

PROGRAMMABLE CONTROLLER
PROSEC T3

**USER'S MANUAL
- HARDWARE -**

[Contents](#)

Toshiba Corporation

Important Information

Misuse of this equipment can result in property damage or human injury. Because controlled system applications vary widely, you should satisfy yourself as to the acceptability of this equipment for your intended purpose. In no event will Toshiba Corporation be responsible or liable for either indirect or consequential damage or injury that may result from the use of this equipment.

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Safety Precautions


This manual is prepared for users of Toshiba's Programmable Controller PROSEC T3. Read this manual thoroughly before using the T3. Also, keep this manual and related manuals so that you can read them anytime while the T3 is in operation.


General Information

1. The T3 has been designed and manufactured for use in an industrial environment. However, the T3 is not intended to be used for systems which may endanger human life. Consult Toshiba if you intend to use the T3 for a special application, such as transportation machines, medical apparatus, aviation and space systems, nuclear controls, submarine systems, etc.
2. The T3 has been manufactured under strict quality control. However, to keep safety of overall automated system, fail-safe systems should be considered outside the T3.
3. In installation, wiring, operation and maintenance of the T3, it is assumed that the users have general knowledge of industrial electric control systems. If this product is handled or operated improperly, electrical shock, fire or damage to this product could result.
4. This manual has been written for users who are familiar with Programmable Controllers and industrial control equipment. Contact Toshiba if you have any questions about this manual.
5. Sample programs and circuits described in this manual are provided for explaining the operations and applications of the T3. You should test completely if you use them as a part of your application system.

Hazard Classifications

In the following pages, the following two hazard classifications are used to explain the safety precautions.

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

 **CAUTION** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Even a precaution is classified as CAUTION, it may cause serious results depending on the situation. Observe all the safety precautions described on this manual.

Safety Precautions

Safety Precautions

Installation:

CAUTION

1. Excess temperature, humidity, vibration, shocks, or dusty and corrosive gas environment can cause electrical shock, fire or malfunction. Install and use the T3 in the environment described in this manual.
2. Improper installation directions or insufficient installation can cause fire or the units to drop. Install the T3 in accordance with the instructions described in this manual.
3. Turn off power before installing or removing any units, modules or terminal blocks. Failure to do so can cause electrical shock or damage to the T3 and related equipment.
4. Entering wire scraps or other foreign debris into to the T3 and related equipment can cause fire or malfunction. Pay attention to prevent entering them into the T3 and related equipment during installation and wiring.

Wiring:

CAUTION

1. Turn off power before wiring to minimize the risk of electrical shock.
2. Exposed conductive parts of wire can cause electrical shock. Use crimp-style terminals with insulating sheath or insulating tape to cover the conductive parts. Also close the terminal covers securely on the terminal blocks when wiring has been completed.
3. Operation without grounding may cause electrical shock or malfunction. Connect the ground terminal on the T3 to the system ground.
4. Applying excess power voltage to the T3 can cause explosion or fire. Apply power of the specified ratings described in this manual.
5. Improper wiring can cause fire, electrical shock or malfunction. Observe local regulations on wiring and grounding.

Safety Precautions

Operation:

WARNING

1. Configure emergency stop and safety interlocking circuits outside the T3. Otherwise, malfunction of the T3 can cause injury or serious accidents.

CAUTION

2. Operate the T3 and the related modules with closing the terminal covers. Keep hands away from terminals while power on, to avoid the risk of electrical shock.
3. When you attempt to perform force outputs, RUN/HALT controls, etc. during operation, carefully check for safety.
4. Turn on power to the T3 before turning on power to the loads. Failure to do so may cause unexpected behavior of the loads.
5. Set operation mode switches of the T3 and I/O modules. Improper switch settings may cause malfunction of the T3 and related equipment.
6. Do not use any modules of the T3 for the purpose other than specified. This can cause electrical shock or injury.
7. Configure the external circuit so that the external power required for output modules and power to the loads are switched on/off simultaneously.
Also, turn off power to the loads before turning off power to the T3.
8. Install fuses appropriate to the load current in the external circuits for the relay output modules. Failure to do so can cause fire in case of load over-current.
9. Check for proper connections on wires, connectors and modules. Insufficient contact can cause malfunction or damage to the T3 and related equipment.
10. Turn off power immediately if the T3 is emitting smoke or odor. Operation under such condition can cause fire or electrical shock.
Also unauthorized repairing will cause fire or serious accidents. Do not attempt to repair. Contact Toshiba for repairing.

Safety Precautions

Maintenance:

CAUTION

1. Do not charge, disassemble, dispose in a fire nor short-circuit the batteries. It can cause explosion or fire. Observe local regulations for disposal of them.
2. Turn off power before removing or replacing units, terminal blocks or wires. Failure to do so can cause electrical shock or damage to the T3 and related equipment.
3. Replace a blown fuse with a specified one. Failure to do so can cause fire or damage to the T3.
4. Perform daily checks, periodical checks and cleaning to maintain the system in normal condition and to prevent unnecessary troubles.
5. Check by referring "Troubleshooting" section of this manual, when operating improperly. Contact Toshiba for repairing if the T3 or related equipment is failed. Toshiba will not guarantee proper operation nor safety for unauthorized repairing.
6. The contact reliability of the relays used in the relay output module will reduce if the switching exceeds the specified life. Replace the module if exceeded.
7. Replace the battery every 2 years to maintain the T3's program and data normally.
8. Do not modify the T3 and related equipment in hardware nor software. This can cause fire, electrical shock or injury.
9. Pay special attention for safety if you attempt to measure circuit voltage at the T3's terminal.
10. Turn off power before replacing modules. Failure to do so can cause electrical shock or damage to the T3 and related equipment.
If you attempt to replace an I/O module while power on (by using on-line I/O replacement function), carefully check for safety.

Safety Precautions

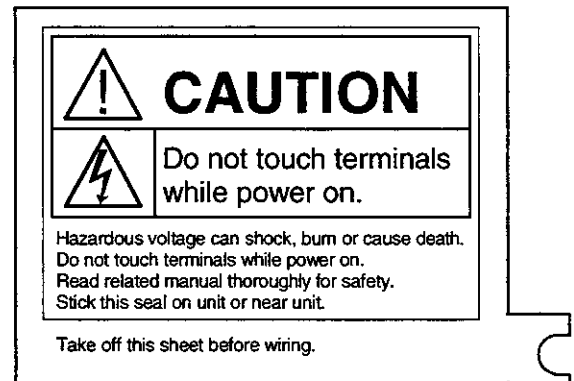
Safety Label

The safety label as shown on the right is attached to the power terminal of the T3.

Remove the mount paper before wiring.

Peel off the label from the mount paper and stick it near the power terminals where it can be readily seen.

Contact Toshiba if the label is damaged.



FOR SAFETY To use the T3 safely, read this section carefully before use.

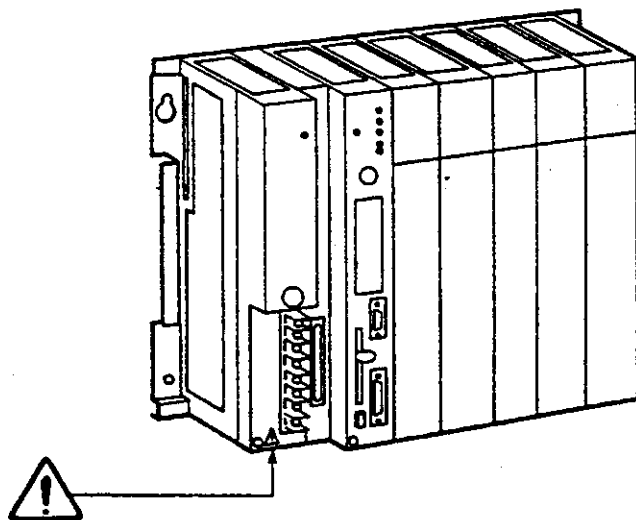
1. Only use the T3 after first carefully reading this Manual and related guides.
2. Do not use in any of the following environments, as they will cause malfunctions:-
 - (1) Where the ambient temperature of the T3 (the temperature inside the panel) is 0°C or below or 55°C or above
 - (2) Where the ambient humidity of the T3 (the humidity inside the panel) is 20% or less or 90% or more
 - (3) Where condensation may form due to severe changes of temperature
 - (4) Where there are vibration or violent shocks
 - (5) Where there are corrosive gases or flammable gases
 - (6) Where there is dust, salinity or iron content
 - (7) Where there is direct sunlight
3. Pay attention to the following at the T3 installation site:-
 - (1) For safety in maintenance and operation, keep a distance of at least 200mm from high-voltage equipment (high-voltage lines) and power equipment (power lines), or separate by a shield such as a steel plate.
 - (2) Keep the expansion cables separate from other power sources when wiring. In particular, separate by at least 200mm from high-power lines.
 - (3) Provide an air space of at least 70mm around the units for ventilation.
 - (4) Install the units vertically.
4. The T3 power supply module is a dedicated module for the T3. Do not use it on its own for other purposes.
5. For the wiring to the module, use crimp-style terminals fitted with reverse power sheaths. When it is not possible to use crimp-style terminals fitted with sheaths, cover with insulating tape and ensure that the conducting parts are not exposed.

Before reading this manual

⚠ This is the warning mark for dangerous locations. It is attached to the equipment in positions where there is a risk of electric shock and in positions where there is a risk of damage to the equipment through wrong wiring.

Take the following precautions where there is a ⚠ mark:-

- (1) Hazardous voltage can shock or cause severe injury if you touch the power input terminals while power on. Do not touch the power input terminals.
- (2) For safety, always switch off power when wiring and during maintenance and inspections.
- (3) Wire the power input terminals correctly and do not apply voltages in excess of the specified voltage limits, since this will cause the equipment damage.



The purpose of this manual

This manual explains the hardware of the programmable controller PROSEC T3. The explanation covers the configuration, specification, installation, wiring, maintenance and service.

Scope of this manual

This manual covers the following basic parts of the T3 system.

T3 main body : CPU module

Power supply module

Rack

Expansion interface module

Basic DI/O : 32 points DC input module (12-24 Vdc)

64 points DC input module (24 Vdc)

32 points AC input module (100-120 Vac, 200-240 Vac)

16 points DC output module (12-24 Vdc)

32 points DC output module (12-24 Vdc)

64 points DC output module (5-24 Vdc)

16 points AC output module (100-240 Vac)

32 points AC output module (100-240 Vac)

32 points relay output module (240 Vac/24 Vdc)

16 points isolated relay output module (240 Vac/24 Vdc)

Before reading this manual

Related manuals

The following related manuals are available for the T3.

T3 User's Manual - Hardware

This manual covers the T3's main body and basic I/O - their specifications, handling, maintenance and services.

T3 User's Manual - Functions

This document explains the functions of the T3 and how to use them. The necessary information to create user program is covered in this volume.

T-series Instruction Set

This manual provides the detailed specifications of instructions for Toshiba's T-series Programmable Controllers.

T-PDS Basic Operation Manual

This manual explains how to install the T-series program development system (T-PDS) into your personal computer and provides basic programming operations.

T-PDS Command Reference Manual

This manual explains each command of the T-series program development system (T-PDS) in detail.

T-series Computer Link Function

This manual explains the specification and handling method of the T-series Programmable Controller's Computer Link function.

Note and caution symbols

Users of this manual should pay special attention to information preceded by the following symbols.



NOTE Calls the reader's attention to information considered important for full understandings of programming procedures and/or operation of the equipment.



CAUTION Calls the reader's attention to conditions or practices that could damage the equipment or render it temporarily inoperative.

Terminology

AWG	American Wire Gage
ASCII	American Standard Code for Information Interchange
CPU	Central Processing Unit
EEPROM	Electrically Erasable Programmable Read Only Memory
IF	Interface
I/O	Input/Output
LED	Light-Emitting Diode
ms	millisecond
NEMA	National Electrical Manufacturers' Association
PLC	Programmable Controller
PS	Power supply
RAM	Random Access Memory
ROM	Read Only Memory
μ s	microsecond
Vac	ac voltage
Vdc	dc voltage

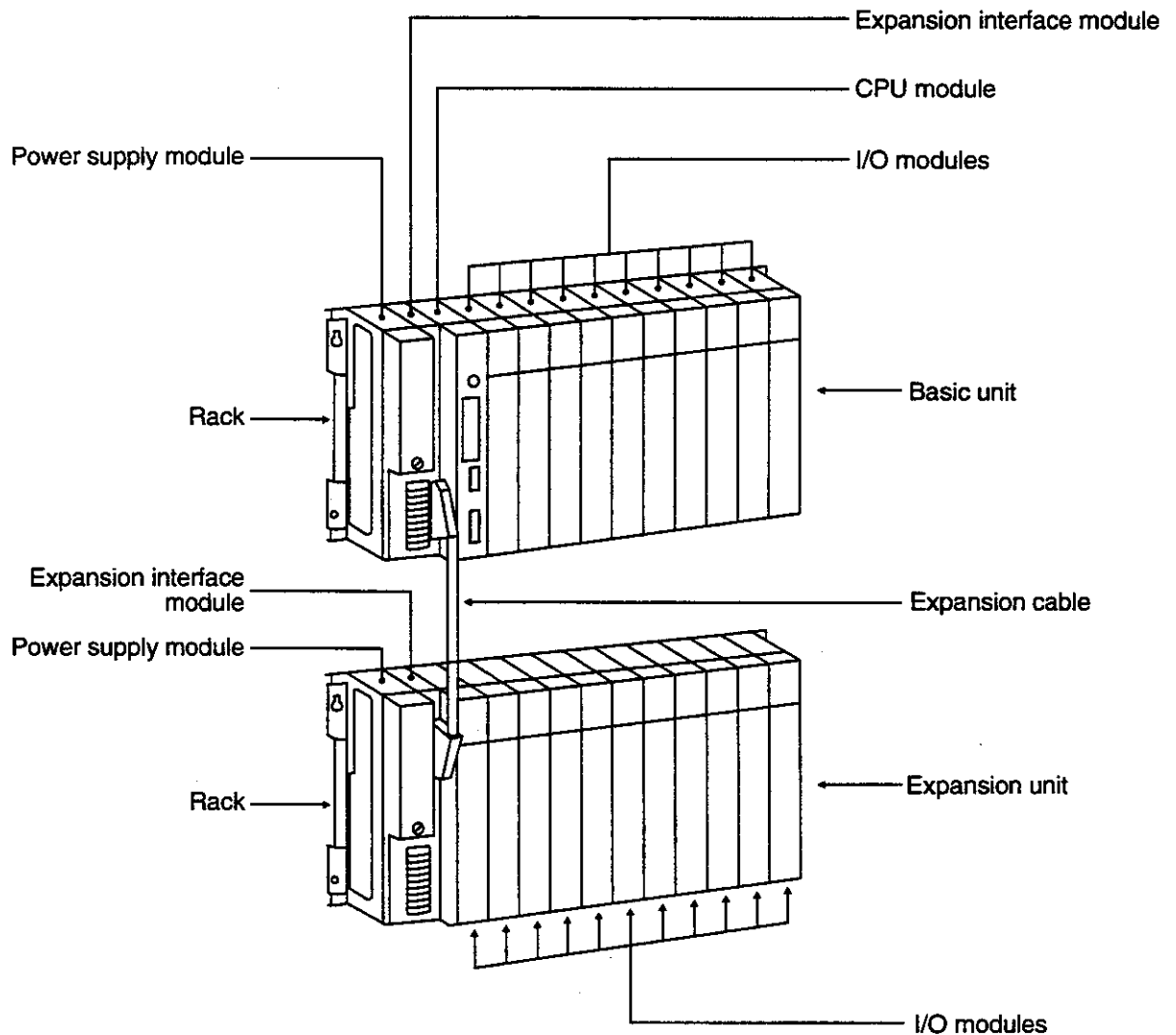
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1. System Configuration

1.1 T3 hardware configuration

The T3 consists of the rack (s), the power supply module (s), the CPU module, the expansion interface module (s), the expansion cables (s) and I/O modules (s).



