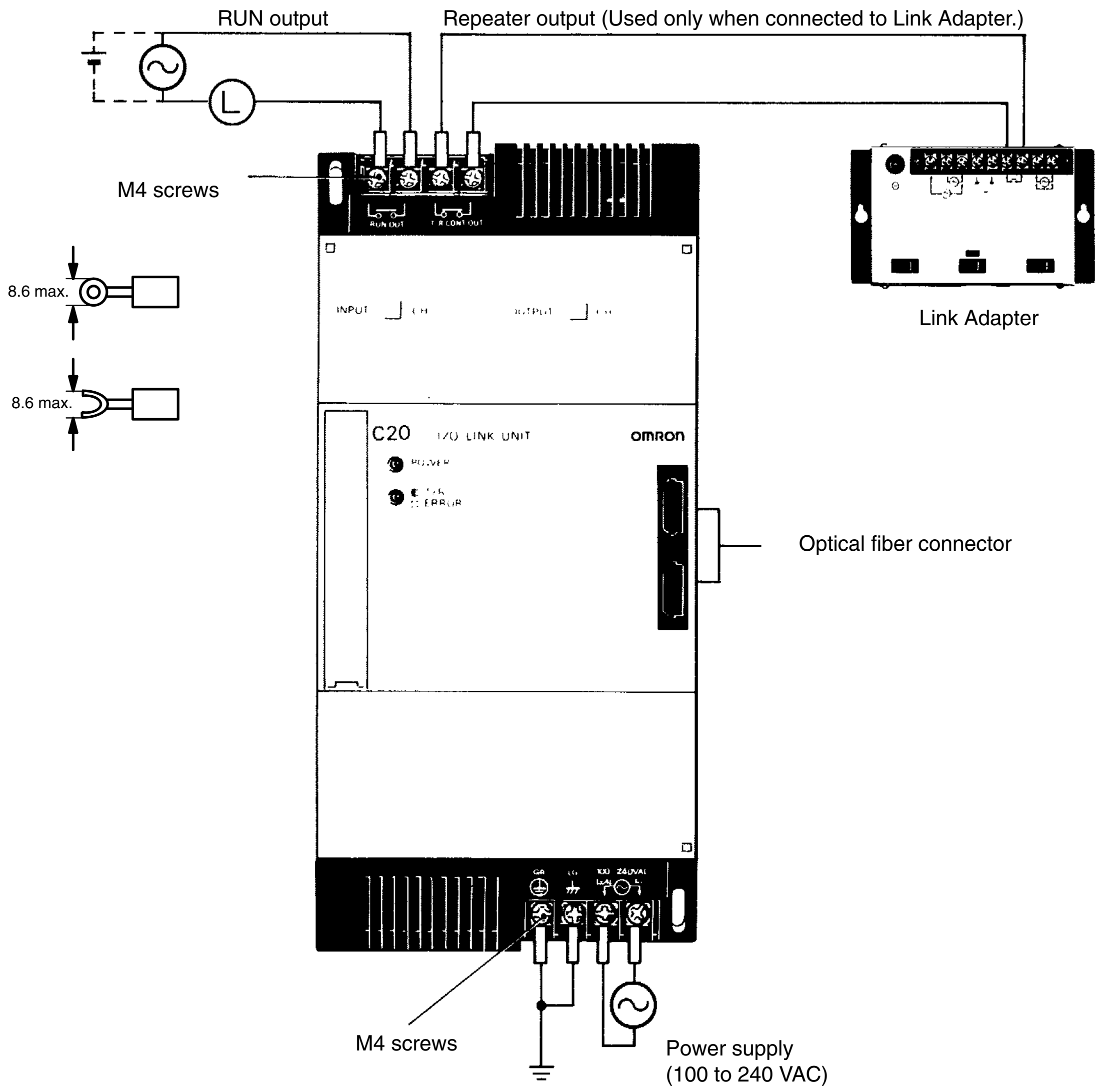
Input Unit C4K-IA



Output Unit C4K-O□□



I/O Link Unit 3G2C7-LK011(-P)E

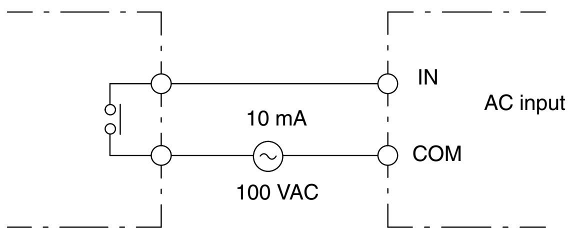


2-6-2 I/O Device Connection Examples

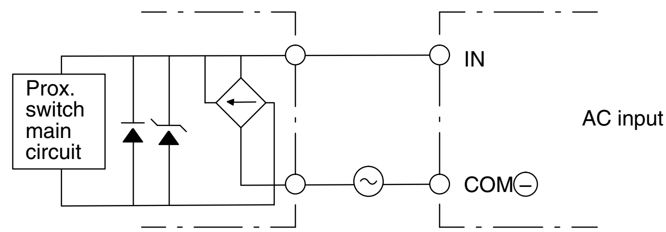
The following diagrams show connection examples for the sensors and switches which can be connected as input devices. Be sure to check all input devices for voltage and amperage compatibility before connecting.

AC Input Devices

Contact output

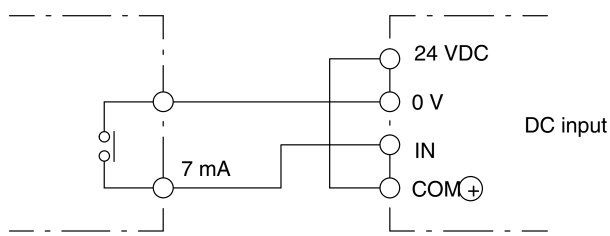


AC-switching

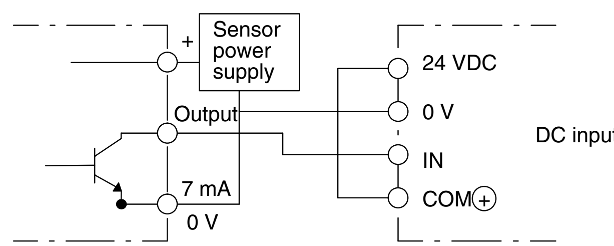


DC Input Devices

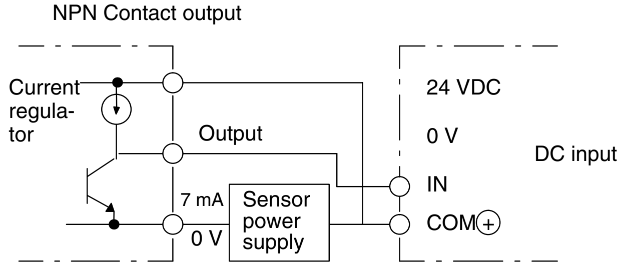
Contact output



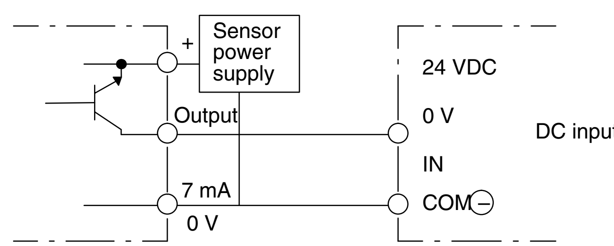
NPN open-collector



NPN Contact output

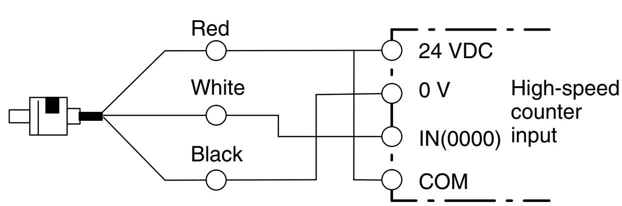


PNP current output

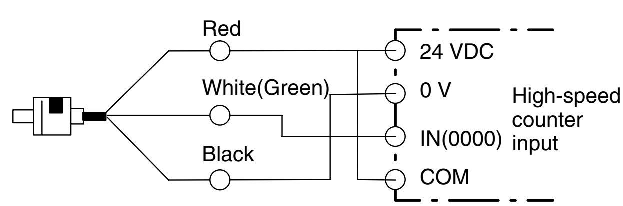


High-speed Counter Input Devices (Rotary Encoder)

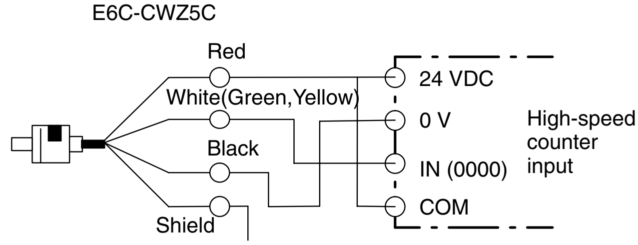
E6A-CS4C



E6A-CW4C



E6C-CWZ5C



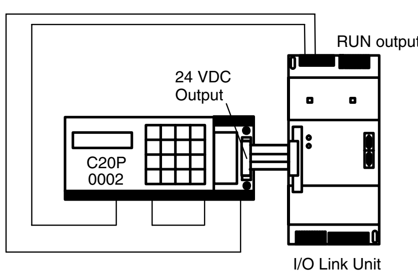
2-7 Special Wiring Precautions

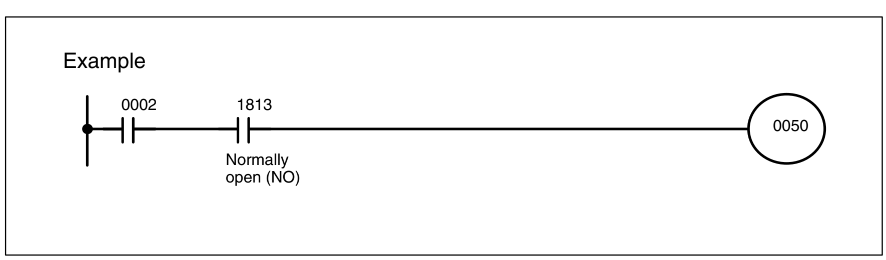
Emergency Stop Circuit

An external relay circuit can be constructed to prevent a CPU breakdown or malfunction from damaging the entire System. In the following diagram, SR bit 1813 is always open when the CPU is operating. If the program is set up as shown in the diagram, then output 0500 will be ON whenever the CPU is in either RUN or MONITOR mode, and it will function as an output to monitor whether the CPU is operating properly or not.

Emergency Stop Circuit When an I/O Link Unit is Used

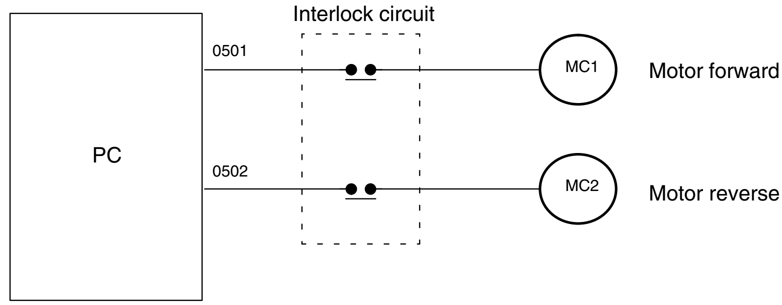
An I/O Link Unit's RUN output terminal is wired to a CPU's input terminal, and can function as an output to monitor whether the entire PC System, including the I/O Link Unit, is operating properly or not. In the diagram below, the I/O Link Unit is connected to input terminal 0002. If the program is set up as shown in the diagram, then output 0500 will be ON whenever the CPU is in either RUN or MONITOR mode. The I/O Link Unit's RUN output and the CPU's RUN or MONITOR output together comprise an AND in the external relay circuit, and this can be used to construct an emergency stop circuit.





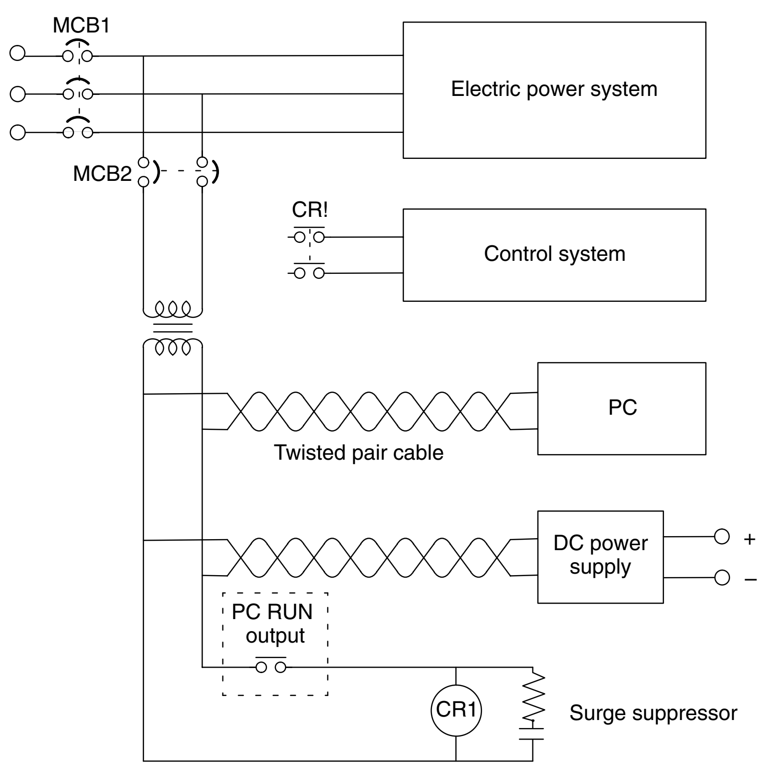
Interlock Circuit

There are sometimes cases in which a PC can direct a machine to do either of two contrasting actions, and in which damage could result from a malfunction in the PC. For example, the PC could be set up to output commands to a motor to operate alternately in forward and reverse. In such cases an interlock circuit can be set up to prevent damage in case of a malfunction. In the example diagram below, the interlock circuit will prevent MC1 and MC2 from turning ON at the same time even if the PC malfunctions and turns outputs 0501 and 0502 ON simultaneously.