1. System Configuration

The modules which configure the T3 system are listed below.
(except I/O modules)

Power supply module

	Type	Description
1	PS361	Power supply voltage : 100-120 Vac/200-240 Vac, common for basic and expansion units
2	PS332	Power supply voltage : 24 Vdc, common for basic and expansion units

CPU module

	Type	Description
1	PU315	RAM
2	PU325	RAM+EEPROM

Rack

	Type	Description	
1	BU31A	For basic unit	10 slots for I/O modules
2	BU315		5 slots for I/O modules
3	BU35B	For expansion unit	11 slots for I/O modules
4	BU356		6 slots for I/O modules

Expansion interface module

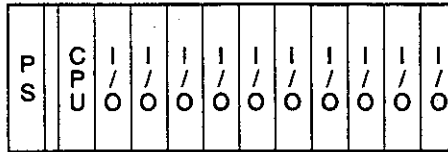
	Type	Description	
1	IF311	For basic unit	Standard type, 2m maximum between the units, total 6 m maximum
2	IF351	For expansion unit	
3	IF312	For basic unit	Long-distance type, total 40 m maximum
4	IF352	For middle expansion unit	
5	IF353	For end expansion unit	

Expansion cable

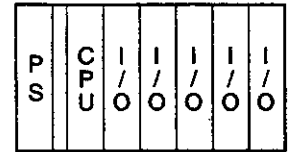
	Type	Description
1	CS3R5	0.5m Standard type, both-end connector (50-pin)
2	CS301	
3	CS302	
4	CL3R5	0.5m Long-distance type, both-end connector (68-pin)
5	CL301	
6	CL305	
7	CL310	
8	CL320	
9	CL340	

1.2 Unit configuration

(1) Minimum configuration of the T3



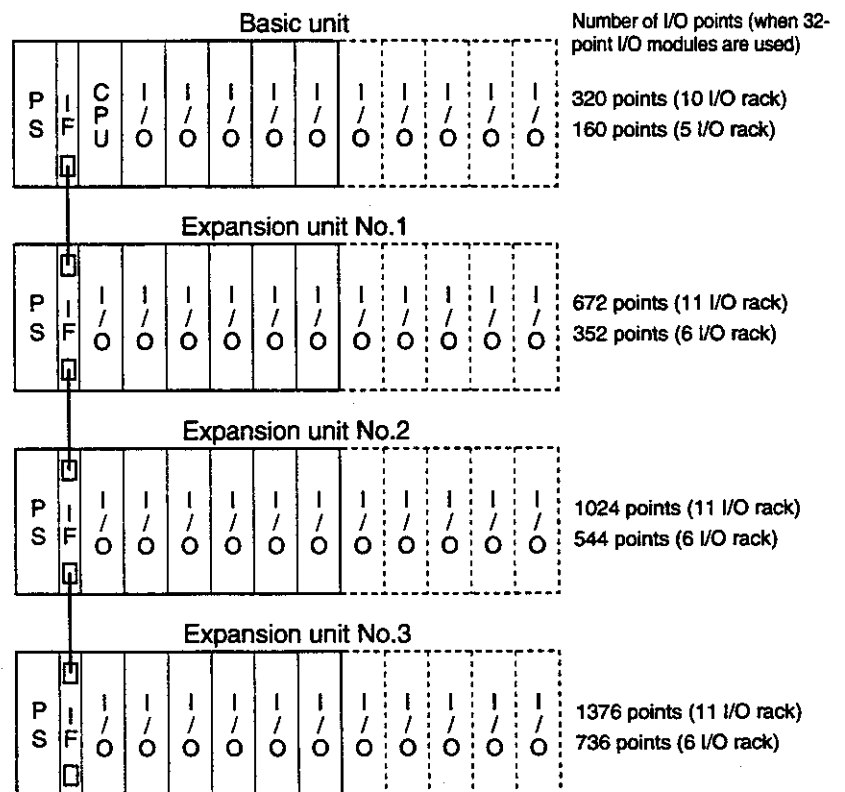
Basic unit (10 I/O rack)
320 points (32-point I/O)



Basic unit (5 I/O rack)
160 points (32-point I/O)

- The minimum configuration of the T3 is one basic unit. In this case, no expansion interface module is needed.

(2) Maximum configuration of the T3



- Up to three expansion units can be connected to the basic unit.
- There is no limitation in combining different size of racks.
- The expansion interface module is needed for each unit. (indicated as "IF" in the figure)
The expansion interface module is dedicated for basic or expansion units

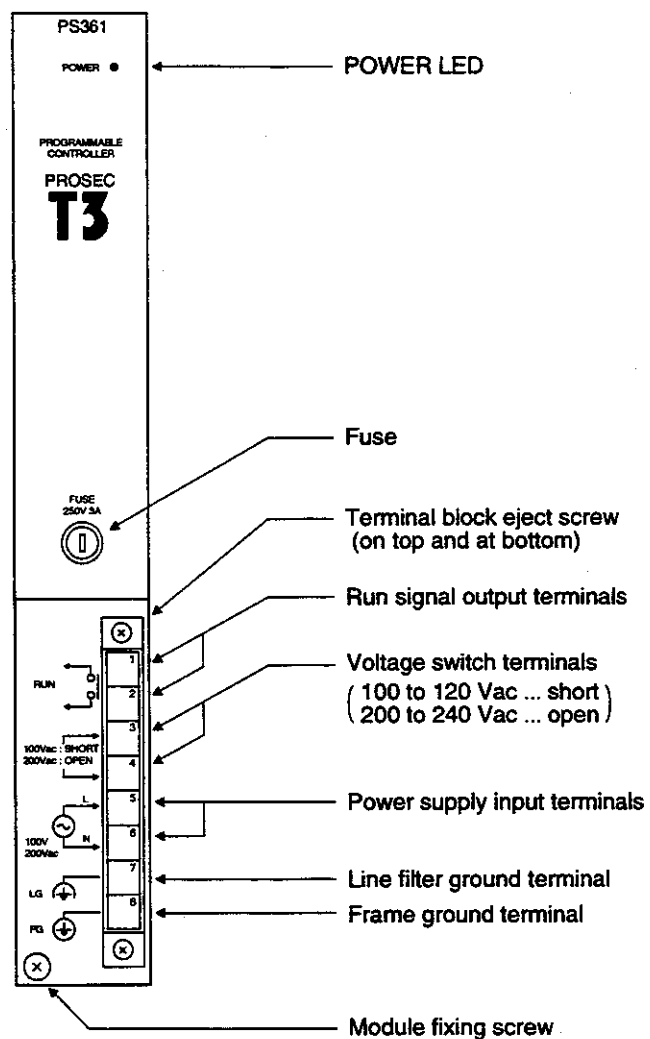
1. System Configuration

- If the standard type expansion is used, all expansion interface modules must be the standard type. In this case, the maximum length of the expansion cable is 2m between units, 6m total.
- If the long-distance type expansion is used, all expansion interface modules must be the long-distance type. In this case, the maximum length of the expansion cable is total 40m.
- If the standard type expansion is used, the necessity of the power supply modules on the expansion units is determined depending on the internal current consumption. (See 1.9 Examining the power supply capacity)
The power supply mode plug of the expansion interface module must be set according to the power supply module mounting status.
- If the long-distance type expansion is used, all expansion units should have the power supply modules.
- The dedicated expansion cables are available for the standard expansion and for the long-distance expansion, respectively.

1.3 Power supply module

The following table shows that two types of power supply modules are available, depending on the power supply voltage. These modules can be used for both the basic unit and the expansion unit. The power supply module is mounted in the extreme left of the rack. However, the expansion rack that is connected to the standard expansion IF may not need the power supply module. For details, see 1.9 Examining the power supply capacity.

Type	Rated voltage	Frequency
PS361	100-120 Vac/200-240 Vac (selectable)	50/60 Hz
PS332	24 Vdc	—



1. System Configuration

POWER LED (green) :

This LED is lit when the internal 5 Vdc power supply is normal.

Fuse :

For PS361...250 Vac-3A (with one spare fuse)

For PS332...250 Vac-6A (with one spare fuse)

Run signal output terminals

Built-in NO contact which closes when T3 is in RUN mode.

Contact output...240 Vac/24 Vdc-2A (max.)

(can also be used on the expansion unit)

Voltage switch terminals :

These terminals are shorted or opened, depending on the power supply voltage (with a short-circuit bar).

100 to 120 Vac...short

200 to 240 Vac...open

Power supply input terminals :

These terminals are used to connect the power supply line.

Line filter ground terminal (LG) :

This terminal is a neutral point for the primary line filter of the power supply. (grounding terminal)

Frame ground terminal (FG) :

This terminal is connected to the frame of the T3. (grounding terminal)

The terminal is connected, via a capacitor, to the signal ground (SG) of the internal circuit.



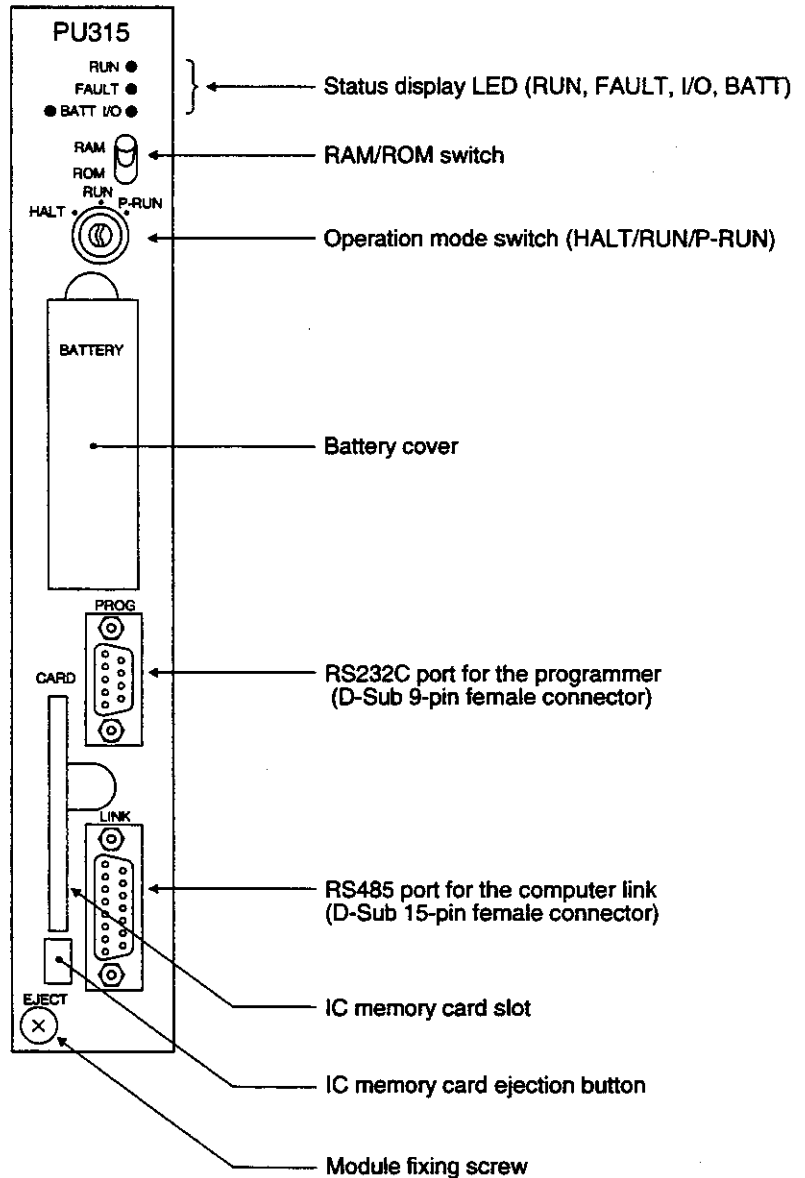
- CAUTION**
- (1) Correctly set the voltage switch terminals, otherwise the module will be damaged.
 - (2) For details, see 2.1 General Specifications, for the external power supply conditions.
 - (3) The screw size for the terminal is M3.5. For details of the wiring, see 4.5, Grounding, and 4.6, Wiring of the Power Supply.

1.4 CPU module

As shown in the table below, the CPU module is available in two types.

Type	Specification
PU315	RAM (battery backup), 32K steps for user program, ladder diagram, SFC
PU325	EEPROM+RAM (battery backup), 32K steps for user program, ladder diagram, SFC

PU315 / PU325



1. System Configuration

Status display LED :

RUN (green)	Lit	User program is executing (in the RUN mode)
	Blink	Execution is stopped (in the HOLD mode)
	Not lit	Execution is stopped (in the HALT mode or in the ERROR mode)
FAULT (red)	Lit	CPU/program error
	Blink	Hardware initialization error
	Not lit	Normal
I/O (red)	Lit	I/O error
	Blink	Hardware initialization error
	Not lit	Normal
BATT (green)	Lit	Normal battery voltage
	Not lit	Battery voltage becomes low

RAM/ROM switch :

Position at power ON	Type of CPU	Operation of the CPU (program transfer at power ON)
RAM	PU315 PU325	Program transfer is not executed.
ROM	PU315	When an IC memory card which stores user program is inserted, contents of the IC memory card is transferred to RAM. (When the operation mode switch is in P-RUN, the program transfer is not executed.)
		When an IC memory card is not inserted or when the IC memory card does not contain a user program, program transfer is not executed.
	PU325	When an IC memory card that stores user program has been inserted, contents of the IC memory card is transferred to RAM. (When the operation mode switch is in P-RUN, the program transfer is not executed.)
		When an IC memory card is not inserted, or when the IC memory card inserted does not contain a user program, the contents of the EEPROM will be transferred to RAM. (When the operation mode switch is in P-RUN, the program transfer is not executed)

By using the RAM/ROM switch and the operation mode switch together, the user can select a initial operation mode when power is applied. For details, see the next page.

Operation mode switch :

Position of the switch	Function
HALT	User program execution is halted (HALT mode). Changing the operation mode by the programmer is invalid. Normally programming is done in this state.
RUN	When the operation mode switch is changed to RUN, the user program execution is started (the RUN mode). Changing the operation mode from the programmer is possible.
P-RUN	When the operation mode switch is changed to P-RUN, user program execution is started (the RUN mode). Changing the operation mode from the programmer is possible. The user program and leading 4K words of data registers (D) are write-protected.