Wiring of Power Supply Systems

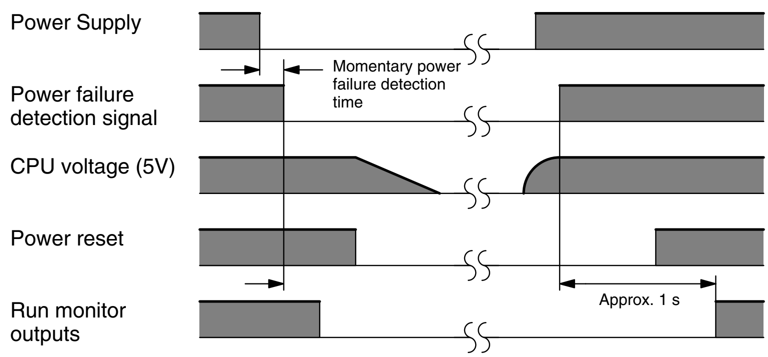
Electric power systems, control systems, PC power supply systems, and I/O power supply systems should all be wired separately, as shown in the following diagram.



Power Failure Protection

A power sequence circuit is incorporated in the PC to prevent malfunctioning due to momentary power failures or voltage drops.

The PC ignores all momentary power failures if the interruption lasts no longer than 10 ms. If the interruption is between 10 ms and 25 ms, it may or may not be detected. If the supply voltage drops below 85 for longer than 25 ms, the PC will stop operating and the external outputs will be automatically turned off. Operation automatically resumes when the supply voltage is restored to more than 85 of the rated voltage. Detection time will be slightly shorter when a DC power supply is used.



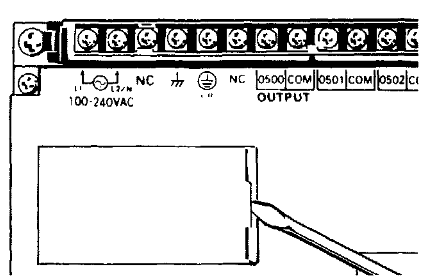
2-8 Switch Settings

After writing the program and preparing the EPROM chip (see the *Operation Manual*), the CPU DIP switch must be set and the EPROM installed.

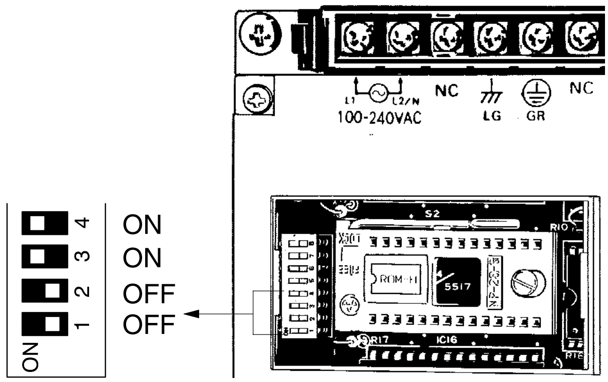
2-8-1 Setting the CPU DIP Switch

1, 2, 3...

1. Turn OFF the power to the CPU.
2. Remove the cover from the CPU, using a screwdriver if necessary.

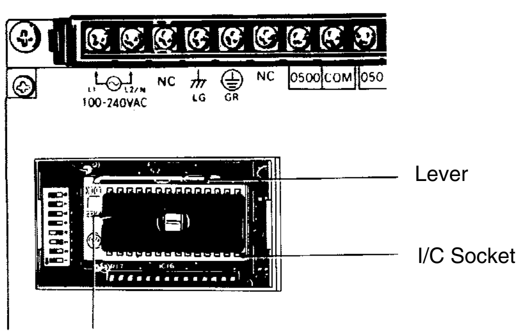


3. Set DIP switch pins 1 and 2 to OFF, and pins 3 and 4 to ON.



2-8-2 EPROM Installation

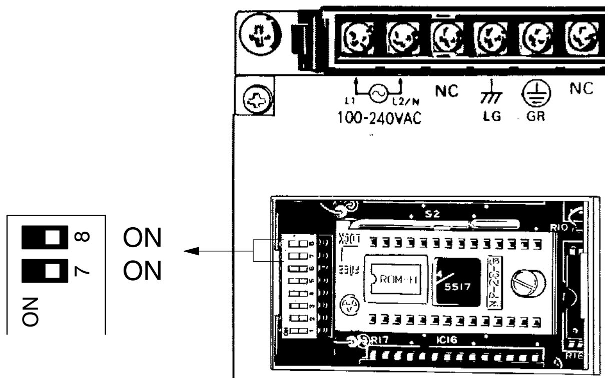
1, 2, 3... 1. Remove the cover as shown above.
2. Raise the lever to unlock the socket.
3. Holding the chip so as not to touch the pins, insert it into the socket with the notch to the left.
4. Check to be sure the chip has been properly installed.
5. Return the lever to its original position, locking the chip in.
6. Replace the cover.
7. Turn the power ON and verify that the CPU is operating in MONITOR mode.



Insert with the notch to the left.

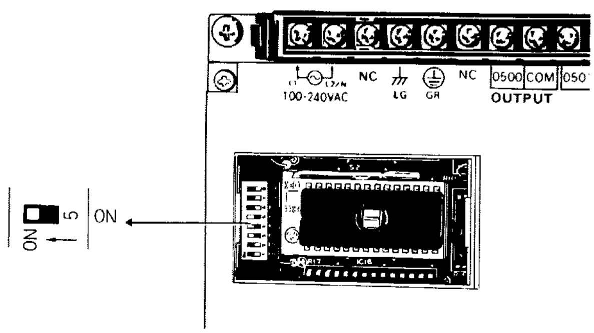
2-8-3 High-speed Counter

When the high-speed counter (HDM(98)) is used, input (0000) is used exclusively for this purpose and responds up to 2 kHz. Either the hardware reset or software reset may be used. The software reset may be delayed, depending on the scan time, since it is based on the program. The hardware reset is unrelated to the scan time and can operate at high speed. To use the hardware reset (input 0001), set DIP switch pins 7 and 8 to ON as shown below. Be sure to set them to OFF whenever the hardware reset is not being used, regardless of whether the high-speed counter is being used or not.



2-8-4 Inhibiting the ALARM Indicator

To inhibit the ALARM indicator when using EPROM, set DIP switch pin 5 to ON as shown below.



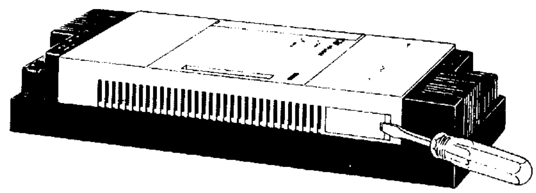
Connect a backup battery to preserve data memory, current counter value, and HR area bits, in case of a power failure. In order to maintain the battery, DIP switch pin 5 should normally be set to OFF. In any case, it must always be OFF when using RAM.

2-8-5 Setting the I/O Link Unit

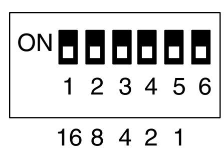
In order for the I/O Link Unit to operate, it is necessary to determine the assignment of I/O words between the I/O Link Unit and the Remote I/O Master Unit controlled by the CPU. This is done with the DIP switch on the I/O Link Unit. The following explanation is intended only to give a general outline of the proper procedure. For details, refer to the *Optical Remote I/O Systems Manual*.

1, 2, 3...
1. Check the last assigned I/O word on the CPU. When setting the I/O Link Unit, be sure not to assign the same word twice or to exceed the number of I/O points in the CPU.

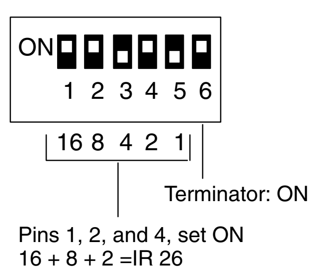
2. Turn OFF the power to the I/O Link Unit.
3. Check to be sure that the power supply LED light is off. Remove the cover on the side panel of the Unit, using a screwdriver if necessary.



4. Use the 6 DIP switch pins to set the word address from 0 to 30. As shown in the diagram below, the word addresses are set in binary, with pin 5 being “1” and pin 1 being “16.” Beginning with pin 1, turn ON the pins required to arrive at the desired words. Turn ON pin 6 to set the termination resistance if the I/O Link Unit is a terminator (the final Unit in the System). If the Unit is not a terminator, leave pin 6 OFF.



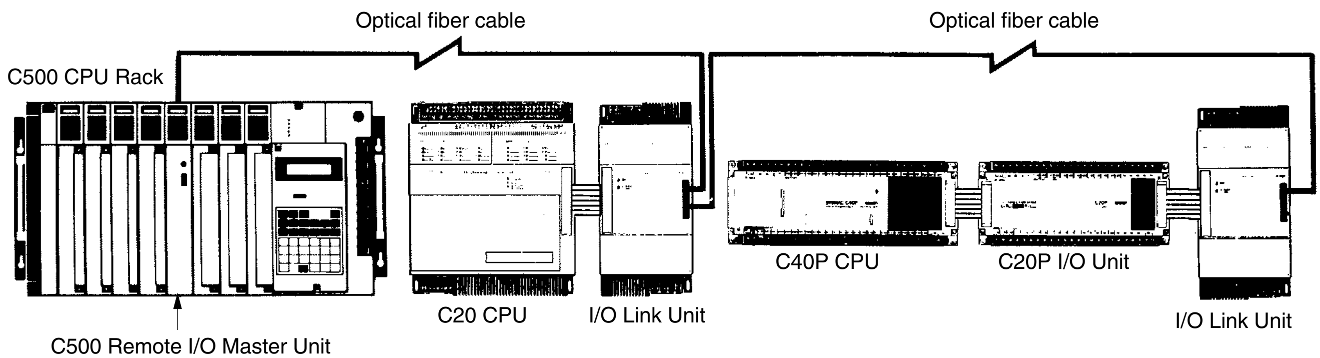
The following example diagram illustrates the proper DIP switch setting for IR 26. In C200H/C1000H/C2000H Remote I/O Systems, the word actually assigned to the I/O Link Unit may vary from the switch setting. Refer to the *Remote I/O System Manual* for details.



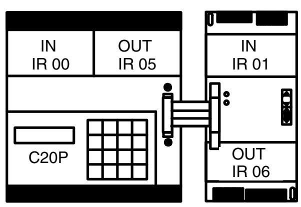
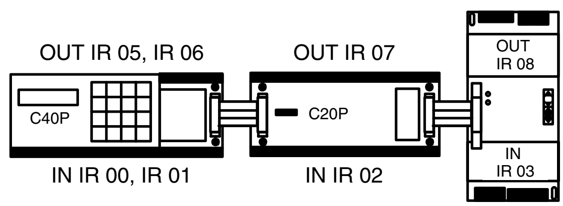
5. After initially setting the DIP switches, an I/O table check should be performed on the CPU to ensure that there are no errors in the settings.
6. Replace the cover. In addition, to prevent dirt or outside light from causing a malfunction, be sure that any unused optical fiber connectors are covered with the protective caps. The Unit should be ready to operate as soon as power is turned on. If it does not operate normally, refer to *3-2 Self-diagnostic Function*.

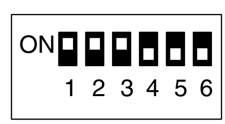
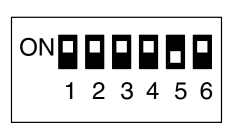
System Configuration Example

In the diagram below, a C20 CPU, a C40P CPU, a C20 I/O Unit and two I/O Link Units can exchange data over a distance with a C500 Remote I/O Master Unit. The C20 I/O Link Unit is set for IR 28 (which accesses IR 29 as well), and the C40P I/O Link Unit is set for IR 30 (which accesses IR 31 as well). The C40P I/O Link Unit is also set as the terminator.



When setting the I/O Link Unit, in this example, it is necessary to take into account not only the I/O words of the C500 Remote I/O Master Unit, but also those of the C20 CPU and the C40P CPU.

C500 Word Assignment			C20 Word Assignment	C40P Word Assignment
Auto-matic	0			
	1			
	2			
	⋮			
	27			
Man-ual	28	I/O Link (C20)		
	29			
	30	I/O Link (C40K)		
	31			

Model	As seen from C20		As seen from C20, C40P	I/O Link Unit DIP Switch Setting
I/O Link (20)	IR 28: 16 output points IR 29: 16 input points Data output to C20 Data input from C20	→ ←	IR 01: 16 input points IR 06: 16 output points Data input from C500 Data output to C500	 Set for IR 28 Not terminator
I/O Link (40P)	IR 30: 16 output points IR 31: input points Data output to C40P Data input from C40P	→ ←	IR 03: 16 input points IR 08: 16 output points Data input from C500 Data output to C500	 Set for IR 30 Set as terminator

SECTION 3
Maintenance and Inspection

3-1 General

This section explains the proper maintenance and inspection procedures for the P-type PCs, including specifics on replacing parts and taking precautionary measures to ensure reliable, trouble-free operation.

3-2 Self-diagnostic Functions

The P-type PC has self-diagnostic functions to identify many types of abnormal system conditions. These functions minimize downtime and enable quick, smooth error correction.

The ERROR light on the front panel of the Programming Console indicates hardware errors such as CPU, Expansion I/O Unit, and Remote I/O Unit malfunctions. The ALARM light indicates such things as scan time overrun, battery error, or user-defined errors. The following chart lists possible malfunctions, error messages, and correction procedures.

☼ Stays lit. ◑ Blinks. ● Not lit.

		PC LED States				
Situation	**Item**	**POWER**	**RUN**	**ALARM ERROR**	**Error Display**	**Correction**
Fatal error	Power failure					Check the power supply voltage and power lines.
	CPU error (watchdog timer over 130 ms)					In PROGRAM mode, turn on power again. Check the user program again.
	Memory error	☼	●	☼	MEMORY ERR	Check the program and fix the error. Rerun the program. Check that the DIP switch settings are correct. Check that the EPROM chip is properly mounted. Check that the battery is properly inserted. Clear the error after fixing it.
	Missing END instruction				NO END INST	Write END in the final address of the program.
	I/O bus error		◑		I/O BUS ERR	Check that all the lines are properly connected between the Units. Check that the CPU Left/Right Selector on the Expansion I/O Unit is properly set. Clear the error after fixing it.
	JMP over				JMP OVER	Make sure that there are no more than 8 JMP(04)–JME(05) pairs in the program.
Non-fatal error	Battery error	☼	☼	◑	BATT LOW	Check battery connections. Replace battery.
	Scan time overrun (watchdog timer 100 to 130 ms)				SCAN TIME OVER	Check the program again.