The table below shows the initial operation modes after power ON depending on the Operation mode switch and RAM/ROM switch status.

RAM/ROM switch	Mode switch	Mode after power on	Remarks
RAM	HALT	HALT	The CPU module is started in the HALT mode and then waits for the RUN command from the programmer, or for a change-over of the operation mode switch (->HALT->RUN).
	RUN	HALT	
	P-RUN	HALT	
ROM	HALT	HALT	The user program is transferred in accordance with the conditions mentioned in the table on the preceding page.
	RUN	RUN	
	P-RUN	RUN	The program transfer is not executed. The CPU module is started based on the contents of RAM.



NOTE

- (1) When power is turned on while the RAM/ROM switch is in RAM, user program execution will not be started. Regardless of the type of CPU module, therefore, the RAM/ROM switch should be set to ROM for normal operation.
- (2) When the Operation mode switch is changed to RUN while the RAM/ROM switch is in ROM, the program transfer is executed, according to the conditions mentioned in the table on the preceding page, before the CPU module starts operation.
- (3) For details on operation modes, see "T3 User's Manual-Functions" in a separate volume.

1. System Configuration

Battery cover :

A battery has been installed inside this cover at the factory shipment. The battery keeps the RAM contents (user program and user data) and supports the clock-calendar operation during power OFF.(See 5.4 Replacing battery)

RS232C port for the programmer :

The T-series programmer (T-PDS or HP911) is connected to the T3 through this port. Dedicated connection cables are available.

RS485 port for the computer link :

The CPU module has the computer link function as standard. By using this function, T3 can communicate with a host computer or an intelligent equipment through RS485 interface. For details of the computer link function, see separate "T-series Computer Link Function Operation Manual".

IC memory card slot :

Optional IC memory card (type : ME914) is inserted into this slot. By installing the IC memory card, user program back-up/switchover or user data expansion become available. Refer to 5.6 IC memory card handling.

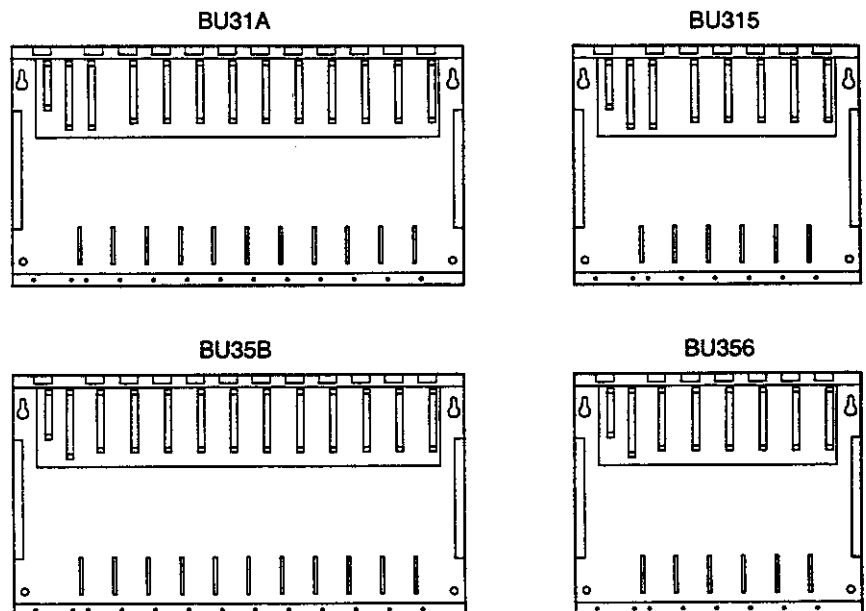
1. System Configuration

1.5 Rack

As described in the table below, in total four racks are available : two racks are for the basic unit, and two racks, for the expansion unit.

Type	Use	Number of modules mountable
BU31A	For basic unit	PS×1, IF×1, CPU×1, I/O×10
BU315		PS×1, IF×1, CPU×1, I/O×5
BU35B	For expansion unit	PS×1, IF×1, I/O×11
BU356		PS×1, IF×1, I/O×6

*) "PS" and "IF" in the above table indicate the power supply module and the expansion interface module respectively.



- The connector on the extreme-left slot of the rack is dedicated to the power supply module, and the connector next to the right slot is dedicated to the expansion interface module. The third connector from the extreme left slot of the basic unit rack (BU31A, BU315) is dedicated to the CPU module.



CAUTION Place a cap on each of the connectors where no module is mounted so that no foreign material will enter.

1. System Configuration

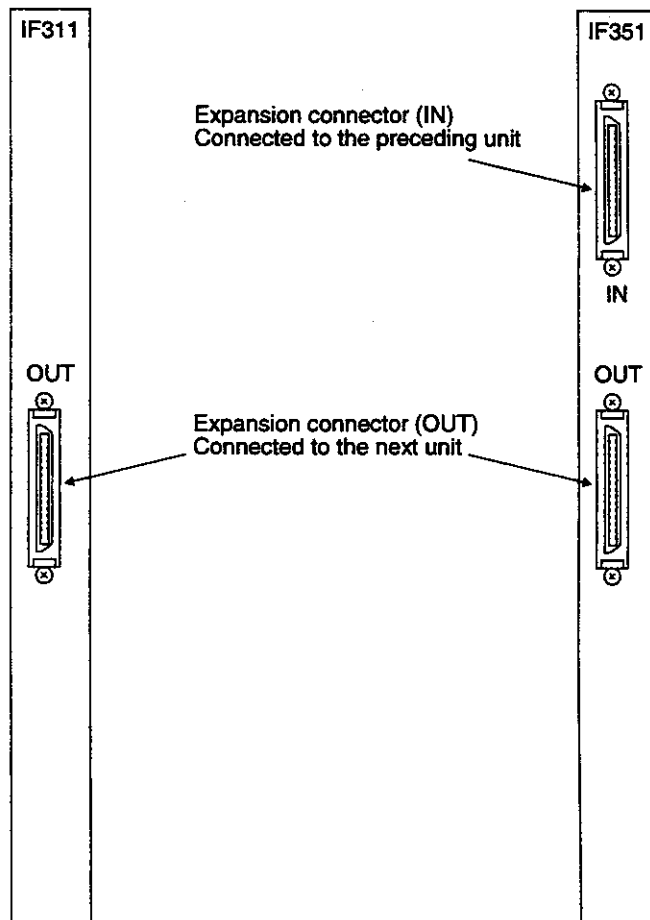
1.6 Expansion interface module

If the expansion units are used, the expansion interface modules must be mounted in each of the basic unit and the expansion units. There are basically two types of expansion interface modules-the standard type and the long-distance type. What type to use will depend on the cable distance. The dedicated expansion interface module must be mounted on each of the basic unit and the expansion units.

Type	Use	Remark
IF311	For basic unit	Standard type 2m maximum between two units, 6m maximum in total cable length
IF351	For expansion unit	
IF312	For basic unit	Long-distance type 40m maximum in total cable length
IF352	For middle expansion unit	
IF353	For end expansion unit	

IF311
(standard type, for basic unit)

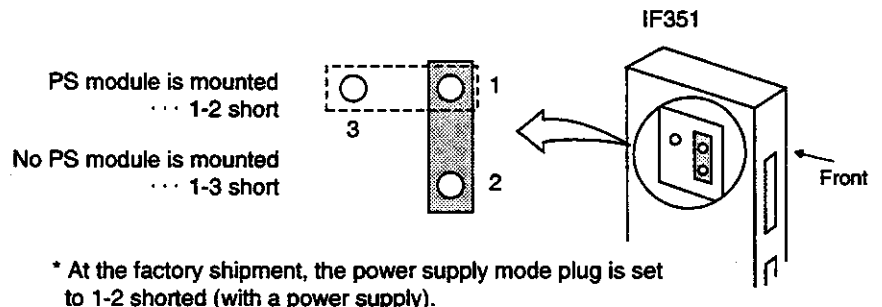
IF351
(standard type, for expansion unit)



1. System Configuration

- Since there is no compatibility between the standard type and the long-distance type, these two types cannot be mixed in one T3 configuration.
- The standard type expansion cable and the long-distance type expansion cable are not compatible with each other. (See Section 1.7 Expansion Cable.)
- If the standard type is used, whether a power supply module is necessary for the expansion unit will depend on the internal 5 Vdc current consumption. (See Section 1.9 Examining the power supply capacity.)

For the IF351, change the power supply mode plug as shown in the figure below (depending on whether a power supply module has been mounted on its own unit).



* At the factory shipment, the power supply mode plug is set to 1-2 shorted (with a power supply).

- For the long-distance type, a power supply module is needed for each of the expansion units.
- In the long-distance type, the IF312 is for basic unit, the IF352 is for middle expansion units and the IF353 is for the end expansion unit.

1.7 Expansion cable

The following types of expansion cables are available.

	Type	Cable length	Remarks
1	CS3R5	0.5m	Standard type With both-end connectors (50-pin)
2	CS301	1m	
3	CS302	2m	
4	CL3R5	0.5m	Long-distance type With both-end connectors (68-pin)
5	CL301	1m	
6	CL305	5m	
7	CL310	10m	
8	CL320	20m	
9	CL340	40m	

1. System Configuration

1.8 List of I/O Modules

This manual explains the basic I/O modules in the list below and how to use them.

Type	Specification	
DI334	DC input	32 points (8 pts common), 12 to 24 Vdc, 10 mA/point
DI334H		32 points (8 pts common), 12 to 24 Vdc, 10 mA/point, high-speed response
DI335		64 points (8 pts common), 24 Vdc, 5 mA/point
DI335H		64 points (8 pts common), 24 Vdc, 5 mA/point, high-speed response
IN354	AC input	32 points (8 pts common), 100 to 120 Vac, 10 mA/point
IN364		32 points (8 pts common), 200 to 240 Vac, 10 mA/point
DO333	DC output	16 points (8 pts common), 12 to 24 Vdc, 2 A/point, 5 A/common
DO334		32 points (16 pts common), 12 to 24 Vac, 0.5 A/point, 5 A/common
DO335		64 points (8 pts common), 5 to 24 Vdc, 100 mA/point
AC363	AC output	16 points (8 pts common), 100 to 240 Vac, 2 A/point, 5 A/common
AC364		32 points (16 pts common), 100 to 240 Vac, 0.5 A/point, 3.2 A/common, 5 A/module
RO364	Relay output	32 points (8 pts common), 240 Vac/24 Vdc, 2 A/point, 5 A/common
RO363S		16 points (isolated contact), 240 Vac/24 Vdc, 2 A/point

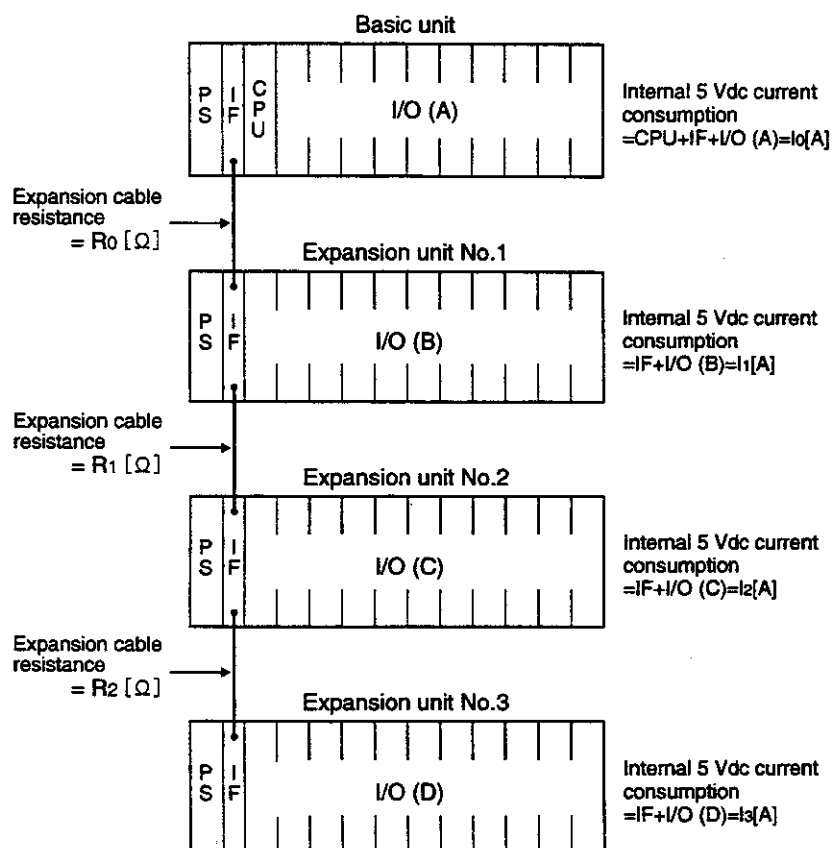
- For details on the specification of I/O modules, see 2.3, I/O module specifications.
- Carefully read the Cautions described in Section 3 for applying I/O modules.
- The I/O module can be mounted in any I/O slot functionally. However, to improve noise-immunity for the entire system, it is recommended to separate the low voltage I/Os and the power I/Os. (See 4.7, I/O Wiring.)

1.9 Examining the power supply capacity

The maximum output current (5 Vdc) of the power supply module (PS361/PS332) is 7 A. (5.1V at factory setting)

In the standard type expansion configuration, if the power supply module of the previous unit can supply 5 Vdc to the following units, no power supply module for the following expansion units is necessary.

In this case, however, there may be a voltage drop of the 5 Vdc power caused by the resistance of the expansion cable. The minimum limit voltage is 4.75 Vdc. It should also be considered.



Concerning the above figures, the following conditions (1) and (2) must be satisfied so that the expansion units NO.1 through 3 can be mounted in the slots using no power supply of their own.

(1) $I_0 + I_1 + I_2 + I_3 < 7\text{A}$

(2) $5.1 - R_0 \times (I_1 + I_2 + I_3) - R_1 \times (I_2 + I_3) - R_2 \times I_3 > 4.75\text{V}$

If either of the above conditions is not satisfied, a power supply module is needed for the expansion unit.

If a power supply module is mounted on the expansion unit, the power supply module will supply 5 Vdc to the own unit and to the following expansion units, disconnecting 5 Vdc line from the previous unit (0V line is common).

1. System Configuration

For example, if the user is going to mount a power supply module on the expansion unit No.2, check that the following conditions are satisfied.

- | | |
|----------------------------------|---|
| (1) $I_0+I_1 < 7A$ | } Conditions for the power supply capacity of the basic unit |
| (2) $5.1-R_0 \times I_1 > 4.75V$ | |
| (3) $I_2+I_3 < 7A$ | } Conditions for the power supply capacity of expansion unit No.2 |
| (4) $5.1-R_2 \times I_3 > 4.75V$ | |

Additional power supply modules may be mounted on the units even though the power supply capacity has enough margin.



- NOTE**
- (1) Correctly set the power supply mode plug of the expansion interface module (IF351) according to a power supply module to be mounted on the unit. If the setting is wrong, the T3 will not work normally. (For details, see 1.6 Expansion interface module.)
 - (2) For the long-distance expansion interface module, each of the units must be equipped with a power supply module.

The table below shows the resistance values (typical value) of expansion cables.

Cable length	Part No.	Resistance value	Remarks
0.5m	CS3R5	38mΩ	Standard type With both-end connectors (50-pin)
1m	CS301	66mΩ	
2m	CS302	112mΩ	

1. System Configuration

The table below lists the internal 5 Vdc current consumption (max.) of the module for calculating allowable power capacity.

Type	Name		Part No.	Internal 5-volt current consumption
Expansion interface	Standard expansion interface (for basic unit)		IF311	20 mA
	Standard expansion interface (for expansion unit)		IF351	20 mA
	Long-distance expansion interface (for basic unit)		IF312	800 mA
	Long-distance expansion interface (for middle expansion unit)		IF352	700 mA
	Long-distance expansion interface (for end expansion unit)		IF353	700 mA
CPU	CPU (RAM)		PU315	2.5 A
	CPU (EEPROM+RAM)		PU325	2.5 A
DC input	32-point DC input		DI334	100 mA
	32-point DC input (high-speed response)		DI334H	100 mA
	64-point DC input		DI335	170 mA
	64-point DC input (high-speed response)		DI335H	170 mA
AC input	32-point AC input (100 to 120 Vac)		IN354	120 mA
	32-point AC input (200 to 240 Vac)		IN364	120 mA
DC output	16-point DC output (12 to 24 Vdc)		DO333	320 mA
	32-point DC output (12 to 24 Vdc)		DO334	210 mA
	64-point DC output (5 to 24 Vdc)		DO335	400 mA
AC output	16-point AC output (100 to 240 Vac)		AC363	530 mA
	32-point AC output (100 to 240 Vac)		AC364	800 mA
Relay output	32-point relay output		RO364	170 mA
	16-point relay output (isolated)		RO363S	100 mA
Special I/O	Analog input (8 channels)		AD368	450 mA
	Analog output (4 channels)	Voltage	DA364	180 mA
		Current	DA374	180 mA
	Pulse input (2 channels)		PI312	800 mA
	DC input (8 pts) with status change detection		CD332	300 mA
	ASCII interface		AS311	1 A
Data link	TOSLINE-S20	Coaxial	SN321	800 mA
		Optic	SN322	800 mA
		Coaxial/optic	SN323	800 mA
	TOSLINE-F10 (master)		MS311	1 A

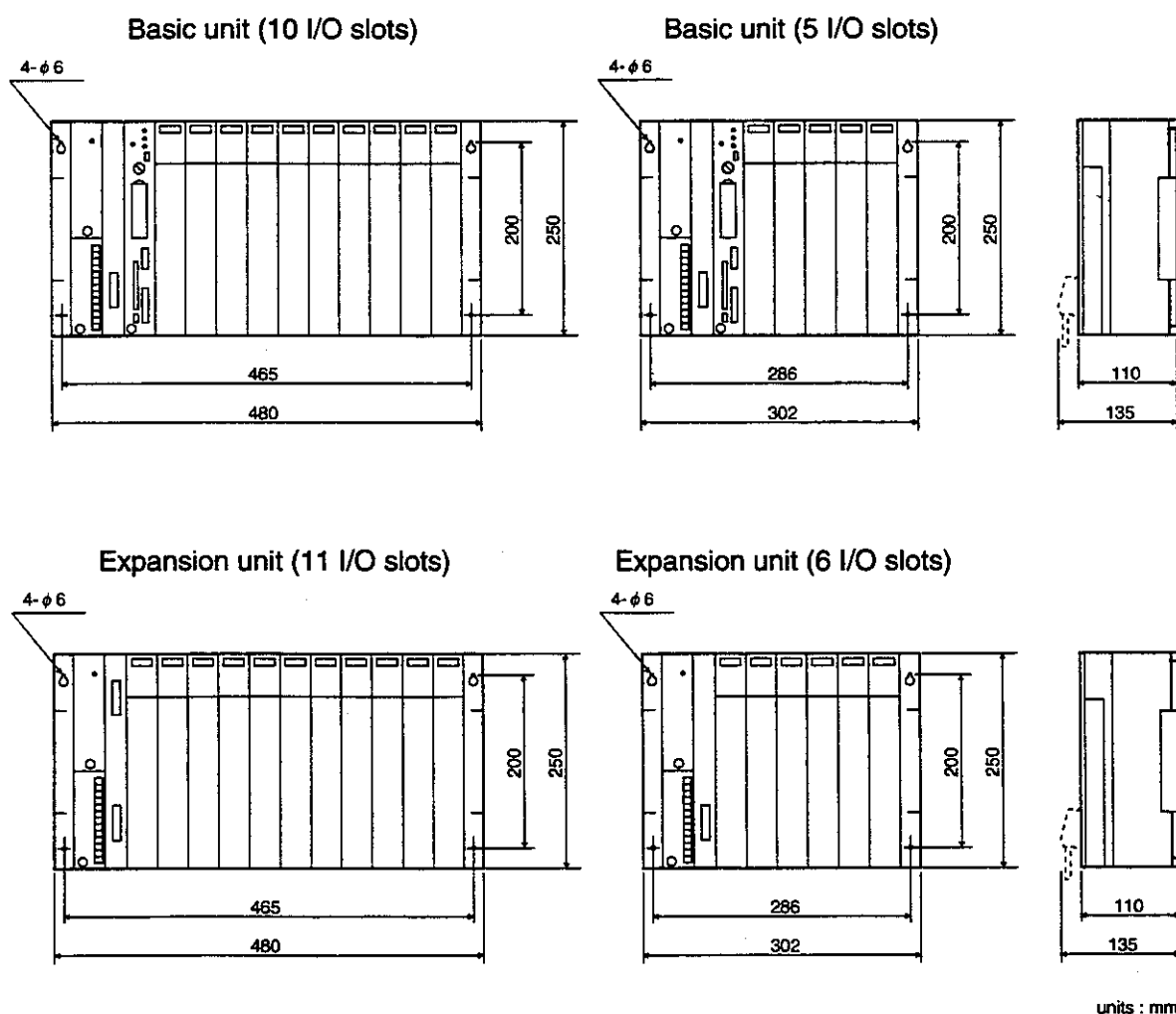
Note) The current consumption of the T3 CPU modules (2.5 A max.) is the value when the handy programmer (HP911) is connected. When the HP911 is not connected, it is 1.5 A max.

2. Specification

2.1 General Specifications

Item		Specification	Remarks
Power supply	Rated voltage	(1) 100 to 120 Vac/200 to 240 Vac	Switchable
		(2) 24 Vdc	
	Voltage tolerance	(1) 85 to 132 Vac/170 to 264 Vac	
		(2) 20.4 to 28.8 Vdc	
	Rated frequency	(1) 50/60 Hz	
	Frequency tolerance	(1) 47 to 63 Hz	
	Retentive power interruption	10 ms or less	
	Power consumption	(1) 80 VA or less	Max. load conditions of one PS module
		(2) 50 W or less	
	Inrush current	(1) 10 A/100 Vac, 20 A/200 Vac	
(2) 6 A			
Insulation resistance		10 MΩ or more (500 Vdc)	Between power terminals and FG
Withstand voltage		1500 Vac for 1 minute	Between power terminals and FG
Operating temperature		0 to 55℃	
Storage temperature		-20 to 75℃	
Ambient humidity		20 to 90% RH	No condensation
Atmosphere		No corrosive gases	
Dust		10 mg/m³ or less	
Vibration immunity		16.7 Hz, 3 mmp-p, 30 seconds	No power
Shock immunity		98 m/s², 3 times, in X, Y, Z directions	No power
Noise immunity		1500 Vp-p, 1 μ s (noise simulator method) NEMA ICS3-304	Power supply noise
Grounding		100Ω or less	
Structure		Control panel built-in type	
Cooling		Natural cooling	
Weight		Approx. 7.6 kg	Basic unit with 10 I/O modules
		Approx. 4.7 kg	Basic unit with five I/O modules

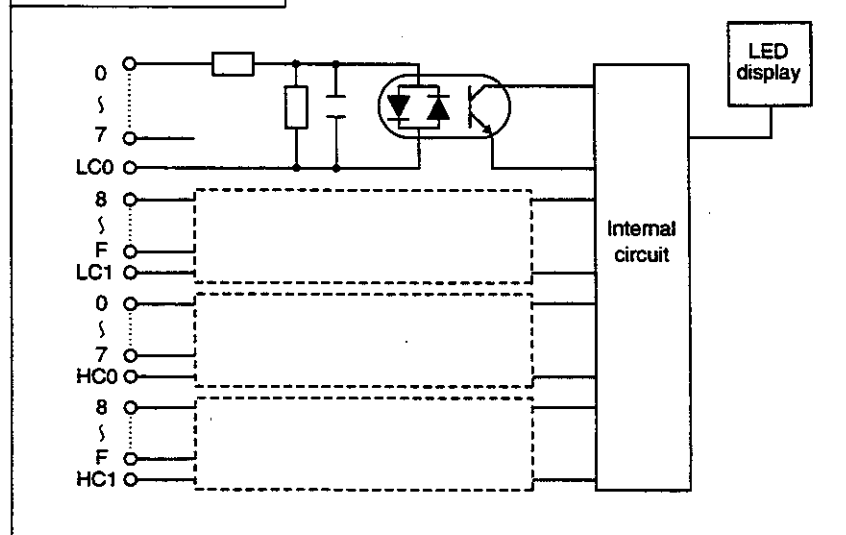
2.2 External Dimensions



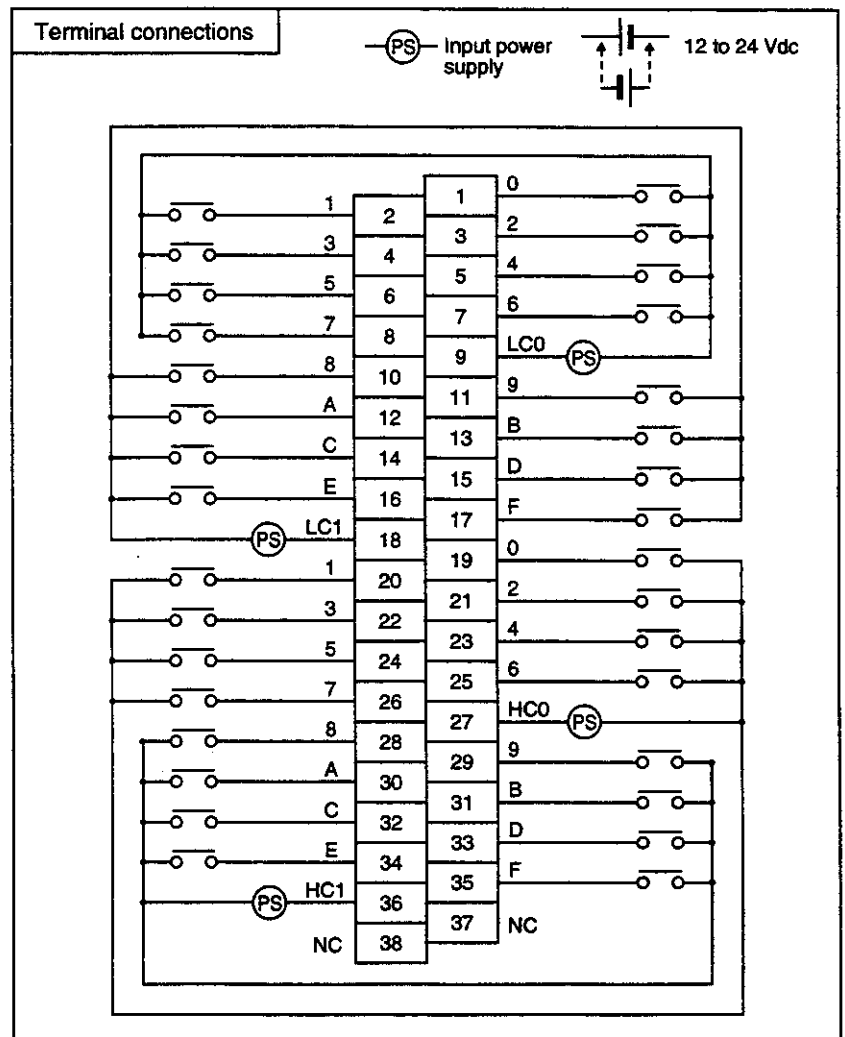
2. Specification

2.3 I/O module specifications 32-point DC input

Type		DI334	DI334H
Category		DC input	
Input type		Current sinking/sourcing	
Number of input points		32 points, 2-word input (X 2 W)	
Insulating method		Photo-coupler	
Rated input voltage		12 to 24 Vdc	
Range of input voltage		10 to 26.4 Vdc	
Rated input current		10 mA (at 24 Vdc)	
Input impedance		2.4 K Ω (at 24 Vdc)	
Operation voltage	Min. ON voltage	9.6V	
	Max. OFF voltage	3.5V	
Delay	OFF \rightarrow ON	10 ms or less	1 ms or less
	ON \rightarrow OFF	15 ms or less	1.5 ms or less
Input signal display		LED display for all points, lit at ON, internal logic side	
External connection		38-pin removable terminal block, M3.5	
No. of commons		4 (insulated between commons)	
No. of input points per common		8 points/common	
Polarity of common		No Polarity	
Derating condition		See NOTE on the next page	
Internal current consumption		5 Vdc, 100 mA or less	
Insulation resistance		10 M Ω or more (500 Vdc)	
Withstand voltage		1500 Vac, 1 minute (between commons, between internal and external circuits)	
Weight		420g	
Internal circuit			

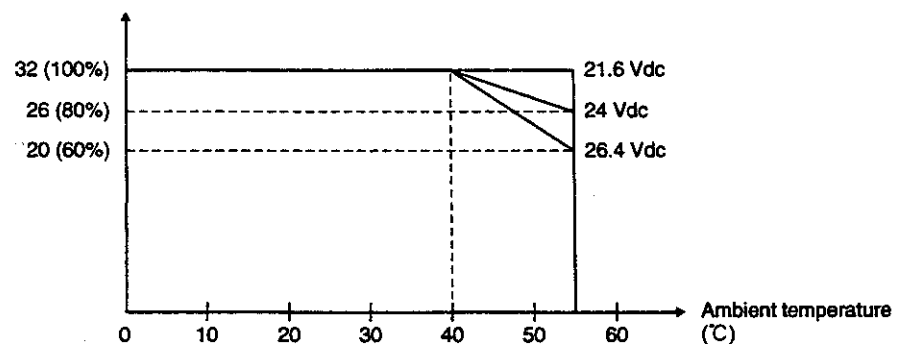


32-point DC input (cont'd)



The number of simultaneous ON input points will be restricted according to the ambient temperature and input voltage, as described in the figure below.