I/O Link Unit Error

	I/O Link Unit LED States		
Item	**POWER**	**ERROR**	**Correction**
Power failure	●	●	Check the power supply voltage and power lines.
Transmission error	☼	☼ *	Check connections of the optical fiber cable and connectors. Check the channel and terminator settings.

*Note: Blinking ERROR LED indicates normal transmission.

3-3 Replacing Parts

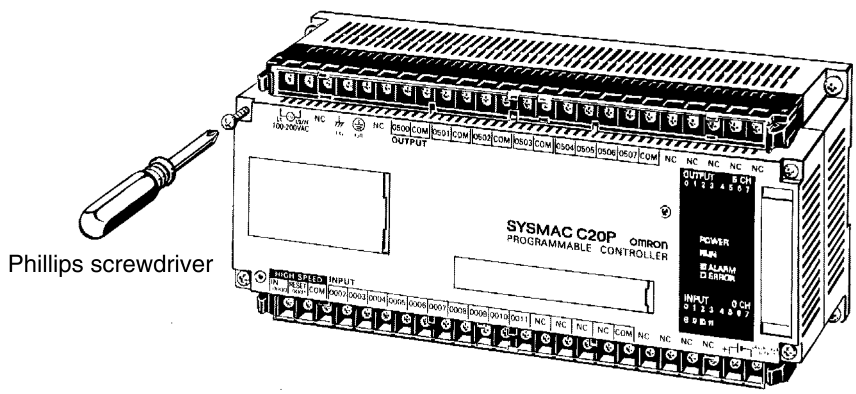
In order that your System be restored to operation as quickly as possible, it is advisable to maintain an adequate stock of replaceable parts on hand.

CAUTION:
Replace all fuses, relays, and other parts as quickly as possible. If the cover is left off for a long period the RAM's contents may be erased.

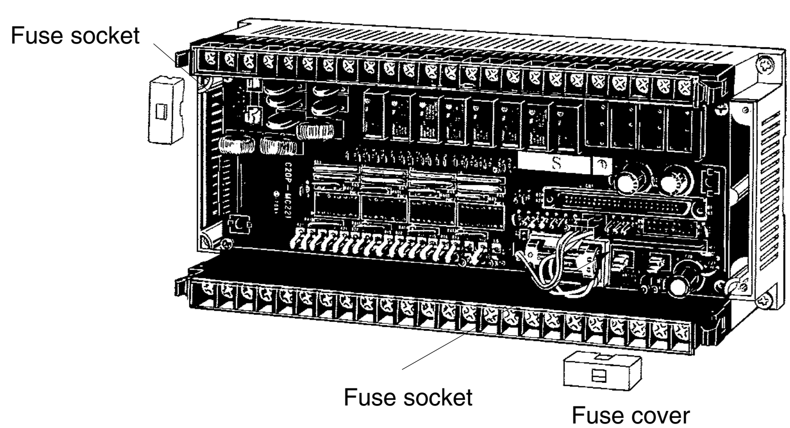
3-3-1 Fuses

Replace fuses as follows:

1, 2, 3...
1. Turn off power to the Unit.
2. Using a Phillips screwdriver to loosen the 4 screws, remove the cover from the Unit, lifting it from the left.

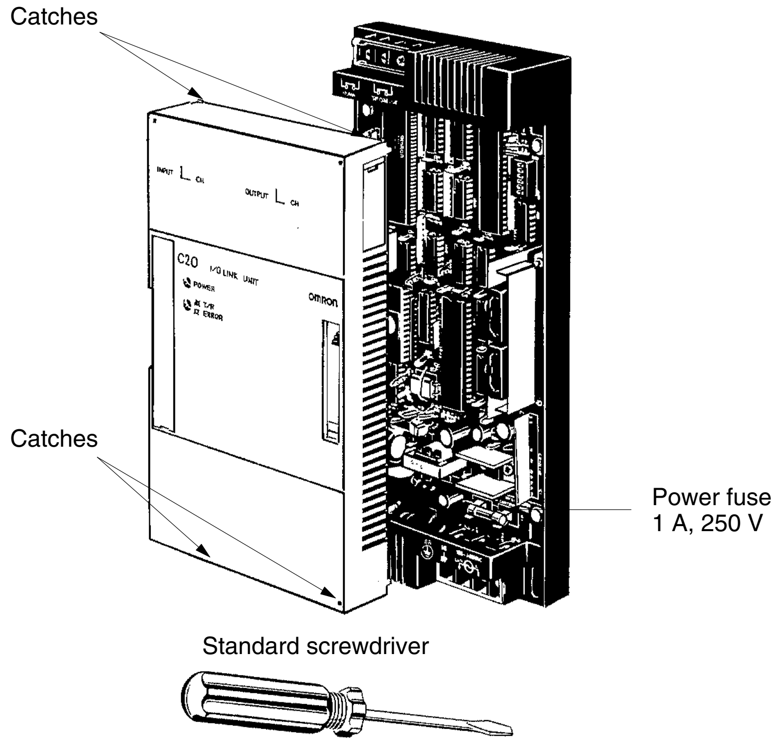


3. Remove the cover from the fuse socket as shown below.



4. Using a standard screwdriver, remove the defective fuses and insert the new ones.
5. Replace the cover, positioning it over the Unit and snapping it into place by applying pressure to the area marked "OMRON."

The above procedure applies to CPUs and Expansion I/O Units. The procedure is similar for I/O Link Units except that the cover is secured by 4 catches instead of 4 screws. Use a standard screwdriver to pop the cover off and insert the fuses as shown below.



Refer to the chart below in selecting the proper fuses.

Power Supply Fuses Dia. 5.2 x 20 (MF1NR)			
CPU's, Expansion I/O Units	A-suffix	C16P	250 V, 1 A
		C20P, C28P, C40P	250 V, 3 A
		C60P	250 V, 3 A
	D-suffix	C16P	125 V. 1 A
		C20P, C28P, C40P	125 V, 5 A
		C60P	125 V, 5 A
I/O Link Units			250 V, 1 A

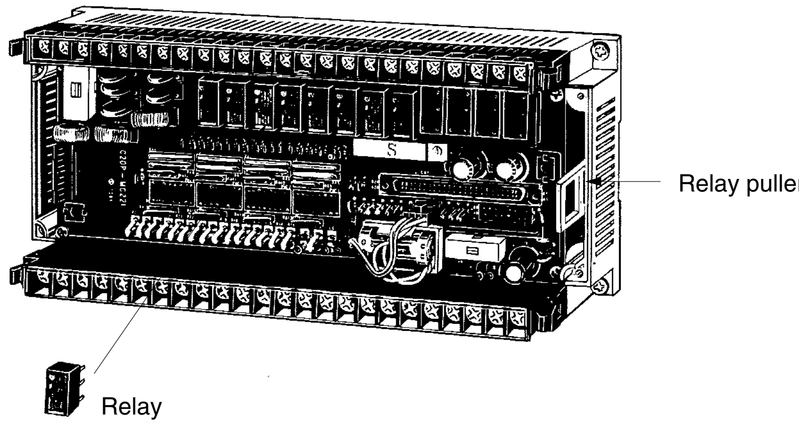
24-VDC Output Fuses Dia. 5.2 x 20 (MF51NR)		
CPUs, Expansion I/O Units (A-suffix only)	C16P	125 V, 0.2 A
	C20P, C28P, C40P, C60P	125 V, 0.5 A

3-3-2 Relays

Replace relays as follows:

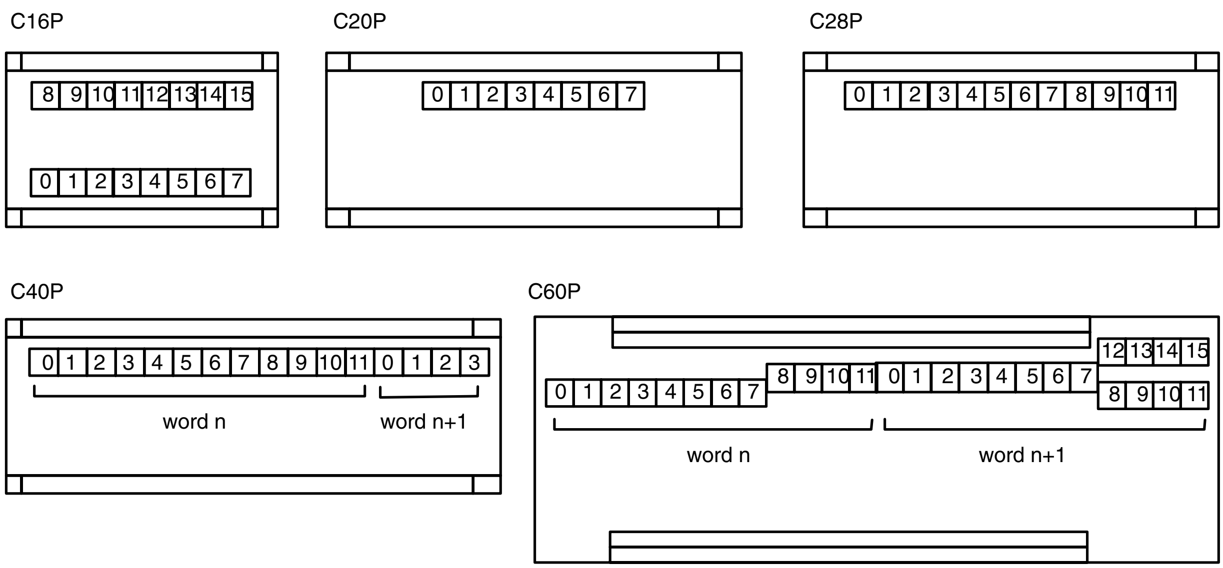
1, 2, 3...
1. Turn off power to the Unit.
2. Using a Phillips screwdriver to loosen the 4 screws, remove the cover from the Unit, lifting it from the left.

3. Using the relay puller attached to the right of the Unit, remove the defective relay and insert the new one.



4. Replace the cover, positioning it over the Unit and snapping it into place by applying pressure to the area marked “OMRON.”

Relays are arranged as follows for the C16P, C20P, C28P, C40P, and C60P. Among these Units, most models have relay sockets, although certain models do not. The C4K is not shown below; in this Unit the relays are directly attached.



3-3-3 Batteries

The service life of the battery (3G2A9-BAT08) is five years at 25° C. It will be shorter at higher temperatures. The ALARM indicator blinks when the battery is discharged. If this happens, replace the battery within one week. The date by which the first battery must be replaced is written on the side panel of the CPU. If, for example, it says “FIRST REPLACEMENT 93/12,” it means that you should replace the battery not later than December 1993.

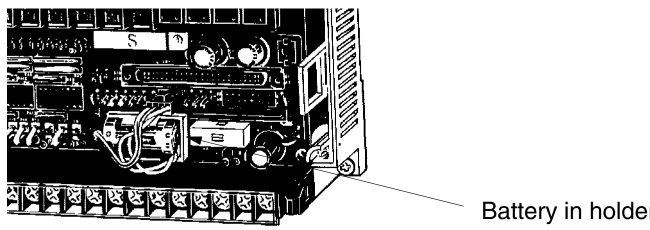
Caution The new battery must be connected within five minutes of removing the old to preserve the data in the CPU. In addition, as there is danger of combustion, explosion or leakage, do not attempt to charge, heat or disassemble the battery, or short-circuit the terminals. When disposing of a used battery, do not throw it into a fire.

Replace the battery as follows:

1. Turn off the power to the Unit. If the power is off to begin with, turn it on and wait for at least 10 seconds. Then turn it off.

2. Using a Phillips screwdriver to loosen the 4 screws, remove the cover from the Unit, lifting it from the left.

3. Pull the battery from the holder and install the new one within five minutes.



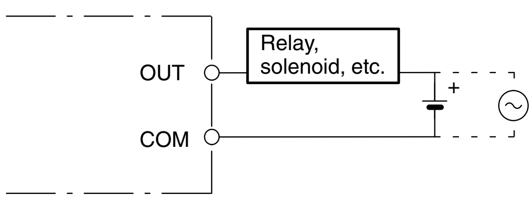
4. Replace the cover, positioning it over the Unit and snapping it into place by applying pressure to the area marked “OMRON.”

5. Clear the ALARM on the Programming Console.

3-4 Preventive Measures

Load Circuit Fuses

A fuse in the load circuit will protect the output elements, circuit board, etc., in the event of a short in the output device.

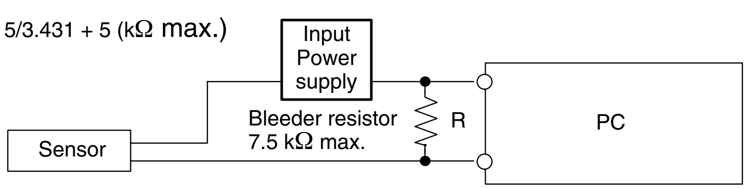


Prevention of Input Leakage Current

When two-wire sensors, such as photoelectric sensors and proximity sensors, or limit switches with neon lamp are connected to the CPU as input devices, the input signal may be erroneously turned ON by a leakage current over 1.5 A. To prevent this, connect a bleeder resistor as shown below.

Determine the resistance of the bleeder resistor by the following equation, where I is the leakage current.

R = 17.15/3.431 + 5 (kΩ max.)



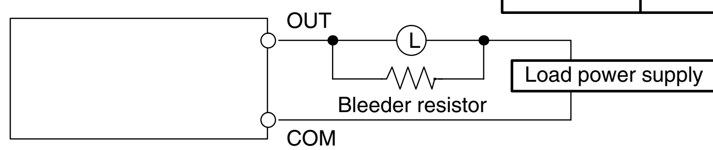
Prevention of Output Leakage Current

Likewise, if there is a danger of leakage current causing a transistor or triac to malfunction, connect a bleeder resistor as shown below. Determine the resistance of the bleeder resistor by the following equation.