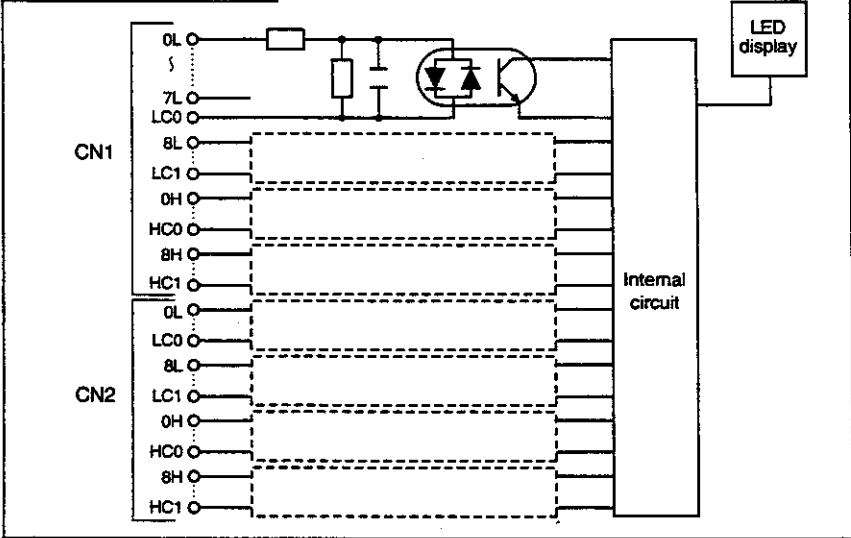
Number of simultaneous ON input points



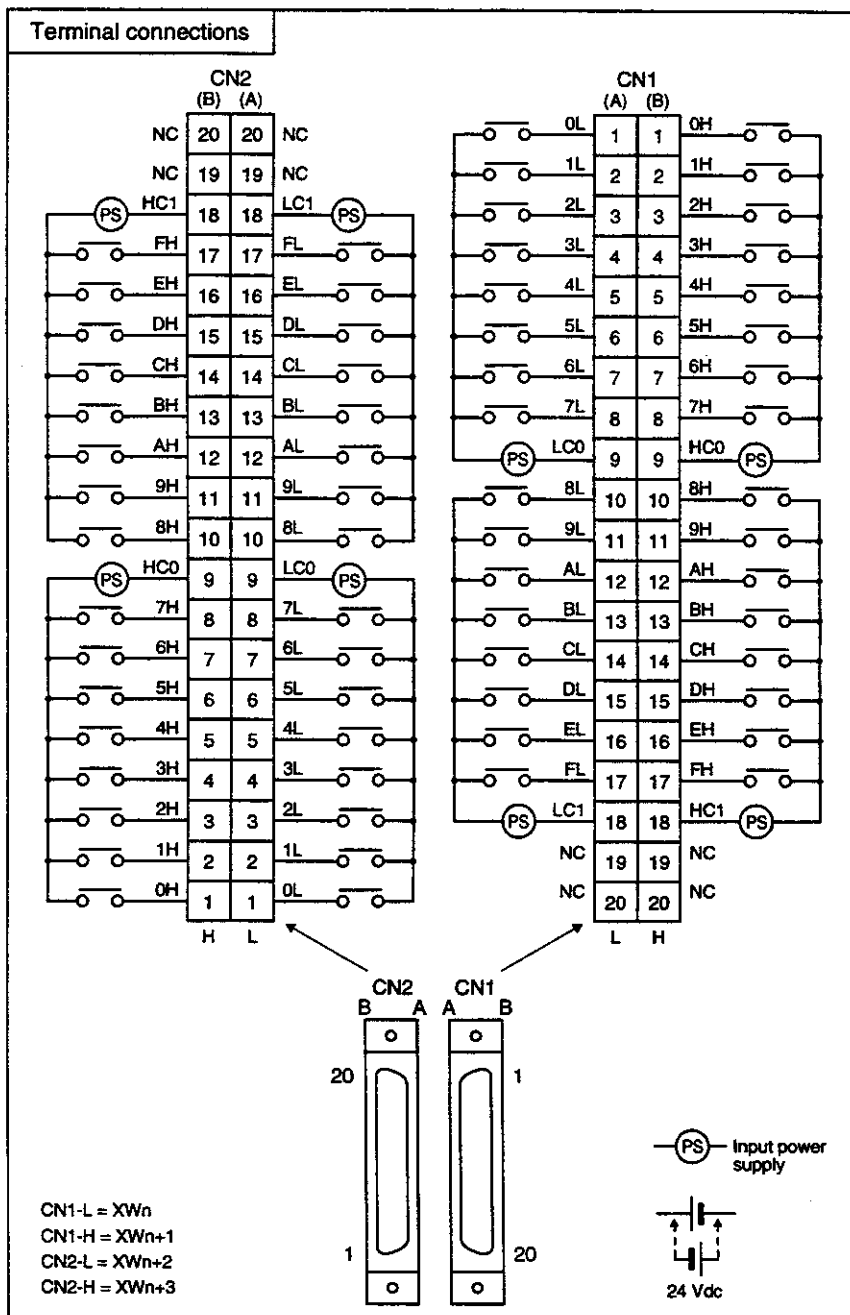
2. Specification

64-point DC input

Type		DI335	DI335H
Category		DC input	
Input type		Current sinking/sourcing	
Number of input points		64 points, 4-word input (X 4 W)	
Insulating method		Photo-coupler	
Rated input voltage		24 Vdc	
Range of input voltage		18 to 26.4 Vdc	
Rated input current		5 mA (at 24 Vdc)	
Input impedance		4.8 K Ω (at 24 Vdc)	
Operation voltage	Min. ON voltage	16V	
	Max. OFF voltage	5V	
Delay	OFF \rightarrow ON	10 ms or less	1 ms or less
	ON \rightarrow OFF	15 ms or less	1.5 ms or less
Input signal display		LED display for all points, lit at ON, internal logic side	
External connection		Connector (40-pin) \times 2	
No. of commons		8 (insulated between commons)	
No. of input points per common		8 points/common	
Polarity of common		No Polarity	
Derating condition		As same as DI334/DI334H	
Internal current consumption		5 Vdc, 170 mA or less	
Insulation resistance		10 M Ω (500 Vdc)	
Withstand voltage		1500 Vac, 1 minute (between internal and external circuits)	
Weight		600g (including connectors)	
Internal circuit			



64-point DC input (cont'd)



NOTE

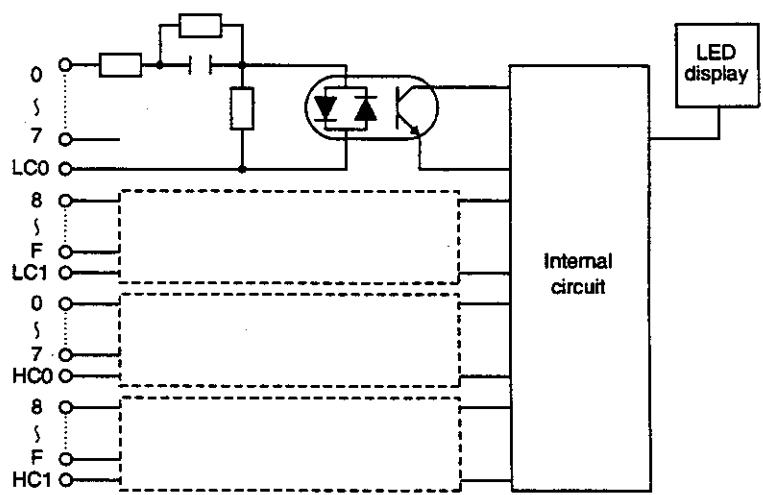
Type of the connector of the module side:

FCN-365P040-AU (Fujitsu)

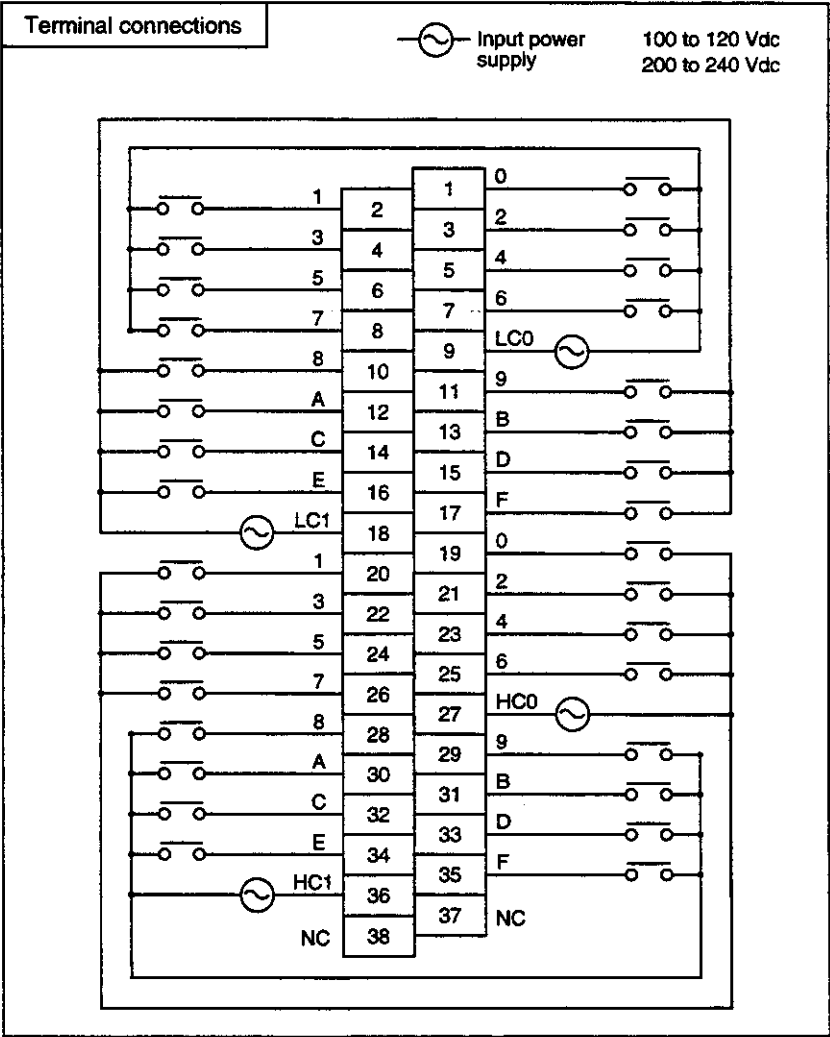
Connectors (2, soldering types) of the cable side are attached as standard.

2. Specification

32-point AC input

Type		IN354	IN364
Category		AC input	
Number of input points		32 points, 2-word input (X 2 W)	
Insulating method		Photo-coupler	
Rated input voltage		100 to 120 Vac	200 to 240 Vac
Range of input voltage		85 to 132 Vac	170 to 264 Vac
Frequency		50/60Hz (47 to 63Hz)	
Rated input current		10 mA (at 100 Vac, 50Hz)	10 mA (at 200 Vac, 50Hz)
Input impedance		10 K Ω (50Hz), 8 K Ω (60Hz)	22 k Ω (50 Hz), 18 k Ω (60 Hz)
Operation voltage	Min. ON voltage	70 Vac	140 Vac
	Max. OFF voltage	25 Vac	50 Vac
Delay	OFF \rightarrow ON	15 ms or less	
	ON \rightarrow OFF	15 ms or less	
Input signal display		LED display for all points, lit at ON, internal logic side	
External connection		38-pin removable terminal block, M3.5	
No. of commons		4 (insulated between commons)	
No. of input points per common		8 points per common	
Derating condition		None	
Internal current consumption		5 Vdc, 120 mA or less	
Insulation resistance		10 M Ω or more (500 Vdc)	
Withstand voltage		1500 Vac, 1 minute (between commons, between internal and external circuits)	
Weight		480g	
Internal circuit			

32-point AC input
(cont'd)

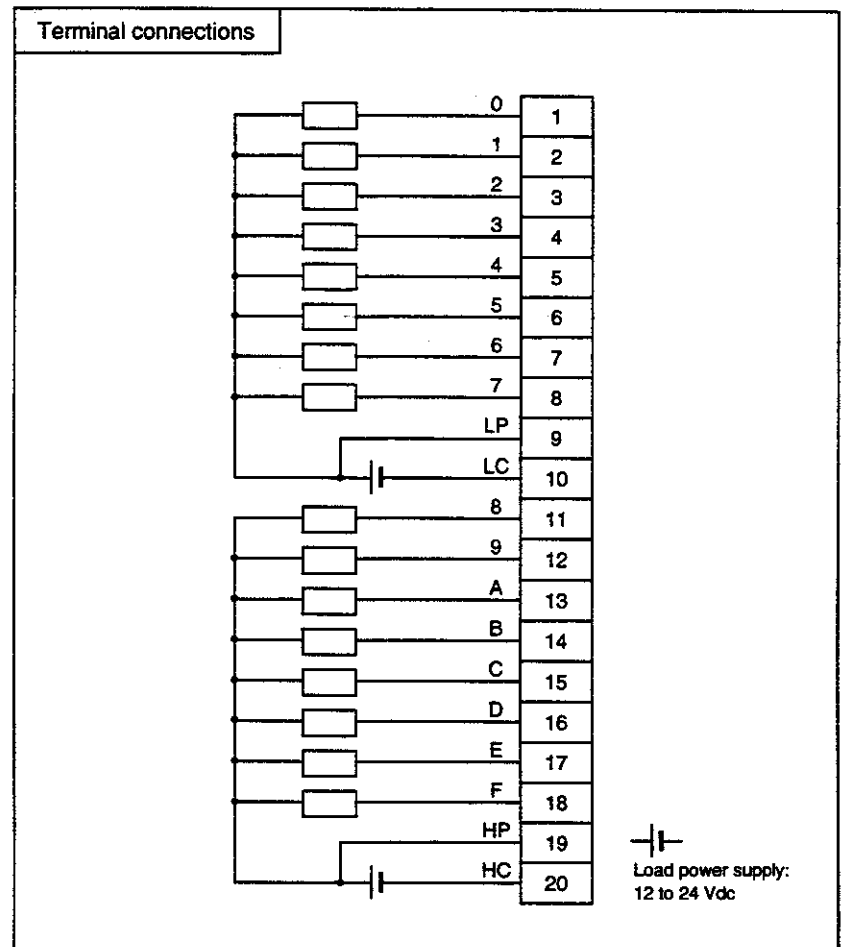


2. Specification

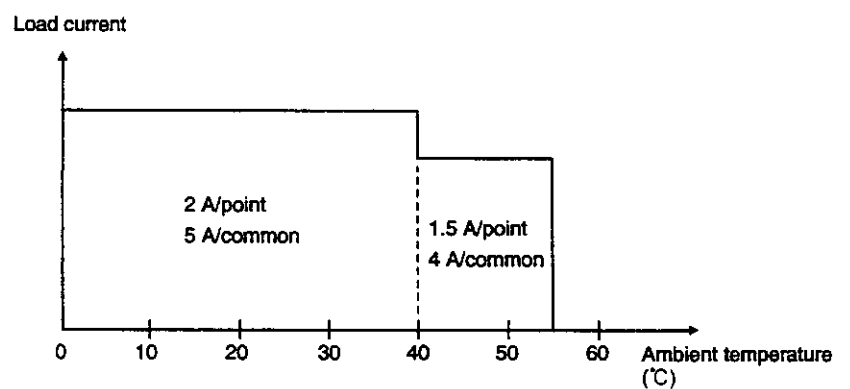
16-point DC output

Type		DO333
Category		Transistor output
Output type		Current sinking
No. of output points		16 points, 1-word input (Y 1 W)
Insulating method		Photo-coupler
Rated input voltage		12 to 24 Vdc
Range of load voltage		10 to 30 Vdc
Max. load current		2 A/point, 5 A/common
Voltage drop at ON		1.5 V or less (at 24 Vdc)
Leakage current at OFF		0.1 mA or less (at 24 Vdc)
Delay	OFF → ON	1 ms or less
	ON → OFF	1 ms or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		Fusing/external abnormal power supply LED (FL, FH), lit at abnormal state
External connection		20-pin removable terminal block, M3.5
No. of commons		2 (insulated between commons)
No. of output points per common		8 points per common
Common polarity		negative (-) polarity
Derating condition		See NOTE on the next page
Internal current consumption		5 Vdc, 320 mA or less
Insulation resistance		10 MΩ (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between commons, between internal and external circuits)
Built-in fuse		6 A/common×2
Surge suppressor		Diode
Weight		410g
Internal circuit		

16-point DC output (cont'd)



The maximum load current has the following restrictions, depending on the ambient temperature.