R < Von/I

Von = ON voltage of the load (V)
I = leakage current (mA)
R = bleeder resistance (kΩ)

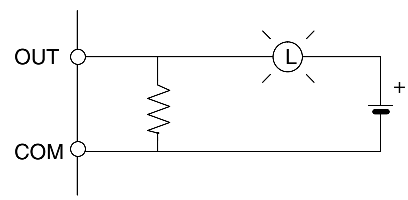
Transistor	24 VDC	0.1 mA
Triac	100 VAC	2.0 mA
	200 VAC	5.0 mA



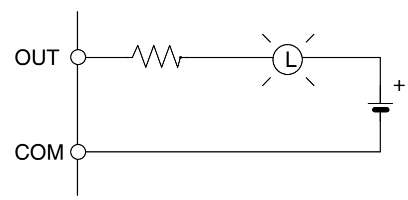
Precautions for Inrush Current

When connecting the resistor or triac output to a device (such as an incandescent lamp) which allows a high inrush current to flow, care must be taken to ensure the safety of the transistor or triac. The transistors and triacs are able to withstand an inrush current of ten times the rated current. If the actual inrush current will exceed that amount, use one of the following two circuits to reduce it.

This circuit allows a slight current (about 1/3 of the rated current) to flow through the load (i.e., the lamp), thus eliminating any initial surge of current.



This circuit acts directly on the inrush current to limit it, but also reduces the voltage across the load.



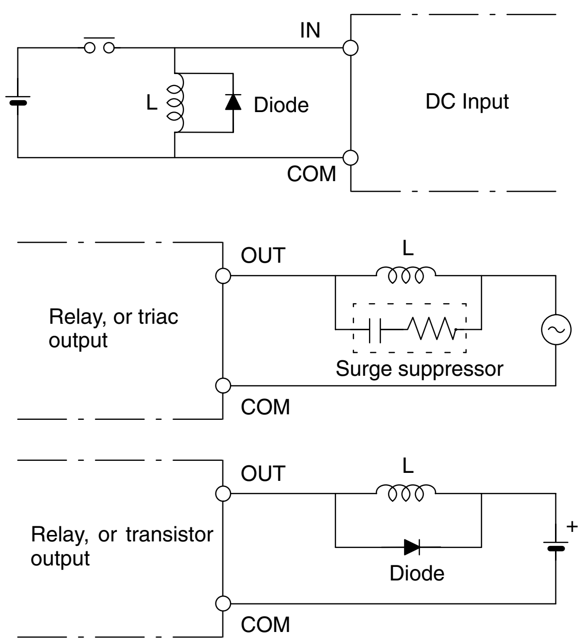
Transistor Output Residual Voltage

When connecting TTL circuits to transistor outputs, it is necessary (because of the transistor's residual voltage) to connect a pull-up resistor and a CMOS IC between the two.

Inductive Load Surge Suppressors

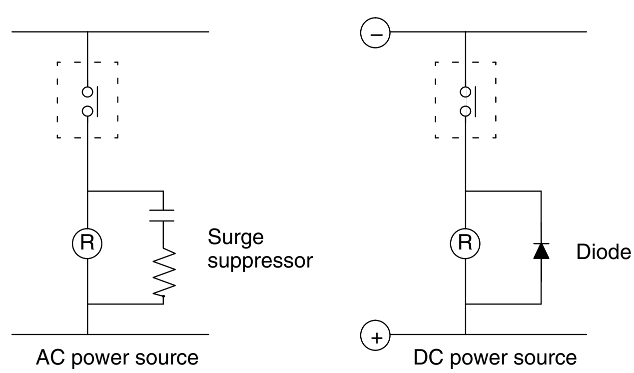
When an inductive load is connected to the input or output of the CPU, it is necessary to connect a surge suppressor or a diode in parallel with the load, as shown below, to absorb the counter-electromotive force produced by the load.

Resistor:	50 Ω
Capacitor:	0.47 μF
Voltage:	200 V
Diode:	Must withstand voltages more than three times the load voltage and an average current of 1 A



Output Loads

Be sure to take appropriate measures when any electrical device likely to produce noise is connected to the CPU as a load. For example, electromagnetic relays and valves generating noise of more than 1,200 V require noise suppression. For AC noise sources, connect a surge suppressor in parallel with the coil of each device. For DC noise sources, connect a diode in parallel with the coil of each device. When mounting a CPU and an Expansion I/O Unit on a control panel, be sure to completely ground the intermediate mounting plate. The mounting plate must be finished with high-conductivity plating to ensure noise immunity.



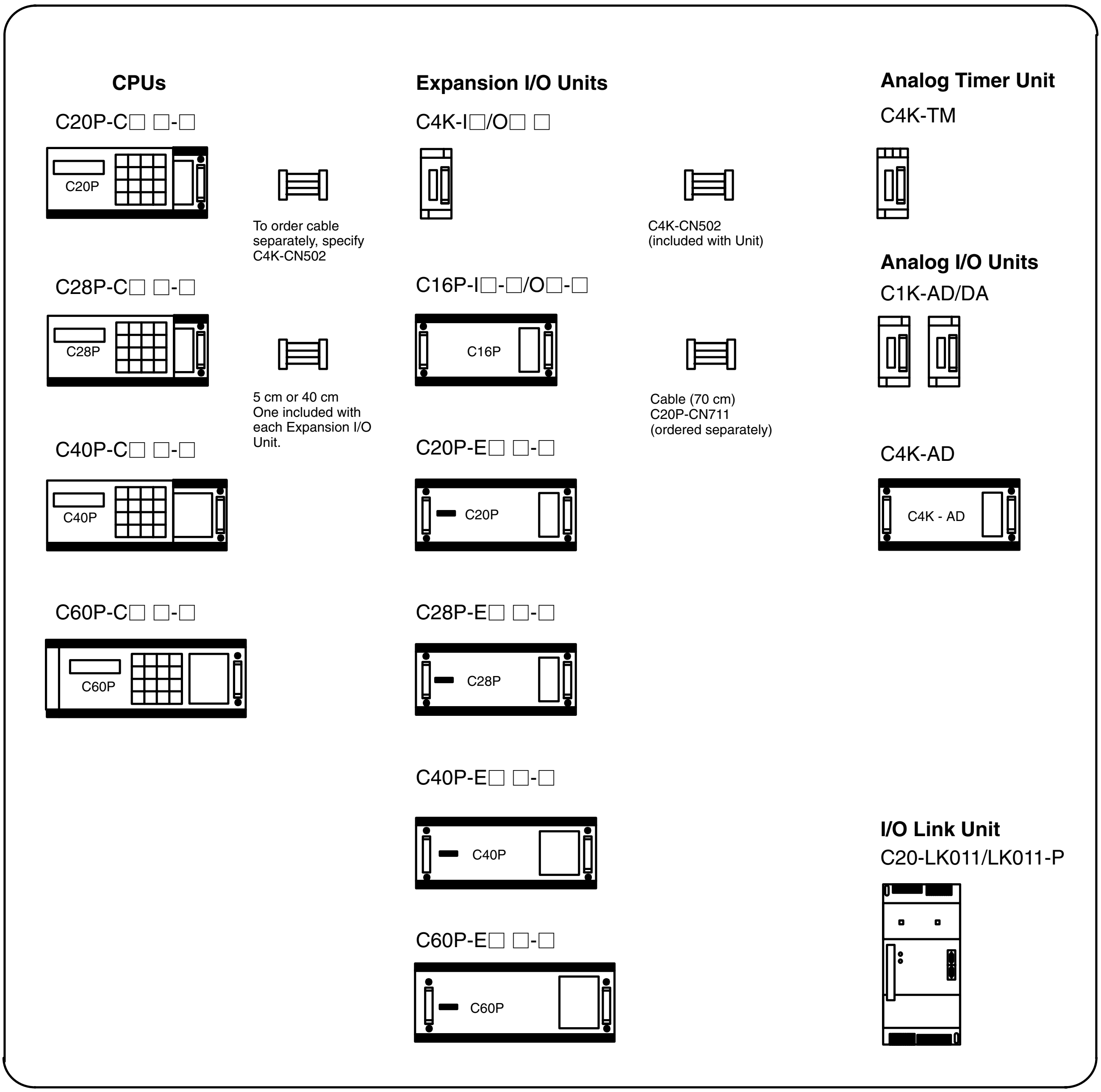
3-5 Inspection

In order for your PC to continue operating at optimum condition, periodic inspections are necessary. The main components of the PC are semiconductors and have a long service life, but, depending on the operating environment, there may be more or less deterioration of these and other parts. A standard inspection schedule would be once every six months to one year, but more frequent inspections may be advisable depending on the operating environment. Try to maintain the inspection schedule once it has been set.

Check to be sure that the power supply, ambient temperature, humidity, and so on, are within the specifications (see *Appendix B*). Be sure that there are no loose screws in any of the Units and that all battery and cable connections are secure. Clean any dust or dirt that has accumulated. Check all fuses, relays, and other replaceable parts.

Appendix A
Standard Models

There are four basic sizes of P-type C-series CPU. A CPU can be combined with any of six basic sizes of Expansion I/O Unit and/or Analog Timers, Analog I/O Units, or an I/O Link Unit.



CPUs

Name	Power supply	Inputs	Outputs		Model number	Standards
C20P	100 to 240 VAC	24 VDC, 12 pts.	Relay with socket	8 pts.	C20P-CDR-AE	U, C, N, L
			Transistor, 1 A		C20P-CDT1-AE	U, C, N, L
			Triac, 1 A		C20P-CDS1-AE	U, C, N, L
		24 VDC, 2 pts. 100 VAC, 10 pts.	Relay with socket		C20P-CAR-AE	U, C, N, L
	24 VDC	24 VDC, 12 pts.	Relay with socket		C20P-CDR-DE	U, C, N, L
			Transistor, 1 A		C20P-CDT1-DE	U, C, N, L
C28P	100 to 240 VAC	24 VDC, 16 pts.	Relay with socket	12 pts.	C28P-CDR-AE	U, C, N, L
			Transistor, 1 A		C28P-CDT1-AE	U, C, N, L
			Triac, 1 A		C28P-CDS1-AE	U, C, N, L
		24 VDC, 2 pts. 100 VAC, 14 pts.	Triac, 1A		C28P-CAS1-AE	U, C, N, L
	24 VDC	24 VDC, 24 pts.	Relay with socket		C28P-CDR-DE	U, C, N, L
			Transistor, 1 A		C28P-CDT1-DE	U, C, N, L
C40P	100 to 240 VAC	24 VDC, 24 pts.	Relay with socket	16 pts.	C40P-CDR-AE	U, C, N, L
			Transistor, 1 A		C40P-CDT1-AE	U, C, N, L
			Triac, 1 A		C40P-CDS1-AE	U, C, N, L
		24 VDC, 2 pts. 100 VAC, 22 pts.	Relay with socket		C40P-CAR-AE	U, C, N, L
			Triac, 1 A		C40P-CAS1-AE	U, C, N, L
	24 VDC	24 VDC, 24 pts.	Relay with socket		C40P-CDR-DE	U, C, N, L
			Transistor, 1 A		C40P-CDT1-DE	U, C, N, L
C60P	100 to 240 VAC	24 VDC, 32 pts.	Relay with socket	28 pts.	C60P-CDR-AE	U, C
			Transistor, 1 A		C60P-CDT1-AE	U, C
			Triac, 1 A		C60P-CDS1-AE	U, C
		24 VDC, 2 pts. 100 VAC, 30 pts.	Relay with socket		C60P-CAR-AE	U, C
			Triac, 1 A		C60P-CAS1-AE	U, C
	24 VDC	24 VDC, 32 pts.	Relay with socket		C60P-CDR-DE	U, C
			Transistor, 1 A		C60P-CDT1-DE	U, C

- U: UL, C: CSA, N: NK

See Omron sales representatives concerning operating conditions under which UL, CSA, and NK standards were met (Aug. 1988).

Expansion I/O Units

Name	Power supply	Inputs	Outputs		Model number	Standards
C4K Expansion I/O Unit	---	24 VDC, 4 pts.	---		C4K-ID	U, C
		100 to 120 VAC, 4 pts.	---	4 pts.	C4K-IA	U, C
		---	Relay with socket		C4K-OR2	U, C
			Transistor, 1 A		C4K-OT2	U, C
			Triac, 1A		C4K-OS2	U, C
C16P Expansion I/O Unit	100 to 240 VAC	24 VDC, 16 pts.	---		C16P-ID-A	U, C
		---	Relay with socket	16 pts.	C16P-OR-A	U, C
			Transistor, 1 A		C16P-OT1-A	U, C
			Triac, 1A		C16P-OS1-A	U, C
	---	24 VDC, 16 pts.	---		C16P-ID	U, C
		100 to 120 VAC, 16 pts.	---		C16P-IA	U, C
	24 VDC	---	Relay with socket	16 pts.	C16P-OR-D	U, C
			Transistor, 1 A		C16P-OT1-D	U
C20P Expansion I/O Unit	100 to 240 VAC	24 VDC, 12 pts.	Relay with socket	8 pts.	C20P-EDR-A	U, C, N, L
			Transistor, 1 A		C20P-EDT1-A	U, C, N, L
			Triac, 1A		C20P-EDS1-A	U, C, N, L
		100 to 120 VAC, 12 pts.	Relay with socket		C20P-EAR-A	U, C, N, L
			Triac, 1A		C20P-EAS1-A	U, C, N, L
	24 VDC	24 VDC, 12 pts.	Relay with socket		C20P-EDR-D	U, C, N, L
			Transistor, 1 A		C20P-EDT1-D	U, C, N, L
C28P Expansion I/O Unit	100 to 240 VAC	24 VDC, 16 pts.	Relay with socket	12 pts.	C28P-EDR-A	U, C, N, L
			Transistor, 1 A		C28P-EDT1-A	U, C, N, L
			Triac, 1A		C28P-EDS1-A	U, C, N, L
		100 to 120 VAC, 16 pts.	Relay with socket		C28P-EAR-A	U, C, N, L
			Triac, 1A		C28P-EAS1-A	U, C, N, L
	24 VDC	24 VDC, 16 pts.	Relay with socket		C28P-EDR-D	U, C, N, L
			Transistor, 1 A		C28P-EDT1-D	U, C, N, L
C40P Expansion I/O Unit	100 to 240 VAC	24 VDC, 24 pts.	Relay with socket	16 pts.	C40P-EDR-A	U, C, N, L
			Transistor, 1 A		C40P-EDT1-A	U, C, N, L
			Triac, 1A		C40P-EDS1-A	U, C, N, L
		100 to 120 VAC, 24 pts.	Relay with socket		C40P-EAR-A	U, C, N, L
			Triac, 1A		C40P-EAS1-A	U, C, N, L
	24 VDC	24 VDC, 24 pts.	Relay with socket		C40P-EDR-D	U, C, N, L
			Transistor, 1 A		C40P-EDT1-D	U, N, L
C60P Expansion I/O Unit	100 to 240 VAC	24 VDC, 32 pts.	Relay with socket	28 pts.	C60P-EDR-A	U, C
			Transistor, 1 A		C60P-EDT1-A	U, C
			Triac, 1A		C60P-EDS1-A	U, C
		100 VAC, 32 pts.	Relay with socket		C60P-EAR-A	U, C
			Triac, 1A		C60P-EAS1-A	U, C
	24 VDC	24 VDC, 32 pts.	Relay with socket		C60P-EDR-D	U, C
			Transistor, 1 A		C60P-EDT1-D	U, C