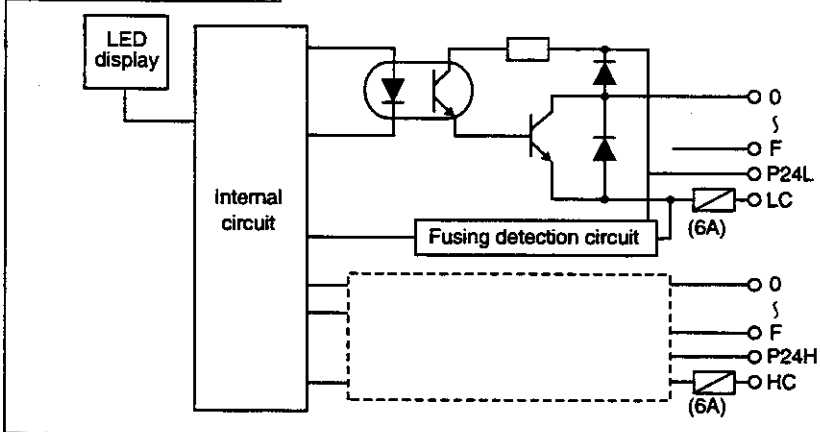


2. Specification

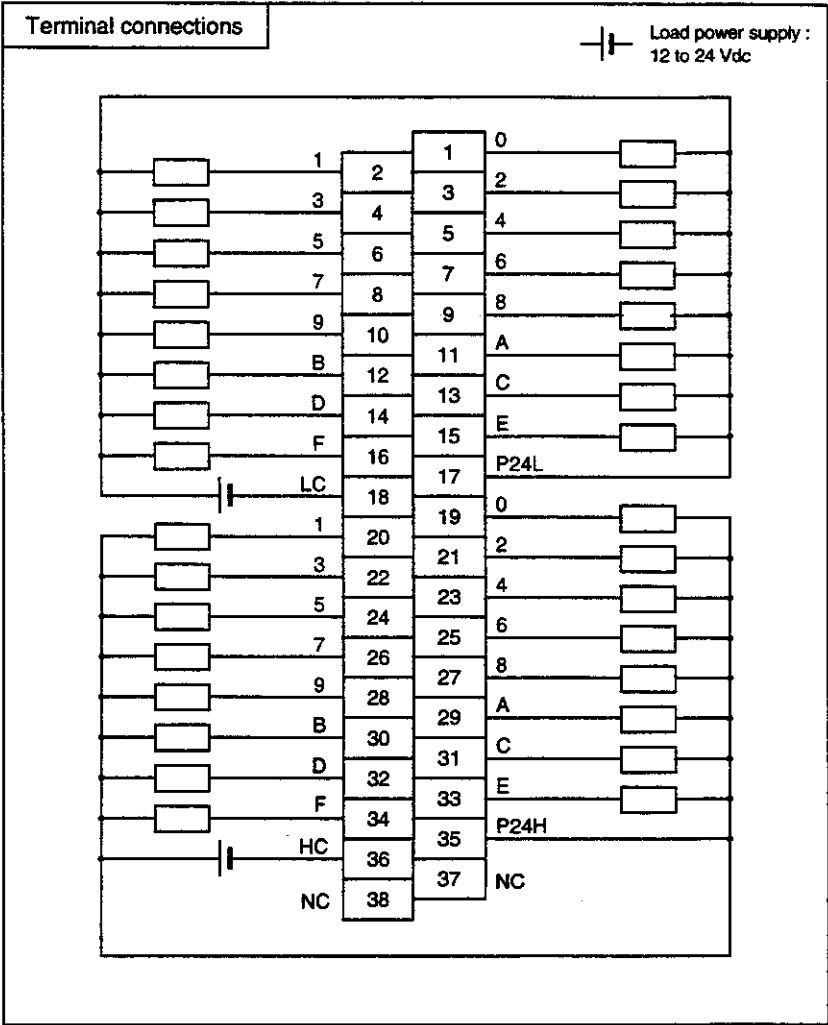
32-point DC output

Type		DO334
Category		Transistor output
Output type		Current sinking
No. of output points		32 points, 2-word output (Y 2 W)
Insulating method		Photo-coupler
Rated load voltage		12 to 24 Vdc
Range of load voltage		10 to 30 Vdc
Max. load current		0.5 A/point, 5 A/common
Voltage drop at ON		1.5 V or less
Leakage current at OFF		0.1 mA or less (at 24 Vdc)
Delay	OFF → ON	1 ms or less
	ON → OFF	1 ms or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		Fusing/external abnormal power supply LED (FL, FH), lit at abnormal state
External connection		38-pin removable terminal block, M3.5
No. of commons		2 (insulated between commons)
No. of output points per common		16 points per common
Common polarity		negative (-) polarity
Derating condition		See NOTE on the next page
Internal current consumption		5 Vdc, 210 mA or less
Insulation resistance		10 MΩ (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between commons, between internal and external circuits)
Built-in fuse		6 A/common×2
Surge suppressor		Diode
Weight		530g
Internal circuit		

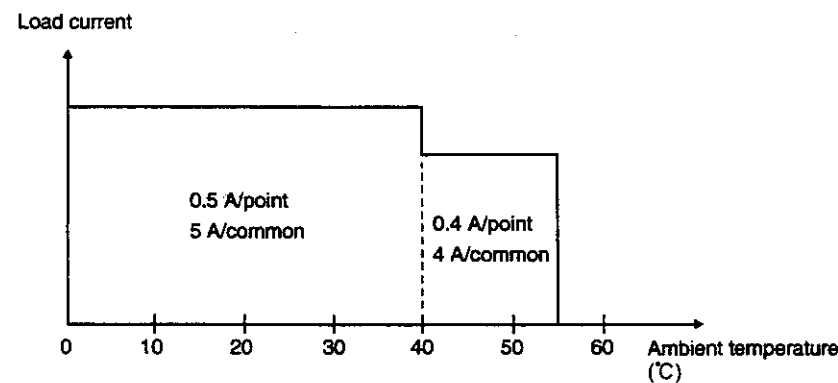
The diagram illustrates the internal circuitry of the DO334 module. It features an LED display connected to an internal circuit block. The internal circuit includes a transistor output stage with a photo-coupler, a fusing detection circuit with a 6A fuse, and two common output sections (P24L and HC) each with a 6A fuse. The output terminals are labeled 0, S, F, P24L, LC, and HC.



32-point DC output
(cont'd)



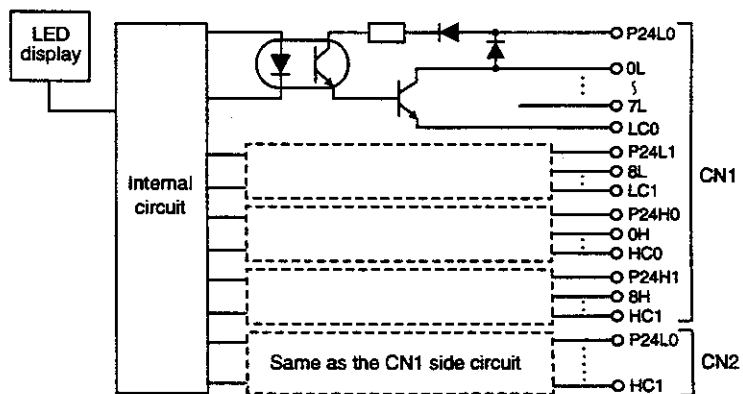
NOTE Maximum load current has the following restrictions, depending on the ambient temperature.



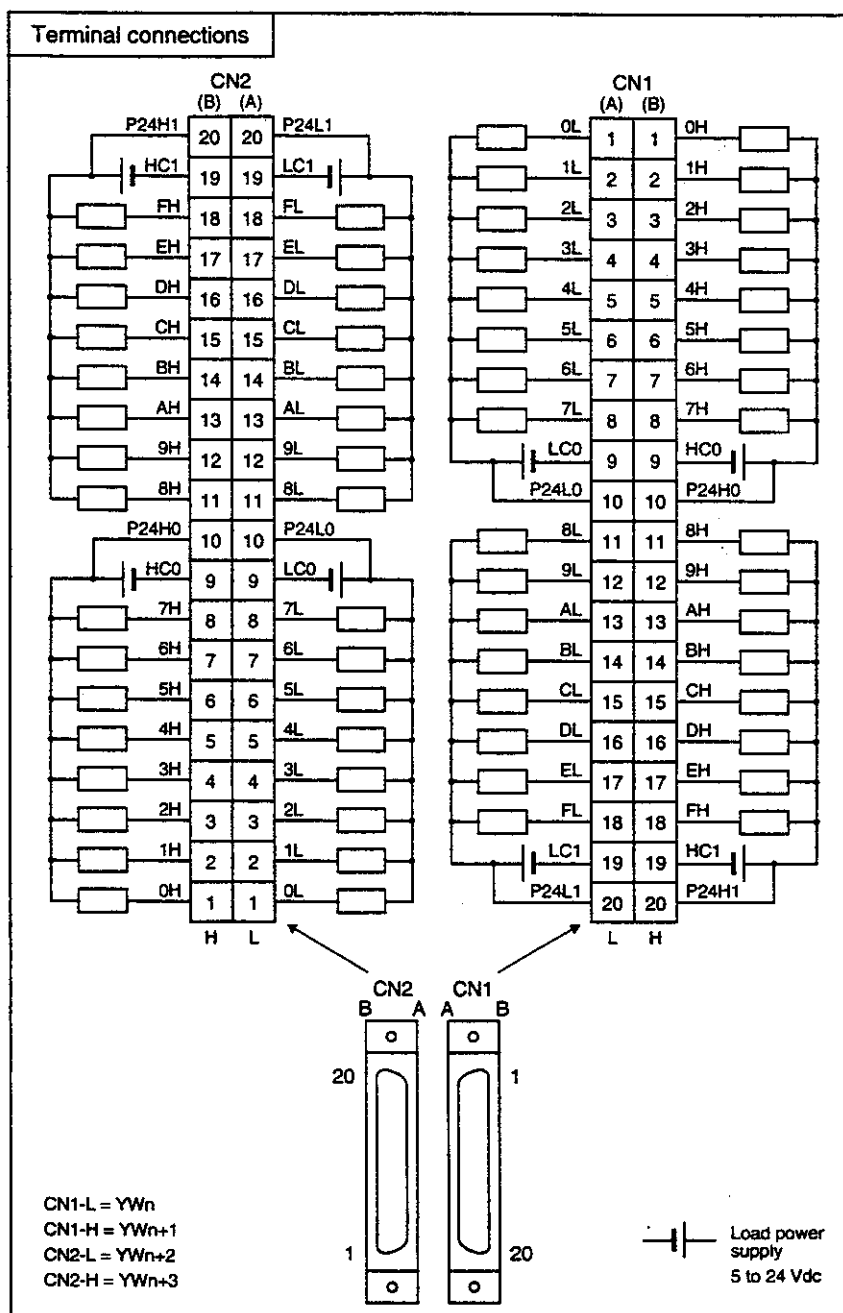
2. Specification

64-point DC output

Type		DO335
Category		Transistor output
Output type		Current sinking
No. of output points		64 points, 4-word output (Y 4 W)
Insulating method		Photo-coupler
Rated input voltage		5 Vdc/12 to 24 Vdc
Range of load voltage		4.5 to 9.5 Vdc/9.6 to 26.4 Vdc
Max. load current		0.1 A/point (9.6 to 26.4 Vdc) 0.05 A/point (4.5 to 9.5 Vdc)
Voltage drop at ON		0.4 V or less
Leakage current at OFF		0.1 mA or less (at 24 Vdc)
Delay	OFF → ON	1 ms or less
	ON → OFF	1 ms or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		None
External connection		40-pin connector×2
No. of commons		8 (insulated between commons)
No. of output points per common		8 points per common
Common polarity		negative (-) polarity
Derating condition		None
Internal current consumption		5 Vdc, 400 mA or less
Insulation resistance		10 MΩ or less (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between internal and external circuits)
Built-in fuse		None
Surge suppressor		Diode
Weight		550g (including connectors)
Internal circuit		



64-point DC output (cont'd)



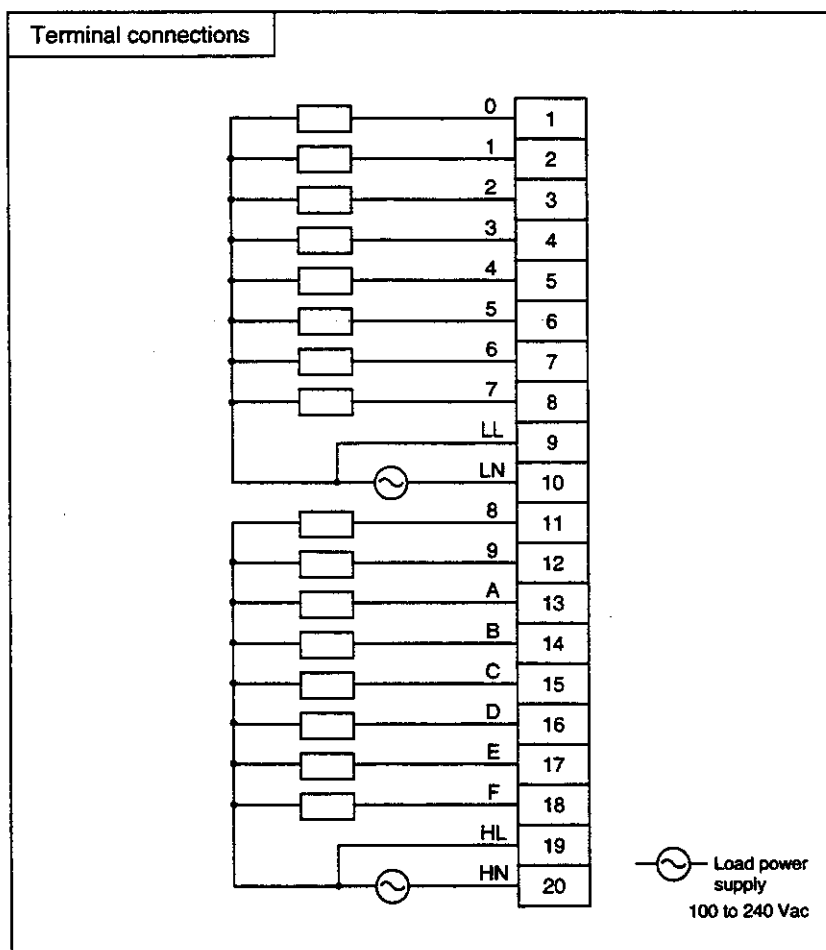
NOTE Type of the connector on the module side :
FCN-365P040-AU (Fujitsu)
The connectors (two, soldering types) of the cable side
are attached as standard.

2. Specification

16-point AC output

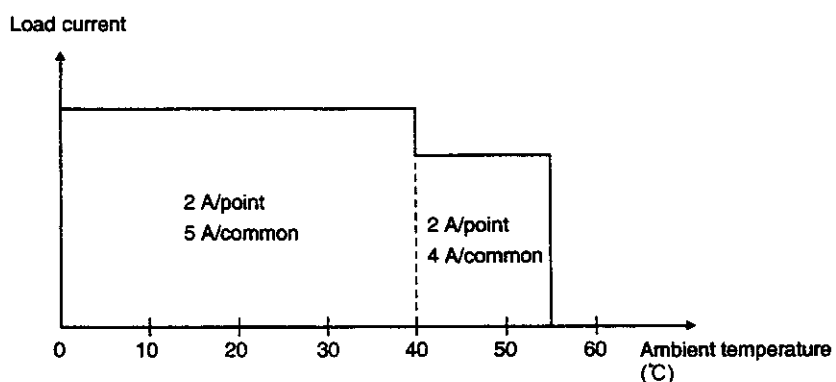
Type		AC363
Category		Triac output
No. of output points		16 points, 1-word output (Y 1 W)
Insulating method		Photo-coupler
Rated load voltage		100 to 240 Vac (50/60 Hz)
Range of load voltage		24 to 264 Vac (47 to 63 Hz)
Max. load current		2 A/points, 5 A/common
Voltage drop at ON		1.5 V or less
Leakage current at OFF		1.0 mA or less (at 100 Vac, 50 Hz) 2.4 mA or less (at 200 Vac, 60 Hz)
Min. load current		100 mA (24 Vac), 50 mA (100 to 240 Vac)
Max. inrush current		20 A/20 ms (point), 40 A/20 ms (common)
Delay	OFF → ON	1 ms or less
	ON → OFF	1 ms+1/2cycle or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		Fusing display LED (FL, FH), lit at fusing
External connection		20-pin removable terminal block, M3.5
No. of commons		2 (insulated between commons)
No. of output points per common		8 points per common
Derating condition		See NOTE on the next page
Internal current consumption		5 Vdc, 530 mA or less
Insulation resistance		10 MΩ or less (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between commons between internal and external circuits)
Built-in fuse		6 A/common×2
Surge suppressor		CR snubber circuit, varistor
Weight		500g
Internal circuit		

16-point AC output (cont'd)



NOTE

Maximum load current has the following restrictions, depending on the ambient temperature.

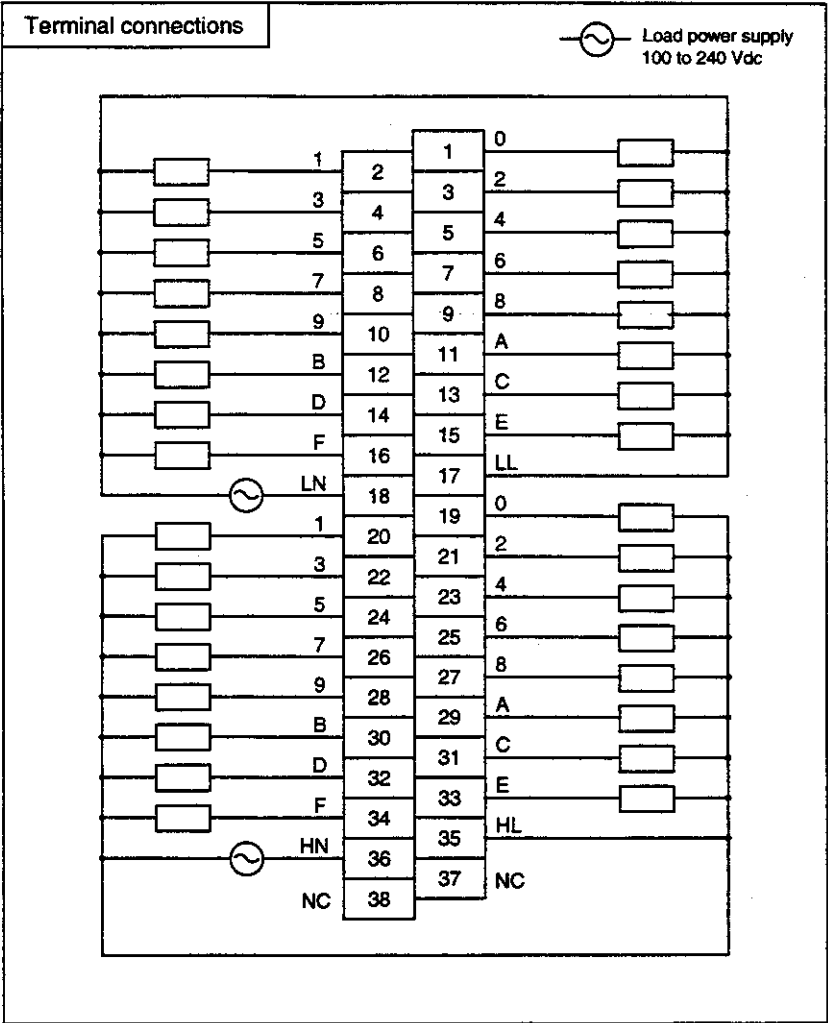


2. Specification

32-point AC output

Type		AC364
Category		Triac output
No. of output points		32 points, 2-word output (Y 2 W)
Insulating method		Photo-coupler
Rated load voltage		100 to 240 Vac (50/60 Hz)
Range of load voltage		24 to 264 Vac (47 to 63 Hz)
Max. load current		0.5 A/point, 3.2 A/common, 5 A/module
Voltage drop at ON		1.5 V or less
Leakage current at OFF		0.8 mA or less (at 100 Vac, 50 Hz) 1.6 mA or less (at 200 Vac, 50 Hz)
Min. load current		100 mA (24 Vac), 50 mA (100 to 240 Vac)
Max. inrush current		20 A/20 ms (points and common)
Delay	OFF → ON	1 ms or less
	ON → OFF	1 ms+1/2cycle or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		Fusing display LED (FL, FH), lit at fusing
External connection		38-pin removable terminal block, M3.5
No. of commons		2 (insulated between commons)
No. of output points per common		16 points per common
Derating condition		None
Internal current consumption		5 Vdc, 800 mA or less
Insulation resistance		10 MΩ or less (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between commons, between internal and external circuits)
Built-in fuse		6 A/common×2
Surge suppressor		CR snubber circuit
Weight		540g
Internal circuit		<p>The internal circuit diagram shows an LED display connected to an internal circuit. The internal circuit includes a triac output stage with a snubber circuit (resistor and capacitor in series) and a fusing detection circuit. The output terminals are labeled 0, F, LL, and LN (6A). There is also a second set of terminals labeled 0, F, HL, and HN (6A).</p>

32-point AC output
(cont'd)



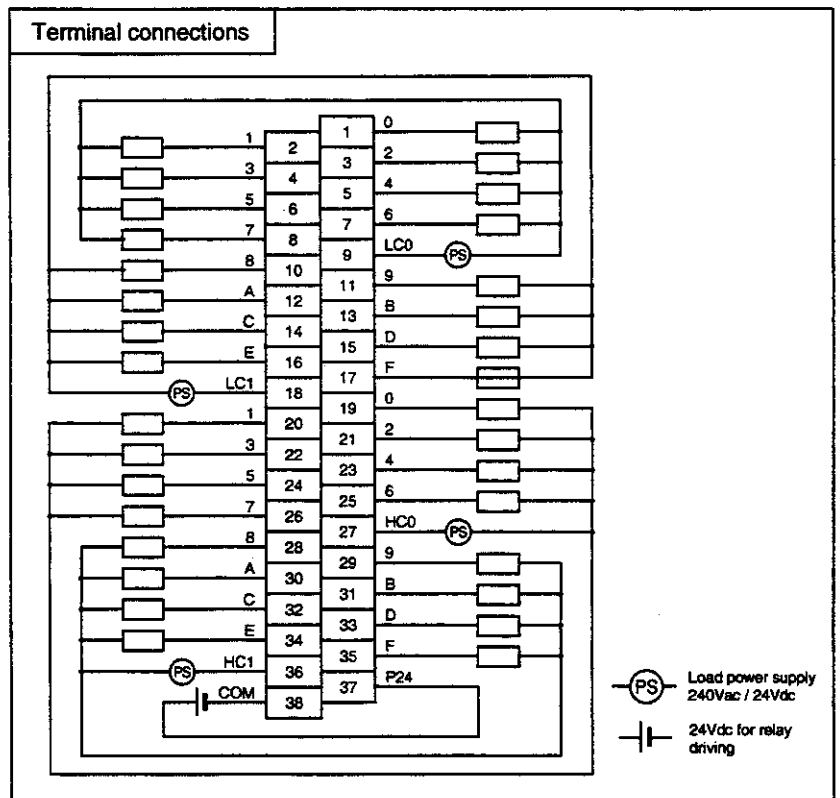
NOTE Minimum 24 Vac can be used as the load voltage. However, if load voltage becomes 85 Vac or less, the fusing detection circuit may work. In this case, although AC output operation has no problem, the fusing display LED (FL, FH) will light.

2. Specification

32-point relay output

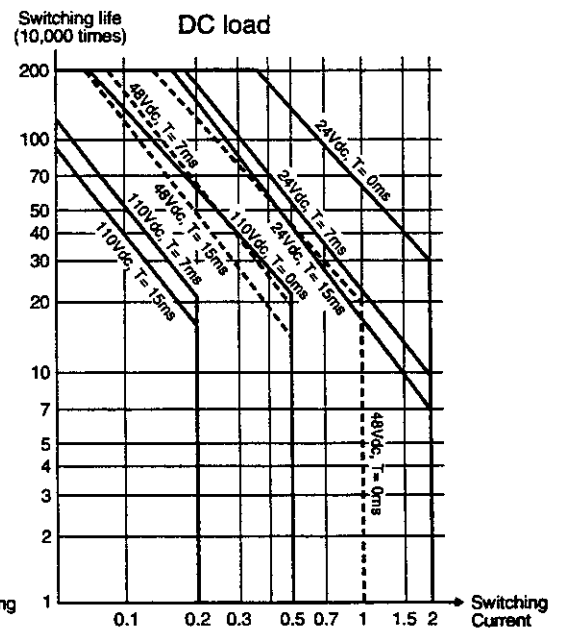
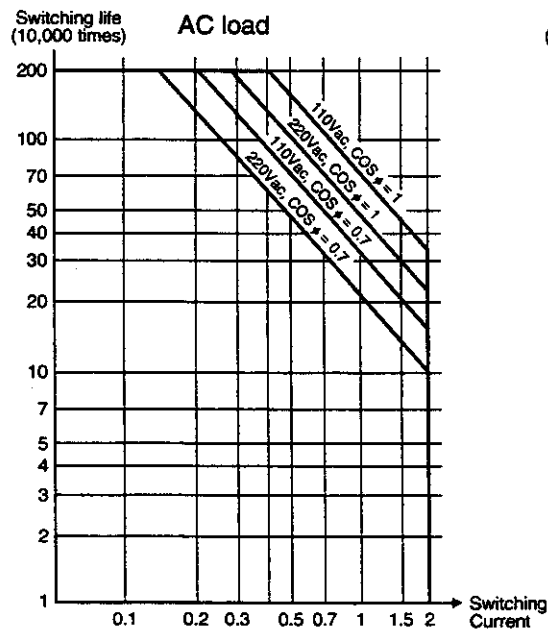
Type		RO364
Category		Electromechanical relay output
Output type		NO-contact
No. of output points		32 points, 2-word output (Y 2 W)
Insulating method		Photo-coupler
Rated load voltage		240 Vac/24 Vdc
Range of load voltage		Up to 264 Vac/125 Vdc
Max. load current		2 A/point (resistive load), 5 A/common
Contact ON resistance		50 m Ω or less (initial value)
Leakage current at OFF		None
Min. load current		5 Vdc, 10 mA (50 mW or more)
Delay	OFF \rightarrow ON	10 ms or less
	ON \rightarrow OFF	10 ms or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		Abnormal external power supply display LED (F), lit at abnormal state
External connection		38-pin removable terminal block, M3.5
No. of commons		4 (insulated between commons)
No. of output points per common		8 points per common
Internal current consumption		5 Vdc, 170 mA or less
External power for relay	Rated voltage	24 Vdc
	Rated current	300 mA (24 Vdc, at all points ON)
	Voltage range	21.6 to 26.4 Vdc
Mechanical life		20 million times or more
Electrical contact life		See the next page
Insulation resistance		10 M Ω or more (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between commons, between internal and external circuits)
Built-in fuse		None
Weight		510g
Internal circuit		

32-point relay output (cont'd)



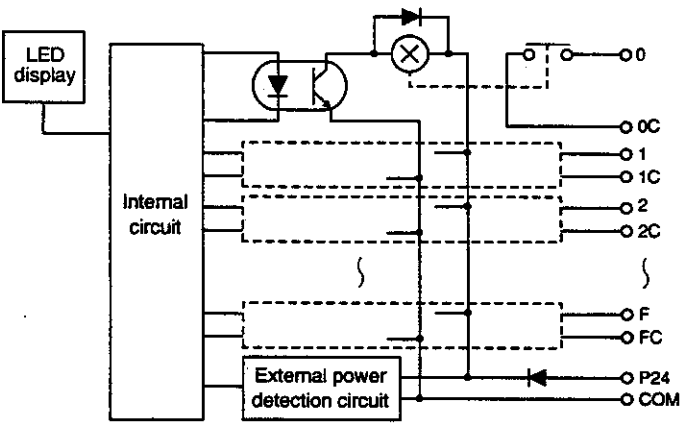
NOTE

The following figures indicate life curves of the output relay. The data are based on 1800 switching times/hour. For more frequently operation, the life of the output relay will become shorter.