Special Units

Name	Specifications		Model number	Standards
Analog Timer Unit	Settings: 0.1 s to 10 min (C4K-CN502 Cable, included)		C4K-TM	U, C
Analog Timer External Connector	2-m cable and connector		C4K-CN223	---
Analog Input Unit	1 input; input ranges: 4 to 20 mA, 1 to 5 V		C1K-AD	U, C
	4 inputs; input ranges: 4 to 20 mA, 1 to 5 V		C4K-AD	U, C
Analog Output Unit	1 output; output ranges: 4 to 20 mA, 1 to 5 V		C1K-DA	U, C
Host Link Unit	RS-232C		3G2C7-LK201-EV1	---
	RS-422		3G2C7-LK202-EV1	---
I/O Link Unit	APF/PCF		3G2C7-LK011-P	U, L
	PCF		3G2C7-LK011	U, C
I/OConnectingCable	For horizontal mounting; cable length: 5 cm (for maintenance)		C20P-CN501	---
	For vertical mounting; cable length: 40 cm (for maintenance)		C20P-CN411	---
I/OConnecting Cable	For horizontal mounting; connects to C4K I/O Units, Analog Timer Unit, or Analog I/O Units (for maintenance)	Cable length: 5 cm	C4K-CN502	---
		Cable length: 50 cm	C4K-CN512	---
		Cable length: 1 m	C4K-CN122	---
I/O Link Connecting Cable	Cable length: 70 cm; for I/O Link Units only		C20P-CN711	---
EPROM	2764		ROM-H	L
Battery Set	Built into CPU (same for all C-series PCs)		3G2A9-BAT08	---
Relay	24-VDC contact relay, 250 VAC/24 VDC, 2 A		G6B-1174P-FD-US DC 24	U, C
	24-VDC transistor relay, 5 to 24 VDC, 0.01 to 0.6 A		G3SD-Z01P-PD-US DC 24	U, C
	24-VDC triac relay, 85 to 240 VAC, 0.6 A		G3S-201PL-PD-US DC 24	U, C

- U: UL, C: CSA, N: NK

See Omron sales representatives concerning operating conditions under which UL, CSA, and NK standards were met (Aug. 1988).

DIN Products

Name	Specifications		Model number	Standards
DIN Track	Length: 50 cm	Not usable with C60P	PFP-50N	---
	Length: 1 m		PFP-100N	
			PFP-100N2	
End Plate	---		PFP-M	
Spacer	---		PFP-S	

Factory Intelligent Terminal (FIT)

Name	Specifications	Model number	Standards
FIT	1. FIT Computer 2. SYSMATE Ladder Pack (2 system disks, 1 data disk) 3. MS-DOS 4. GPC Communications Adapter (C500-IF001) 5. Peripheral Connecting Cable (3G2A2-CN221) 6. Power Cord and 3-pin/2-pin plug 7. Carrying Case	FIT10-SET11-E	---

Graphic Programming Console (GPC)

Name	Specifications	Model number	Standards
GPC (LCD display)	With battery; power supply: 32 kw, 100 to 120 VAC; with comments;SystemMemoryCassetteorderedseparately.	3G2C5-GPC03-E	---
	With battery; power supply: 32 kw, 220 VAC; with comments;SystemMemoryCassetteorderedseparately.	3G2C5-GPC04-E	
GPC Carrying Case	With side pocket for accessories	C500-CS001	
GPC System Memory Cassette	With comments	3G2C5-MP303-EV2	
Cassette Interface Unit	Used to load programs in V8, M1R, M5R, POR, or S6 cassettes to GPC and print them through a Printer Interface Unit.	3G2A5-CMT01-E	

Peripheral Devices

Name	Specifications		Model number	Standards
Programming Console	Vertical, with backlight		3G2A5-PRO13-E	U, C
	Horizontal, with backlight		3G2A6-PRO15-E	U, C
	Hand-held, with backlight. The Programming Console Adapter AP003 and connecting cable CN222/CN422 are necessary. They are sold separately.		C200H-PR027-E	U, C
Programming Console Mounting Bracket	Used to attach Hand-held Programming Console to a panel.		C200H-ATT01	---
Programming Console Connecting Cables	For C20P/C28P/C40P/C60P only	1 m	3G2C7-CN122	---
		50 cm	3G2C7-CN512	---
	For Hand-held Programming Console	2 m	C200H-CN222	---
		4 m	C200H-CN422	---
Programming Console Adapter	Required to use Hand-held Programming Console with any PC but C200H, C20.		C500-AP003	---
Cassette Recorder Connecting Cable	Used to connect Programming Console, GPC, or Cassette Deck Interface Unit to a cassette deck; length: 1 m.		SCYPOR-PLG01	---
PROM Writer	Used for all P-type PCs.		C500-PRW06	---
Printer Interface Unit	Interface for X-Y plotter or printer; System Memory Cassette ordered separately.		3G2A5-PRT01-E	---
Printer Interface Unit Memory Pack	When mounting to P-type CPUs		C20-MP009-EV3	
Printer Connecting Cable	2 m (also used for X-Y plotter)		SCY-CN201	---
Floppy Disk Interface Unit	C20P/C28P/C40P. With comment file; able to connect to NEC floppy disk controller		3G2C5-FDI03-E	---
Peripheral Interface Unit	To connect GPC or FIT to P-type PCs		3G2C7-IP002-V2	
Connecting Cable	Used to connect FIT or GPC to Peripheral Interface Unit and to connect Programming Console Adapter and Programming Console Base.	2 m	3G2A2-CN221	---
		5 m	C500-CN523	
		10 m	C500-CN131	
		20 m	C500-CN231	
		30 m	C500-CN331	
		40 m	C500-CN431	
		50 m	C500-CN531	

- U: UL, C: CSA, N: NK

See Omron sales representatives concerning operating conditions under which UL, CSA, and NK standards were met (Aug. 1988).

Appendix B
Specifications

General Ratings

General Ratings

Supply voltage	-A suffix: 100 to 240 VAC 50/60 Hz -D suffix: 24 VDC
Operating voltage range	-A suffix: 85 to 264 VAC -D suffix: 20.4 to 26.4 VDC
Power consumption	-A suffix: 60 VA max. -D suffix: 40 W max.
24-VDC output*	0.3 A 24 VDC +10% (Use as DC power supply)
Insulation resistance	10 MW min. (at 500 VDC) between AC terminals and housing**
Dielectric strength	2,000 VAC 50/60 Hz for 1 min (between AC terminals and housing), Leakage current: 10 mA max. 500 VAC 50/60 Hz for 1 minute (between DC terminals and housing), Leakage current: 1 mA max.
Noise immunity	1,000 V p–p, pulse width: 100 ns to 1 ms, rise time 1 ns
Vibration	10 to 35 Hz, 2 mm double amplitude, in X, Y, and Z directions; 2 hours each. (When mounted on a DIN rail: 16.7 Hz, 1 mm double amplitude, in X, Y, and Z directions, 1 hour each.)
Shock	10 G in X, Y, and Z directions, 3 times each
Ambient temperature	Operating: 0% to 55%C Storage: –20% to 65%C
Humidity	35% to 85% (without compensation)
Grounding	Less than 100 W
Structure	IEC IP-30 (mounted in a panel)
Weight CPUs Expan. I/O Units	C20K, C28K: 1.9 kg max; C40K: 2.2 kg max.; C60K: 2.6 kg max. C20P, C28P: 1.7 kg max.; C40P: 2.0 kg max.; C60P: 2.4 kg max.
Dimensions (CPUs and Expan. I/O Units)	C20K, C28K: 250 (W) x 110 (H) x 100 (D); C40K: 300 (W) x 110 (H) x 100 (D); C60K: 350 (W) x 140 (H) x 100 (D)

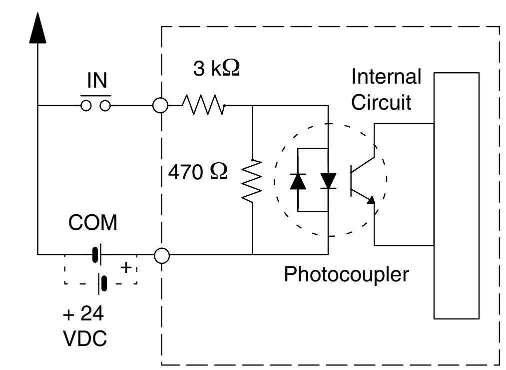
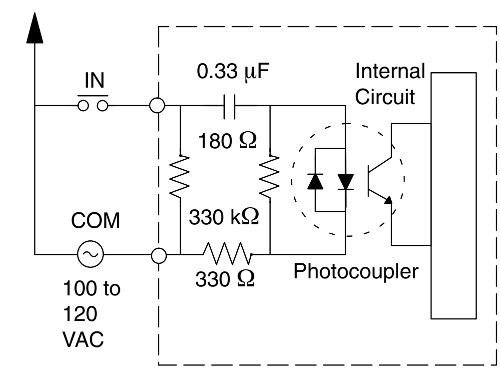
*This output is not provided on models with the suffix -D in the model number (models accepting a DC supply voltage).

*Disconnect the LR terminal from the GR terminal when testing the insulation resistance. Failure to do so will destroy internal circuits.

CPU Characteristics

Main control elements	MPU, CMOS, LSTTL
Programming method	Ladder diagram
Instruction length	1 address/instruction, 6 bytes/instruction
Number of instructions	49
Execution time	10 μs/instruction (average)
Memory capacity	1,194 addresses
IR bits	I/O bits: 160 (IR 0000 to IR 0915) Max. of 148 usable for I/O IR 0000 is used for count input and IR 0001 is used for hardware reset for high-speed counter (HDM(98)) Work bits: 136 (IR 1000 to IR 1807) IR 1807 is reserved for HDM(98)
SR bits	16 (SR 1808 to SR 1907) Always ON, Always OFF, battery failure, initial scan ON, 0.1-s clock pulse, 0.2-s clock pulse, 1.0-s clock pulse, etc.
HR bits	160 (HR 000 to HR 915)
TM bits	8 (TR 0 to TR 7)
DM words	64 (DM 00 to DM 63) DM 32 to DM 63 are reserved as upper and lower limit setting areas for HDM(98) if it is used.
Timer/counters	48 (total of TIM's, CNT's, and CNTR's) TIM 00 to TIM 47 (0 to 999.9 s) TIMH 00 to TIMH 47 (0 to 99.99 s) CNT 00 to CNT 47 (0 to 9999 counts) CNTR 00 to CNTR 47 (0 to 9999 counts) TC 47 is used for HDM(98). When this instruction is not used, TC 47 can be used for other purposes.
High-speed counter	Count input: IR 0000 Hardware reset input: IR 0001 Software inset: IR 1807 Maximum response frequency: 2 kHz Preset count range: 0000 to 9999 Number of outputs: 16
Memory protection	Status of HR bits, present value of counters, and contents of DM words are retained during power failure.
Battery life	5 years at 25%C Battery life is shortened at temperatures higher than 25°C. Replace battery with new one within 1 week when ALARM indicator blinks.
Self-diagnostic features	CPU failure (watchdog timer) Memory failure I/O bus failure Battery failure, etc.
Program check	Program check (executed on start of RUN operation) END(01) instruction missing JMP(04)–JME(05) error Coil duplication Circuit error DIFU(13)/DIFD(14) over error IL(02)/ILC(03) error

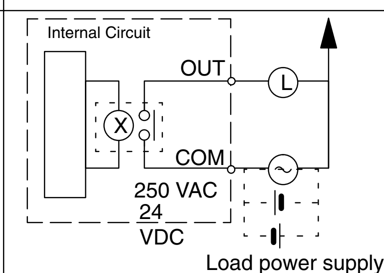
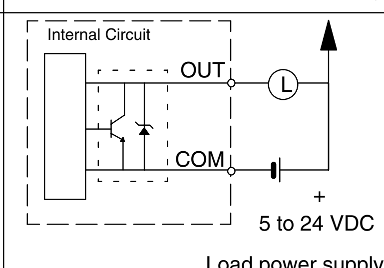
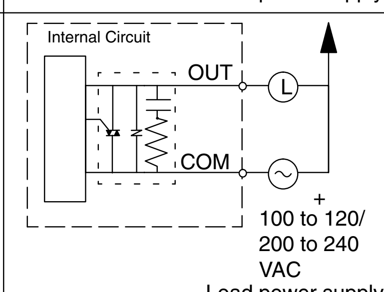
Input Specifications

	DC input (photocoupler-isolated)	AC input* (photocoupler-isolated)
Supply voltage	24 VDC +10%	100 to 120 VAC + 10%, –15% 50/60 Hz
Input imped.	3 kΩ	9.7 kΩ (50 Hz), 8 kΩ (60 Hz)
Input current	7 mA at 24 VDC	10 mA at 100 VAC
ON voltage	15 VDC min.	60 VAC min.
OFF voltage	5 VDC max.	20 VAC max.
ON delay time	2.5 ms max. (input 0000 and 0001: 0.15 ms)	35 ms max.
OFF delay time	2.5 ms max. (input 0000 and 0001: 0.15 ms)	55 ms max.
		

* IR 0000 and IR 0001 on CPUs operate on DC input voltage. The circuit configuration of these two points is the same as the DC input circuit shown above.

Note : The 24 VDC power source can be connected to either the positive or the negative terminal. Therefore both PNP input (negative common) and NPN (positive common) can be used.

Output Specifications

	ON-delay	OFF-delay	Switching capacity		Circuit configuration
			Max.	Min.	
Relay (photocoupler-isolated)	15 ms max.	15 ms max.	2 A at 250 VAC 2 A at 24 VDC (p.f. 1) 0.5 A at 250 VAC (p.f.0.4) 4 A/Common (4 points/Common) 6 A/Common (8 points/Common)	10 mA at 5 VDC	
Transistor* (photocoupler-isolated)	1.5 ms max.	1.5 ms max.	1 A/point at 5 to 24 VDC, 1.6 to 4 A/4 points 4 A/Common (4 points/Common) 6 A/Common (8 points/Common)	10 mA at 5 VDC, saturation voltage: 1.5 V max.	
Triac* (photocoupler-isolated)	1.5 ms max.	1/2 of load frequency + 1 ms max.	1 A/point at 85 to 250 VAC, 1.6 to 4 A/4 points 4 A/Common (4 points/Common) 6 A/Common (8 points/Common)	10 mA at 100 VAC, 20 mA at 200 VAC	

I/O Link Units

Supply voltage	100 to 120/200 to 240 VAC, 50/60 Hz
Operating voltage range	85 to 132/170 to 264 VAC
Power consumption	15 VA max.
Insulation resistance	10 MW min. (at 500 VDC) between AC terminals and housing
Dielectric strength	2,000 VAC 50/60 Hz for 1 min (between AC terminals and housing)
Noise immunity	1,000 V p–p, pulse width: 100 ns to 1 µs, rise time: 1 ns
Vibration	10 to 35 Hz, 2-mm double amplitude, in X, Y, and Z directions, 2 hours each
Shock	10G in X, Y, and Z directions, 3 times each
Ambient temperature	Operating: 0° to 55°C Storage: –20° to 65°C
Humidity	35% to 85% (without condensation)
Grounding	Less than 100 Ω
Structure	IEC IP-30 (mounted in a panel)
Weight	1 kg max.
Dimensions	120 (W) x 250 (H) x 43 (D)

Relay Service Life (at Maximum Switching Capacity)

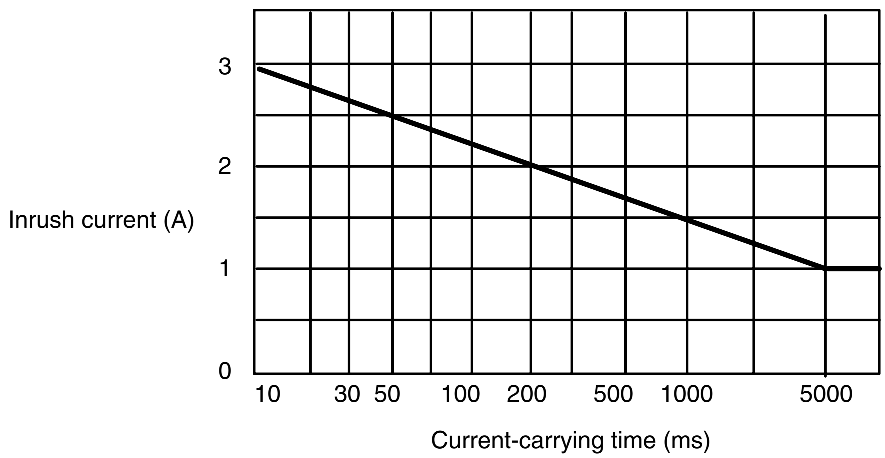
Electrical	300,000 operations [under resistive load (p.f. 1)] 100,000 operations [under inductive load (p.f. 0.4)]
Mechanical	50,000,000 operations

Transistor and Triac Specifications

	Transistor G3SD-Z01P-PD-US	**Triac G3S-201PL-PD-US**
Max. switching capacity	1 A at 5 to 24 VDC	1 A at 85 to 250 VAC
Min. switching capacity	10 mA at 5 VDC	10 mA at 100 VAC 20 mA at 200 VAC
Leakage current	100 µA at 24 VDC	2 mA at 100 VAC 5 mA at 200 VAC
Residual voltage	1.5 V max.	1.5 V max.
ON-delay time	1.5 ms max.	1.5 ms max.
OFF-delay time	1.5 ms max.	1/2 of load frequency + 1 ms max.

Do not mix output devices within the same common circuit.

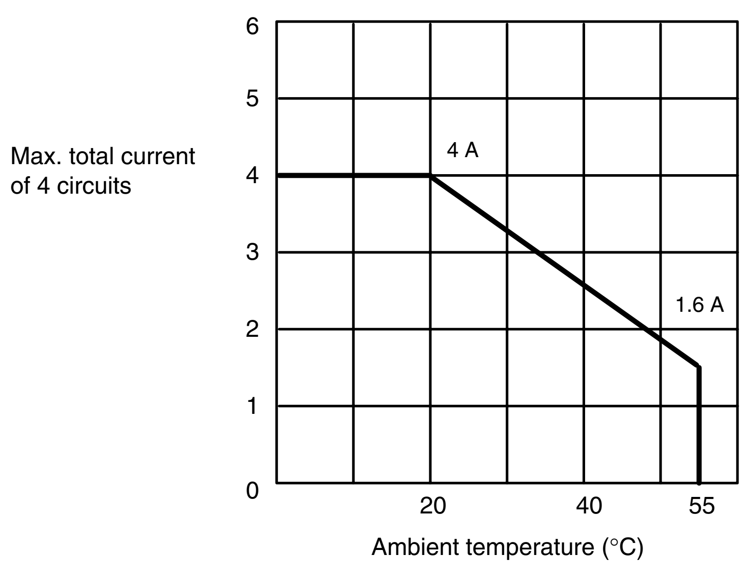
Transistor Inrush Current



Transistor and Triac Maximum Load Current

The maximum load current for the four common circuits varies with the ambient temperature and is 4 to 1.6 A within a range of 20° to 55° C as shown below. Do not exceed the current value indicated in the chart at any given temperature.

Ambient Temperature vs. Total Load Current of Each Common Circuit



Analog Timer Unit Specifications

Item	Specifications
Oscillation method	RC oscillation
Time setting range	Use the program to set any of the following four ranges, according to the chart shown below. 0.1 to 1 second 1 to 10 seconds 10 to 60 seconds 1 to 10 minutes
Timer pause function	The timing operation can be paused if so specified by the program. therefore, the timers can also be used as cumulative timers.
Number of timer contacts	4
Indicators	SET and TIME UP
External variable resistor	External variable resistors can be used to set the time value when the IN/EXT selector is set to EXT. Use 20 kΩ external variable resistors
Point number assignment	See the tables below
Programming and timing chart	See the diagram below

Point number assignment

Bit	IR n	IR (n + 5)
00	T_0TimeExpiredFlag	T_0 Start
01	T_1TimeExpiredFlag	T_1 Start
02	T_2TimeExpiredFlag	T_2 Start
03	T_3TimeExpiredFlag	T_3 Start
04	Cannot be used	T_0 Pause
05		T_1 Pause
06		T_2 Pause
07		T_3 Pause
08		T_0 Range
09		
10		T_1 Range
11		
12		T_2 Range
13		
14		T_3 Range
15		

Bits 00 to 03:

IR n	“1” when time is up
IR (n + 5)	“1” when time is set

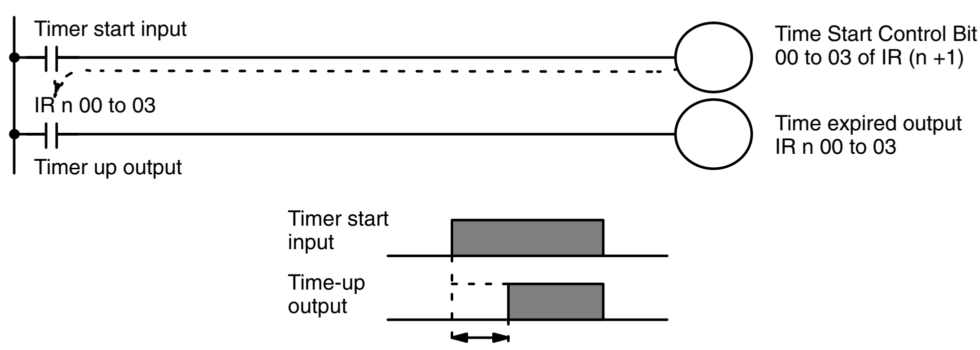
Bits 04 to 07:

0	Operates
1	Stops

Bits 08 to 15:

Timer no.	Bit	0.1 to 1 s	1 to 10 s	10 to 60 s	1 to 10 m
T_0	06	0	1	0	0
	09	0	0	1	1
T_1	10	0	1	0	0
	11	0	0	1	1
T_2	12	0	1	0	0
	13	0	0	1	1
T_3	14	0	1	0	0
	15	0	0	1	1

Programming and timing chart

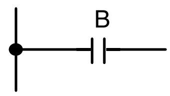
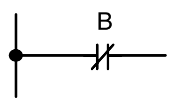
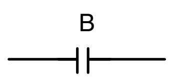
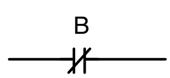
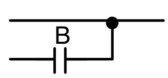
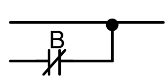
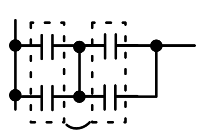
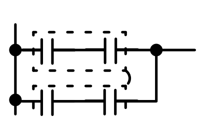


Appendix C
Programming Instructions

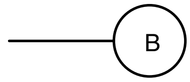
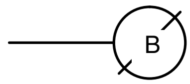
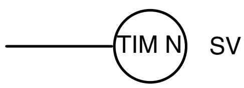
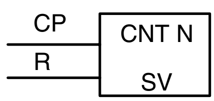
A PC instruction is input either by inputting the corresponding Programming Console key(s) (e.g., LD, AND, OR, NOT) or by using function codes. To input an instruction via its function code, press FUN, the function code, and then WRITE.

Function code	Name	Mnemonic	Page
—	AND	AND	p. 74
—	AND Load	AND LD	p. 74
—	AND NOT	AND NOT	p. 74
—	Counter	CNT	p. 75
—	Load	LD	p. 74
—	Load NOT	LD NOT	p. 74
—	OR	OR	p. 74
—	OR NOT	OR NOT	p. 74
—	OR Load	OR LD	p. 74
—	Output	OUT	p. 75
—	Output NOT	OUT NOT	p. 75
—	Timer	TIM	p. 75
00	No Operation	NOP	p. 75
01	End	END	p. 75
02	Interlock	IL	p. 75
03	Interlock Clear	ILC	p. 75
04	Jump	JMP	p. 75
05	Jump End	JME	p. 75
10	Shift Register	SFT	p. 76
11	Keep	KEEP	p. 76
12	Reversible Counter	CNTR	p. 76
13	Differentiate Up	DIFU	p. 76
14	Differentiate Down	DIFD	p. 76
15	High-speed Timer	TIMH	p. 76
16	Word Shift	WSFT	p. 76
20	Compare	CMP	p. 76
21	Move	MOV	p. 77
22	Move NOT	MVN	p. 77
23	BCD to Binary	BIN	p. 77
24	Binary to BCD	BCD	p. 77
30	BCD Add	ADD	p. 77
31	BCD Subtract	SUB	p. 77
40	Set Carry	STC	p. 78
41	Clear Carry	CLC	p. 78
76	4 to 16 Decoder	MLPX	p. 78
77	16 to 4 Encoder	DMPX	p. 78

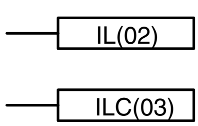
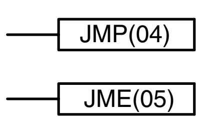
Basic Instructions

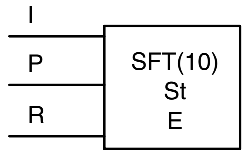
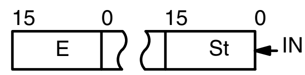
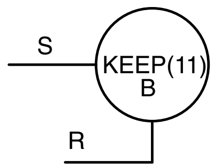
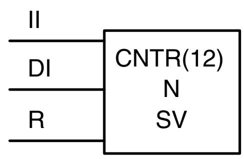
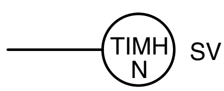
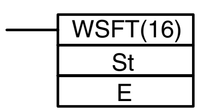
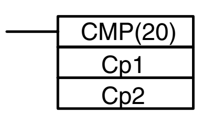
Name Mnemonic	Symbol	Function	Operands
Load LD		Used to start instruction line with status of designated bit.	**B:** IR SR HR AR LR TC TR
Load NOT LD NOT		Used to start instruction line with inverse of designated bit.	**B:** IR SR HR AR LR TC
AND AND		Logically ANDs status of designated bit with execution condition.	**B:** IR SR HR AR LR TC
AND NOT AND NOT		Logically ANDs inverse of designated bit with execution condition.	**B:** IR SR HR AR LR TC
OR OR		Logically ORs status of designated bit with execution condition.	**B**: IR SR HR AR LR TC
OR NOT OR NOT		Logically ORs inverse of designated bit with execution condition.	**B:** IR SR HR AR LR TC
Block AND AND LD		Logically ANDs results of preceding blocks.	None
Block OR OR LD		Logically ORs results of preceding blocks.	None

Area	IR	SR	HR	TR	TC	DM	#
Bits/Words	0000 to 1807	1808 to 1907	HR 000 to 915	TR 0 to 7	TC 00 to 47	DM 00 to DM 63	0000 to 9999 or 0000 to FFFF

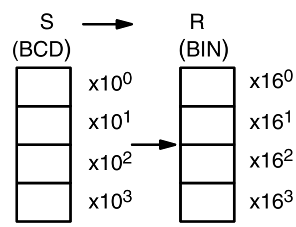
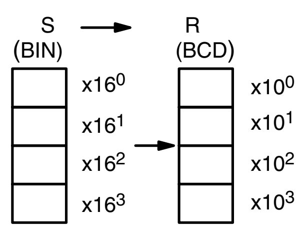
Name Mnemonic	Symbol	Function	Operands
Output OUT		Turns ON B for ON execution condition; turns OFF B for OFF execution condition.	**B:** IR SR HR AR LR TR
Output NOT OUT NOT		Turns OFF B for ON execution condition; turns ON B for OFF execution condition.	**B:** IR SR HR AR LR
Timer TIM		ON-delay (decrementing) timer operation. Set value: 999.9 s; accuracy: +0/–0.1 s. Same TC bit cannot be assigned to more than one timer/ counter. The TC bit is input as a constant.	**N:** TC **SV**: IR HR AR LR DM #
Counter CNT		A decrementing counter. SV: 0 to 9999; CP: count pulse; R: reset input. The TC bit is input as a constant.	**N:** TC **SV:** IR HR AR LR DM #

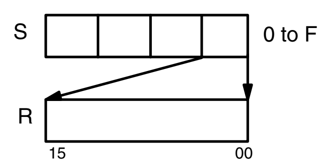
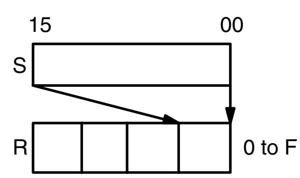
Special Instructions

Name Mnemonic	Symbol	Function	Operands
No Operation NOP (00)	None	Nothing is executed and next instruction is moved to.	None
End END(01)		Required at the end of the program.	None
Interlock IL(02) **Interlock Clear** ILC(03)		If interlock condition is OFF, all outputs are turned OFF and all timer PVs reset between this IL(02) and the next ILC(03). Other instructions are treated as NOP; counter PVs are maintained.	None
Jump JMP(04) **Jump End** JME(05)		All instructions between JMP(04) and the next JME(05) are ignored when execution condition is OFF. No more than eight jumps can be used.	None

Name Mnemonic	Symbol	Function	Operands
Shift Register SFT(10)		Creates a bit shift register from the starting word (St) through the ending word (E). I: input bit; P: shift pulse; R: reset input. St must be less than or equal to E and St and E must be in the same data area. 	**St/E:** IR HR AR LR
Latching Relay KEEP(11)		Defines a bit (B) as a latch controlled by set (S) and reset (R) inputs.	**B:** IR HR AR LR
Reversible Counter CNTR (12)		Increases or decreases PV by one whenever the increment input (II) or decrement input (DI) signals, respectively, go from OFF to ON. SV: 0 to 9999; R: reset input. Must not access the same TC bit as another timer/counter. The TC bit is input as a constant.	**N:** TC **SV:** IR SR HR AR LR DM #
Differentiate Up DIFU(13) **Differentiate Down** DIFD(14)	 	DIFU turns ON the designated bit (B) for one scan on the rising edge of the input signal; DIFD turns ON the bit for one scan on the trailing edge.	**B:** IR HR AR LR
High-speed Timer TIMH(15)		A high-speed, ON-delay (decrementing) timer. SV: 0.01 to 99.99 s; accuracy: +0/–0.1 s. Must not be assigned the same TC bit as another timer or counter. The TC bit is input as a constant.	**N:** TC **SV**: IR SR HR AR LR HR #
Word Shift WSFT(16)		Left shifts data between starting (St) and ending (E) words in word units, writing zeros into starting word. St must be less than or equal to E and St and E must be in the same data area.	**St/E:** IR HR AR LR DM
Compare CMP(20)		Compares two sets of four-digit hexadecimal data (Cp1 and Cp2) and outputs result to GR, EQ, and LE.	**Cp1/Cp2:** IR SR HR AR LR TC DM #

Area	IR	SR	HR	TR	TC	DM	#
Bits/Words	0000 to 1807	1808 to 1907	HR 000 to 915	TR 0 to 7	TC 00 to 47	DM 00 to DM 63	0000 to 9999 or 0000 to FFFF

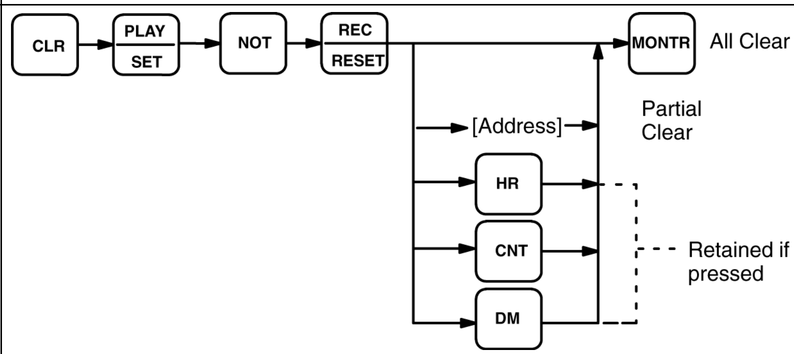
Name Mnemonic	Symbol	Function	Operands
Move MOV(21)	MOV(21) S D	Transfers source data (S) (word or four-digit constant) to destination word (D).	**S:** IR, SR, HR, AR, LR, TC, DM, # **D:** IR, HR, AR, LR, DM
Move NOT MVN(22)	MVN(22) S D	Inverts source data (S) (word or four-digit constant) and then transfers it to destination word (D).	**S:** IR, SR, HR, AR, LR, TC, DM, # **D:** IR, HR, AR, LR, DM
BCD to Binary BIN(23)	BIN(23) S R	Converts four-digit, BCD data in source word (S) into 16-bit binary data, and outputs converted data to result word (R). 	**S:** IR, SR, HR, AR, LR, TC, DM **R:** IR, HR, AR, LR, DM
Binary to BCD BCD(24)	BCD(24) S R	Converts binary data in source word (S) into BCD, and outputs converted data to result word (R). 	**S:** IR, SR, HR, AR, LR, DM **R:** IR, HR, AR, LR, DM
BCD Add ADD(30)	ADD(30) Au Ad R	Adds two four-digit BCD values (Au and Ad) and content of CY, and outputs result to specified result word (R). Au + Ad + $\boxed{CY}$ → R $\boxed{CY}$	**Au/Ad:** IR, SR, HR, AR, LR, TC, DM, # **R:** IR, HR, AR, LR, DM
BCD Subtract SUB(31)	SUB(31) Mi Su R	Subtracts both four-digit BCD subtrahend (Su) and content of CY from four-digit BCD minuend (Mi) and outputs result to specified result word (R). Mi – Su → $\boxed{CY}$ → R $\boxed{CY}$	**Mi/Su:** IR, SR, HR, AR, LR, TC, DM, # **R:** IR, HR, AR, LR, DM

Name Mnemonic	Symbol	Function	Operands
Set Carry STC(40)	STC(40)	Sets carry flag (i.e., turns CY ON).	None
Clear Carry CLC(41)	CLC(41)	CLC clears carry flag (i.e, turns CY OFF).	None
4-to-16 Decoder MLPX(76)	MLPX(76) S Di R	Converts up to four hexadecimal digits in source word (S) into decimal values from 0 to 15 and turns ON, in result word(s) (R), bit(s) whose position corresponds to converted value. Digits to be converted designated by Di (rightmost digit: indicates the first digit; next digit to left: gives the number of digits minus 1). 	**S:** IR, SR, HR, AR, LR, TC, DM **Di:** IR, HR, AR, LR, TC, DM, # **R:** IR, HR, AR, LR, DM
16-to-4 Encoder DMPX(77)	DMPX(77) S R Di	Determines position of highest ON bit in source word(s) (starting word: S) and turns ON corresponding bit(s) in result word (R). Digits to receive converted value are designated by Di (rightmost digit: indicates the first digit; next digit to left: gives number of words to be converted minus 1). 	**S:** IR, SR, HR, AR, LR, TC, DM **R:** IR, HR, AR, LR, DM **Di:** IR, HR, AR, LR, TC, DM, #
High-speed Counter HDM(98)	HDM(98) D	Used to create and control a high-speed (2-kHz) counter for IR 0000 with software and hardware (IR 0001) resets.	**D:** IR, HR, DM

Area	IR	SR	HR	TR	TC	DM	#
Bits/Words	0000 to 1807	1808 to 1907	HR 000 to 915	TR 0 to 7	TC 00 to 47	DM 00 to DM 63	0000 to 9999 or 0000 to FFFF

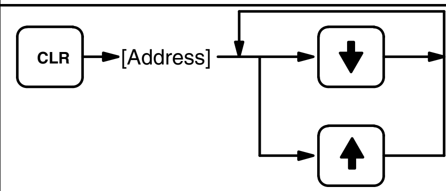
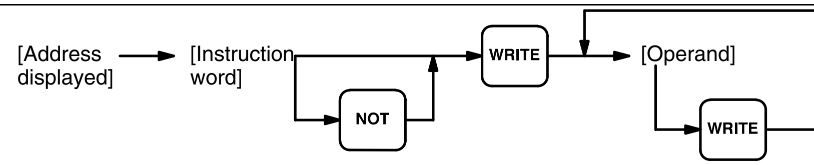
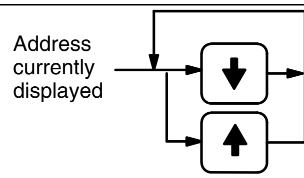
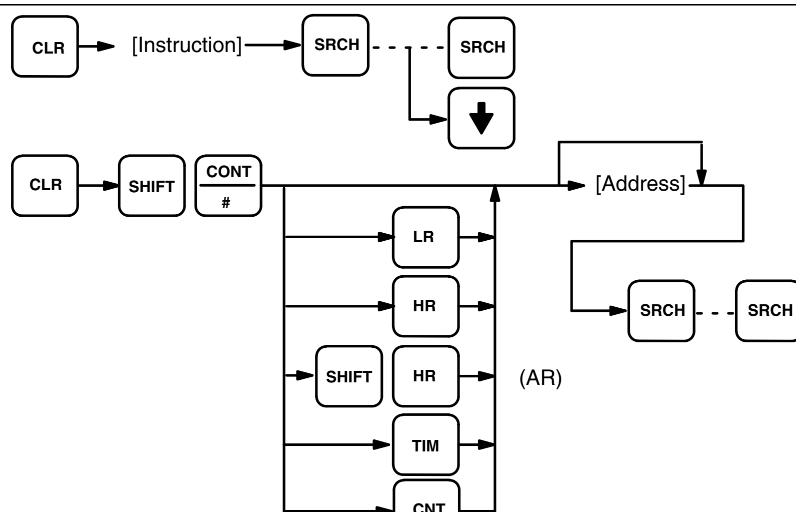
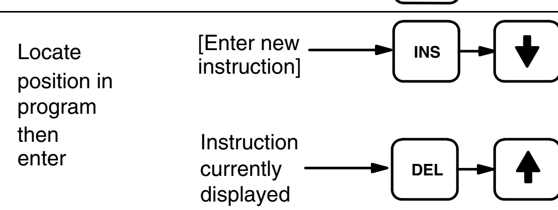
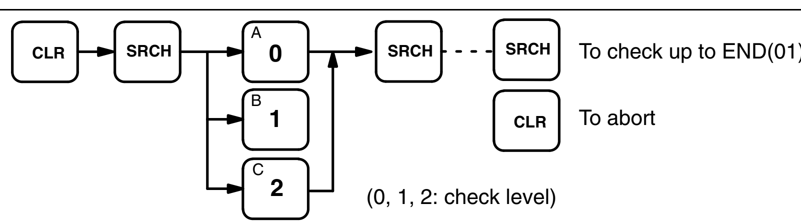
Appendix D
Programming Console Operations

System Operations

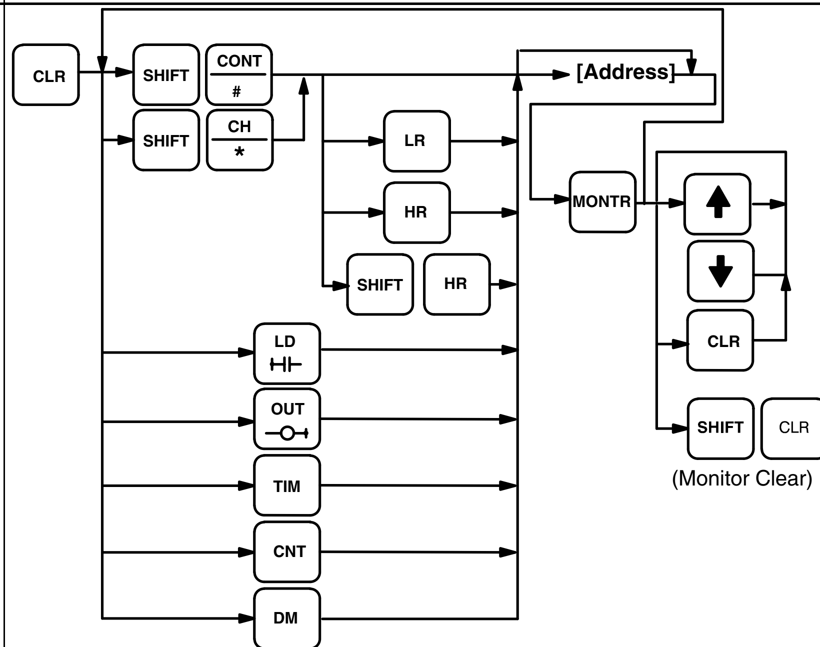
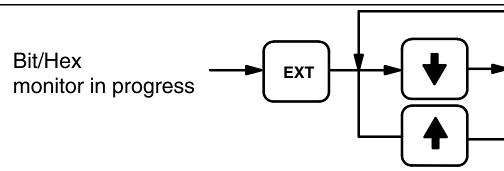
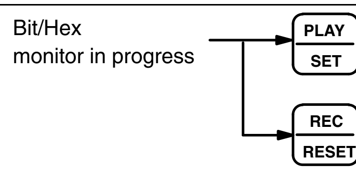
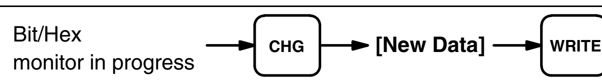
Operation/Description	Modes*	Key sequence
Password Input Controls access to the PC's programming functions. To gain access to the system once "PASSWORD" has been displayed, press CLR, MONTR, and then CLR.	R M P	CLR → MONTR → CLR
Buzzer ON/OFF The buzzer can be switched to operate whenever Programming Console keys are pressed (as well as for the normal error indication). BZ is displayed in the upper right corner when the buzzer is operative. The buzzer can be enabled by pressing SHIFT and then 1 immediately after entering the password or after changing the mode.	R M P	SHIFT → B 1
Data Clear Unless otherwise specified, this operation will clear all erasable memory in Program Memory and IR, HR, DM, and TC areas. To clear EEPROM memory the write-enable switch must be ON. The branch lines shown are used only when performing a partial memory clear, with each of the memory areas entered being retained. Specifying an address will result in the Program Memory from that address on being deleted. All memory up to that address will be retained. When installing a new program, all memory areas should be cleared.	P	
Error Message Read Displays error messages in sequence with most severe messages displayed first. Press monitor to access remaining messages.	R P M	CLR → FUN → MONTR - - - MONTR
Program Header Display Displays the name of the program, along with the version number and the time it was last revised (given in year, month, day, hour, and minute).	R P M	CLR → SHIFT → MONTR

*Modes in which the given instruction is applicable: R = RUN, M = MONITOR, P = PROGRAM

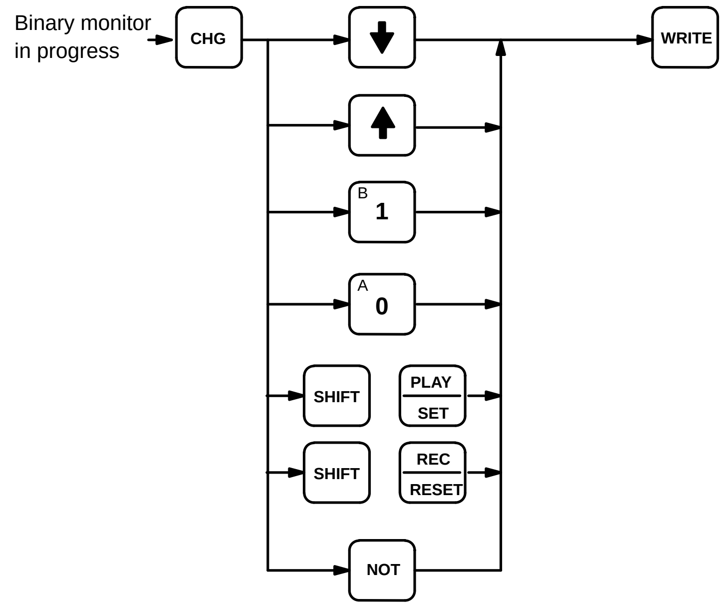
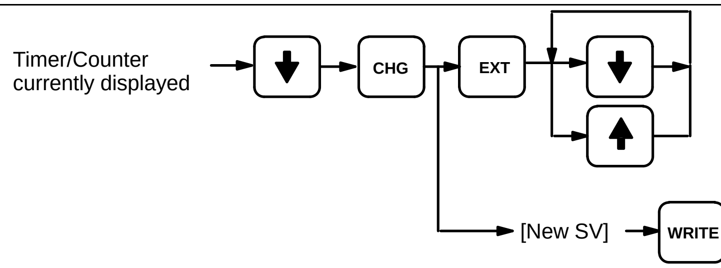
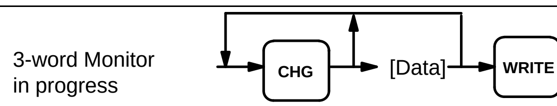
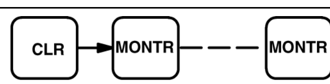
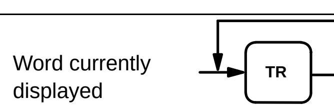
Programming Operations

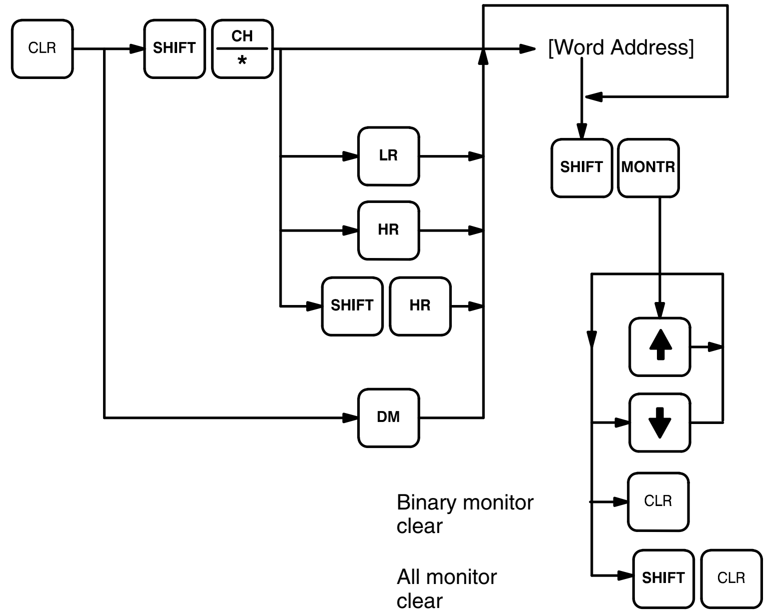
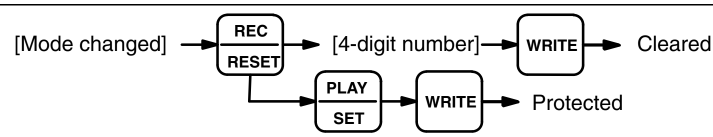
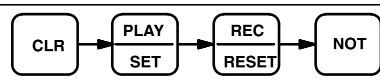
<table>
<tr><th>Operation/Description</th><th>Modes*</th><th>Key sequence</th></tr>
<tr><td>Address Designation
Displays the specified address. Can be used to start programming from a non-zero address or to access an address for editing. Leading zeros need not be entered. The contents of the designated address will not be dislayed until the down key is pressed. The up and down keys can then be used to scroll through the Program Memory.</td><td>R P M</td><td>
</td></tr>
<tr><td>Program Input
Used to enter or edit program instructions. This operation overwrites the contents of the memory at the displayed address. Input NOT for differentiated instructions. Input any operands and press WRITE after each.</td><td>P</td><td>
</td></tr>
<tr><td>Program Read
Allows the user to scroll through the program address-by-address. If the Program Memory is read in RUN or MONITOR mode, the ON/OFF status of each displayed bit is also shown.</td><td>R P M</td><td>
</td></tr>
<tr><td>Program Search
Allows the program to be searched for occurrences of any desiganted instruction or data area address. To designate a bit address, press SHIFT, CONT/#, and then input the address, including the data area code if required. Finally, press SRCH. Pressing SRCH again will fnd the next occurrence. For multiword instructions, the up and down keys can be used to scroll through the words before continuing the search. If the Program Memory is in RUN or MONITOR mode, the ON/OFF status of each displayed bit will also be displayed.</td><td>R P M</td><td>
</td></tr>
<tr><td>Instruction Insert/Delete
The displayed instruction can be deleted, or another instruction can be inserted before it. Care should be taken to avoid inadvertant deletions as there is no way of recovering them. When an instruction is deleted all subsequent instruction addresses are adjusted so that there are no empty addresses.</td><td>P</td><td>
</td></tr>
<tr><td>Program Check
Once a program has been entered, it should be checked for errors. The address where the error was generated will also be displayed.</td><td>P</td><td>
</td></tr>
</table>

Monitoring and Data Changing Operations

Operation/Description	Modes*	Key sequence
Bit/Word Monitor Up to six memory addresses, with either words or bits, or a combination of the two, can be monitored at once. Only three, however, can be displayed at any one time. If operated in RUN or MONITOR Mode, the status of monitored bits will also be displayed. The operation can be started from a cleared display by entering the address of the first word or bit to be monitored and pressing MONTR, or from any address in the program by displaying the address of the bit or word to be monitored and pressing MONTR.	R P M	
3-word Monitor Monitors three consecutive words simultaneously. Specify the lowest valued address of the htree words, press MONTR, and then press EXT to display the data contents of the specified word and the two words that follow. Pressing CLR will change the three-word monitor operation into a single-word display.	R P M	
Force Set/Reset If a bit, timer, or counter address is leftmost on the screen during a bit/word monitor operation, pressing PLAY/SET will turn ON the bit, start the timer, or increment the counter. Pressing REC/RESET will turn OFF the bit, or reset the timer or counter. Timers will not operate in PROGRAM mode. SR bits are not affected by this operation.	P M	
Hex/BCD Data Change Used to edit the leftmost BCD or hexadecimal value displayed during a Bit/Word Monitor operation. If a timer or counter is leftmost on the display, the PV will be the value displayed and affected by this operation. It can only be changed in MONITOR mode and only while the timer or counter is operating. SR words cannot be changed using this operation.	P M	

*Modes in which the given instruction is applicable: R = RUN, M = MONITOR, P = PROGRAM

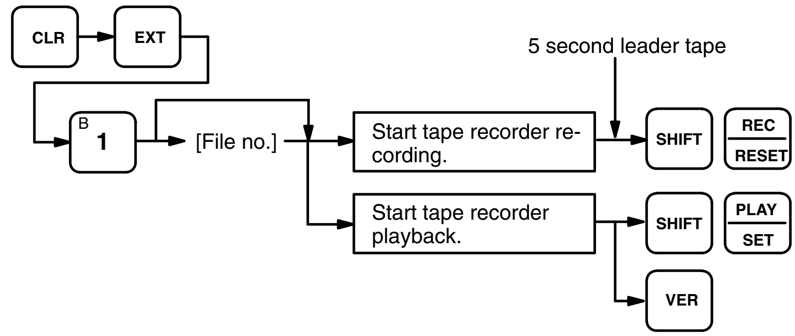
Operation/Description	Modes*	Key sequence
Binary Data Change This operation is used to change the value of 16-bit IR, HR, AR, LR, or DM words bit-by-bit. The cursor can be moved left by using the up key, and right using the down key. The position of the cursor is the bit that will be overwritten. There are two types of changes, temporary and permanent. Temporary changes result if 1 or 0 is entered. Permanent changes are made by pressing SHIFT and SET, or SHIFT and RESET. (These are only available on the C200H PC.) The former will result in an S being displayed in that bit position. Similarly, SHIFT and RESET will produce an R in the display. During operation of the PC, the bits having 1 or 0 values will change according to the conditions. Bits with S or R will, however, always be treated as a 1 or 0, respectively. NOT cancels S and R settings and the bits will become 1 or 0, respectively. Pressing WRITE transfers the changes made on the display to the memory.	P M	
SV Change, **SV Reset** There are two ways of modifying the SVs for timers and counters. One method is to enter a new value. The other is to increment or decrement the existing SV. In MONITOR mode the SV can be changed while the program is being executed. Incrementing and decrementing can only be carried out if the SV has been entered as a constant.	P M M	
3-word Change This operation changes the value of a word displayed during a 3-word monitor operation. The blinking cursor indicates the word that will be affected by the operation. The cursor can be moved by using the up and down keys. When the cursor is at the desired location, press CHG. After entering the new data, pressing WRITE causes the original data to be overwritten.	P M	
Scan Time Display This operation should be performed after all syntax errors have been corrected. The scan time can only be checked in RUN or MONITOR mode and while the program is being executed. The scan time displayed after pressing CLR and MONTR is that for the current scan. Pressing MONTR again will display a new scan time. The difference between the displayed scan times is due to the different execution conditions that exist during each scan.	R M	
Hex-ASCII Display Change Converts 4-digit hexadecimal DM data to ASCII and vice-versa.	R P M	

Operation/Description	Modes*	Key sequence
Binary Monitor The contents of a monitored word can be specified to be displayed in binary by pressing SHIFT and MONTR after entering the word address. Words can be scrolled by pressing the up and down keys to increment and decrement the displayed address. To terminate the binary display, press CLR.	R P M	
Program Read Protect/Clear	R P M	
Clear Forced Set/Reset Simultaneously clears all forced bits within the word currently displayed.	P M	

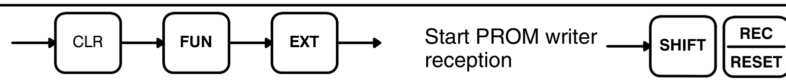
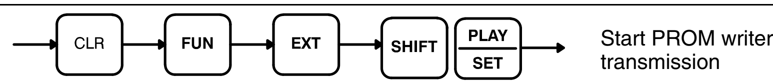
*Modes in which the given instruction is applicable: R = RUN, M = MONITOR, P = PROGRAM

Cassette Tape Operations

Operation/Description	Modes*	Key sequence
Program Memory Save This operation copies data from the Program Memory to tape. The file no. refers to an identifying address for the information within the tape. For ease of information retrieval, the file number and data information should be written clearly on the tape. File numbers should not be used more than once on one tape. If only a part of the Program Memory is to be stored, the appropriate start and stop addresses must be entered. Due to limited memory capacity, each C60 tape can only store apporximately 16K words on each side of the tape. When the start address is entered, the maximum stop address is set as the default. Do not set a stop address past this one. If you wish to record past this address the additional information will need to be recorded either on the flip side of the tape or on a separate tape. After starting the tape recorder, wait about 5 seconds before pressing REC/RESET to allow the leader tape to pass before the data transmission starts.	P	CLR → EXT → A 0 → [File no.] → WRITE → [Start address] → WRITE → [Stop address] → Start recording with the tape recorder. → SHIFT REC/RESET After about 5 seconds (Cancel with the CLR key.)
Program Memory Restore To read Program Memory data which has been recorded on a cassette tape, the keystrokes are as given here. The file no. should be the same as the one entered when the data was recorded. The read operation will proceed from the specified start address up to the end of the tape, unless halted by a CLR command. The instruction must be completed before the leader tape has been played, i.e., before the data is reached on the tape.	P	CLR → EXT → A 0 → [File no.] → WRITE → [Start address] → Start tape recorder playback. → SHIFT PLAY/SET Within about 5 seconds
Program Memory Compare The procedure to compare Program Memory data on a tape with the Program Memory in the Program Memory area is the same as that for reading it (see above), except that after starting the tape playback, VER should be pressed instead of SHIFT and PLAY/SET.	P	CLR → EXT → A 0 → [File no.] → WRITE → [Start address] → Start tape recorder playback. → VER Within about 5 seconds

Operation/Description	Modes*	Key sequence
DM Data Save, Restore, Compare The procedures for transferring DM area data to and from tape, and for comparing it, are basically the same as for the Program Memory, given above. The exceptions are that start and stop addresses are not required, and the DM area is specified instead of the Program Memory. Each operation will continue through to the end of the tape unless cancelled by pressing clear.	P	

PROM Writer Operations

Operation/Description	Modes*	Key sequence
PC to PROM Writer Outputs Program Memory to the RS-232C interface for writing to a commercial PROM writer.	P	
PROM Writer to PC Read Program Memory data from a commercial PROM writer into the PC via the RS-232C interface.	P	

*Modes in which the given instruction is applicable: R = RUN, M = MONITOR, P = PROGRAM

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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.

W167-E1-4A

Revision code

The following table outlines the changes made to the manual during each revision.

Revision code	Date	Revised content	Resource documents
3	April 1990	Revision, Changes made to pages 16, 39, 54, 68, 70	---
4	June 1993	PC configuration charts changed to agree with new maximum number of Units and I/O points (five Units and 148 points). Appendices revised and mistakes removed. Information on Hand-held Programming Console added. **Pages 59 to 65 :** Standard models lists have been updated.	SBCC–379H
4A	July 1994	Address change. Reformat of manual.	

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