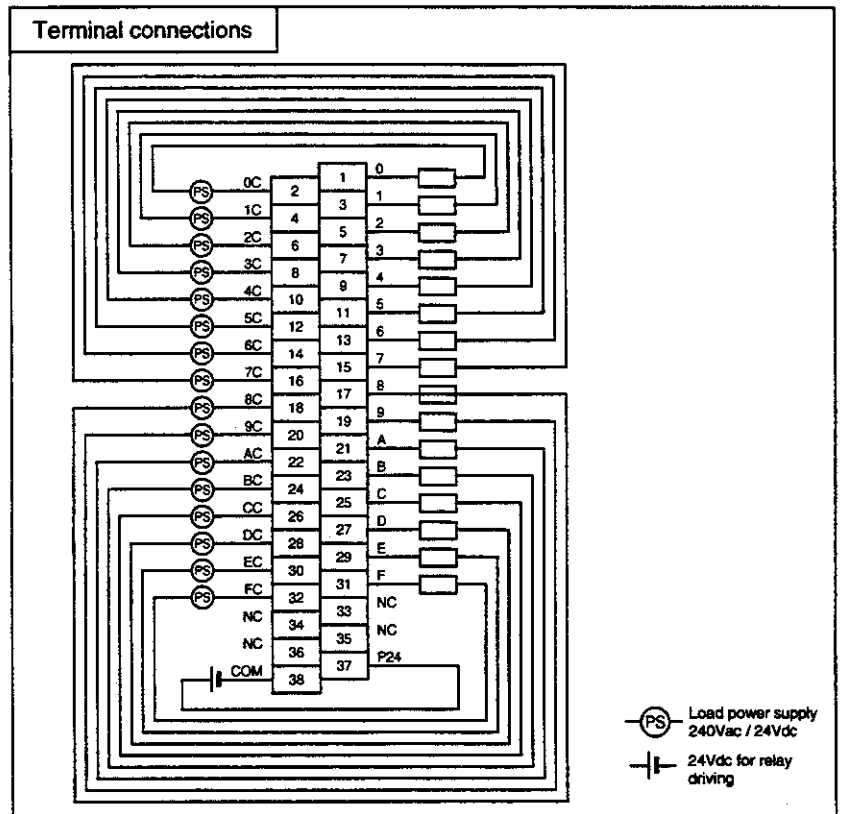


2. Specification

16-point isolated relay output

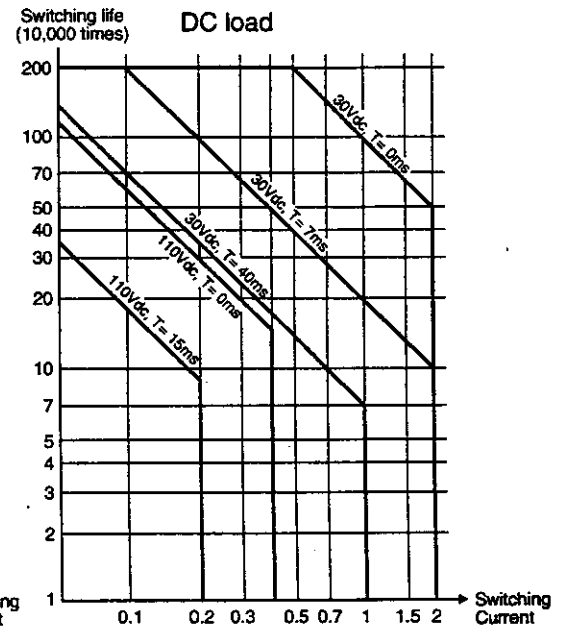
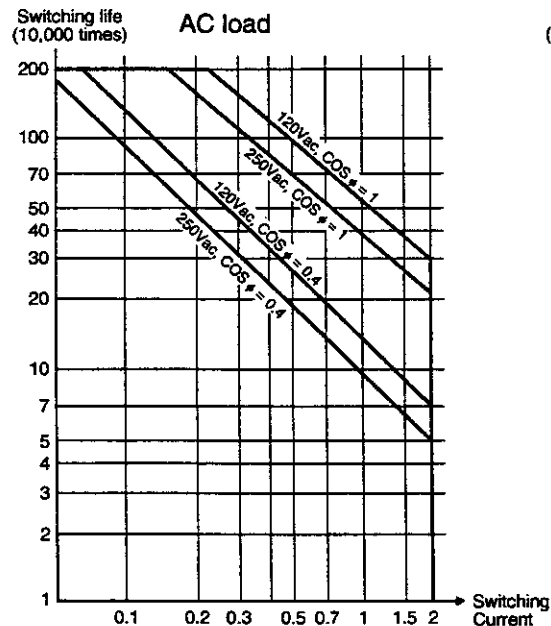
Type		RO363S
Category		Electromechanical relay output
Output type		NO-contact
No. of output points		16 points, 1-word output (Y 1 W)
Insulating method		Photo-coupler
Rated load voltage		240 Vac/24 Vdc
Range of load voltage		Up to 264 Vac /125 Vdc
Max. load current		2 A/point
Contact ON resistance		50 mΩ or less (initial value)
Leakage current at OFF		None
Min. load current		5 Vdc, 10 mA (50 mW or more)
Delay	OFF → ON	10 ms or less
	ON → OFF	10 ms or less
Output signal display		LED display for all points, lit at ON, internal logic side
Module status display		Abnormal external power supply display LED (F), lit at abnormal state
External connection		38-pin removable terminal block, M3.5
Common connection		16-point isolated contact
Internal current consumption		5 Vdc, 100 mA or less
External power for relay	Rated voltage	24 Vdc
	Rated current	145 mA (24 Vdc, at all points ON)
	Voltage range	21.6 Vdc to 26.4 Vdc
Mechanical life		20 million times or more
Electrical contact life		See the next page
Insulation resistance		10 MΩ or more (500 Vdc)
Withstand voltage		1500 Vac, 1 minute (between the points, between internal and external circuits)
Built-in fuse		None
Weight		450g
Internal circuit		

16-point isolated relay output (cont'd)



NOTE

The following figures indicates life curves of the output relay. The data are based on 1800 switching times/hour. For more frequently operation, the life of the output relay will become shorter.



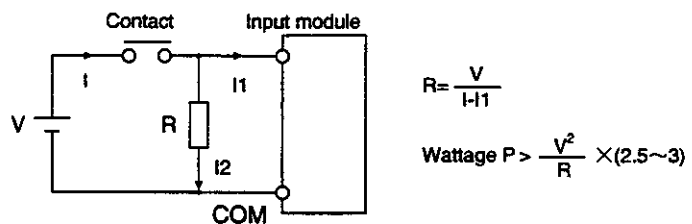
3. Precautions for I/O Modules

3.1 Precautions for DC input modules

- (1) Read conditions for the ON/OFF changes of the input signals are:
Input ON time \geq ON delay time (OFF \rightarrow ON) + Input reading cycle
Input OFF time \geq OFF delay time (ON \rightarrow OFF) + Input reading cycle

Where the "input reading cycle" means PLC scan cycle for the refresh input, or the execution interval of a direct input instruction when the instruction is used.

- (2) For some external contacts, the input current (10 mA/24V for DI334; 5 mA/24V for DI335) of modules may not be able to maintain contact reliability. In this case, install a bleeder resistor between the input and common terminals to increase the contact current.



(An example of selecting a bleeder resistor R)

Input voltage $V = 24 \text{ Vdc}$

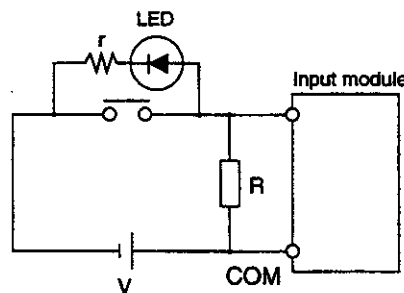
Input module DI334 (10 mA/24 Vdc)

When the contact requires 50 mA current ;

Resistance value R of a bleeder resistor = $0.6 \text{ [k}\Omega\text{]}$

Wattage P of the bleeder resistor = 3 [W]

- (3) If a switch with an LED display is used, the current (leakage current) through the LED may cause the erroneous input (always ON). In this case, install a bleeder resistor to lower the input impedance.



(Example of selecting a bleeder resistor R)

When the voltage between input terminals is V_d at the switch OFF state (with no bleeder resistor), the resistance (R) and the wattage (P) of the bleeder resistor can be selected as follows.

3. Precautions for I/O Modules

$$R < \frac{(V-V_d) V_o}{V(V_d-V_o)} \cdot Z_i$$

$$P = (2.5 \sim 3) \cdot \frac{V^2}{R}$$

V: Input voltage
V_o: Max. OFF voltage of the input module
Z_i: Input impedance of the input module

In case of DI334,

$$V=24 \text{ Vdc}, V_o=3.5 \text{ Vdc}, Z_i=2.4 \text{ k}\Omega$$

If V_d=5 Vdc, R can be calculated as follows.

$$R[\text{k}\Omega] < \frac{(24-5) \times 3.5}{24 \times (5-3.5)} \times 2.4[\text{k}\Omega]$$

As a result,

$$R < 4.4[\text{k}\Omega] \rightarrow 3\text{k}\Omega$$

$$P = (2.5 \sim 3) \times \frac{(24[\text{V}])^2}{3000[\Omega]} \rightarrow 0.5\text{W}$$

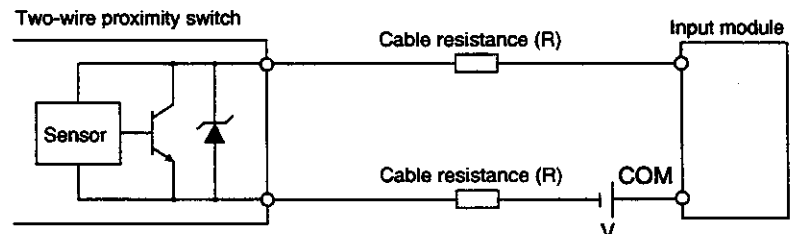
Also, when the bleeder resistor is selected in the above manner, the contact current at the switch ON state should be checked.

$$\text{Contact current} = 24[\text{V}] \times \frac{2.4[\text{k}\Omega] + R}{2.4[\text{k}\Omega] \times R} = 18[\text{mA}]$$

- (4) If the two-wire proximity switch and other solid-state switches are used, be sure that there is no possibility of mis-inputting because of the leakage current, as in procedure (3). (See (3) for details on how to select a bleeder resistor.)

Also in this case, because of the effect of the saturation voltage (voltage drop) at ON, regardless of whether the switch is ON, the input terminal voltage may not be able to reach the ON voltage, thereby failing to read as input ON.

If input voltage is low or if input wiring is too long, special measures are necessary.



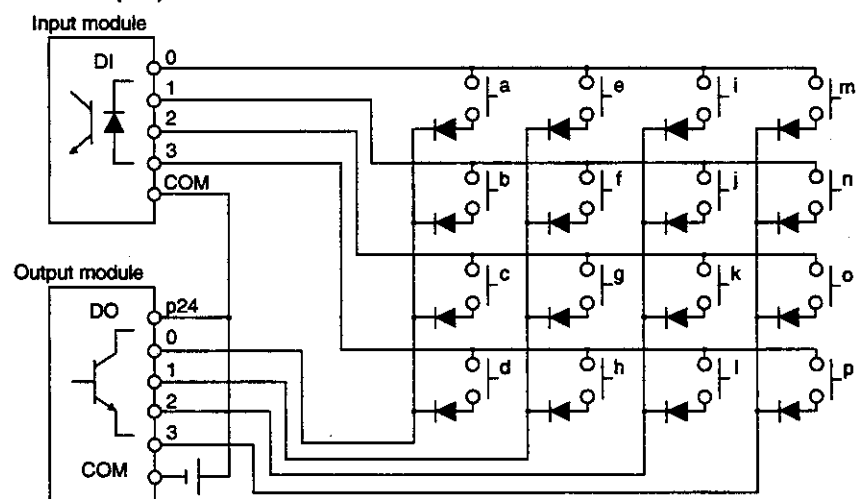
If the cable resistance value is expressed as R[Ω], V_d[V] for the voltage drop of the proximity switch, and Z_i[Ω] for the input impedance of the input module, the voltage V_i[V] applied between the input module terminals will be as expressed below (when the proximity switch is ON) :

$$V_i = \frac{V-V_d}{2R+Z_i} \cdot Z_i$$

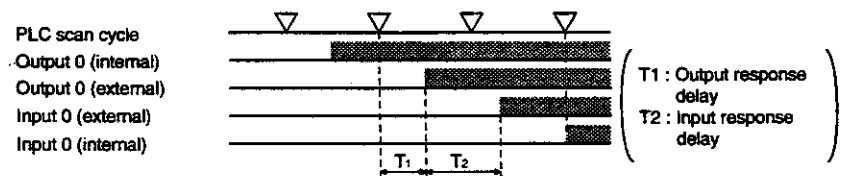
If the above V_i is lower than the minimum ON voltage of the input module, input voltage V must be raised or the value of the cable resistor R must be made smaller.

3. Precautions for I/O Modules

- (5) Because the input filter time constant of the high-speed response input module (DI334H, DI335H) is set to small, the input module may read the wrong input due to chattering of the contact. Use the high-speed response input module to connect with solid-state devices. Also, take measures to suppress noise.
- (6) If input wiring is too long, take measures to prevent erroneous input caused by noise, as follows.
 - Wiring length must be minimized. Do not make unnecessary loops.
 - Keep the input wires away, at least 200 mm, from power cables and high frequency lines, or shield the input cables with a metal plate.
 - If possible, use relays at the leading in the control panel.
 - For some cases, use a shielded cable or twisted-pair cable.
 - Install a bleeder resistor to reduce input impedance.
- (7) If dynamic scan input is configured using a DC input module and a DC output module, in addition to the response-delay of output and input, consider the difference of timing caused by the PLC scan. Moreover, diodes must be installed to prevent erroneous input caused by detour circuit. (the figure below is an example of 4×4 input)



For example, when contact a is ON, the change timing between output 0 and input 0 is as follows :



Note that the change timing of output 0 and input 0 will be affected with the scan time of the PLC and the response time of input and output.

3.2 Precautions in applying AC input modules

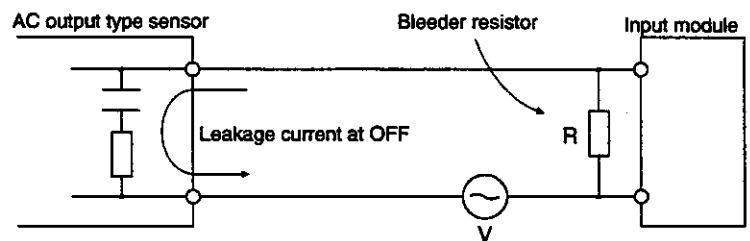
- (1) The conditions to read the ON/OFF state of the input signal are as follows :

Input ON time \geq ON delay time (OFF \rightarrow ON) + Input reading cycle

Input OFF time \geq OFF delay time (ON \rightarrow OFF) + Input reading cycle

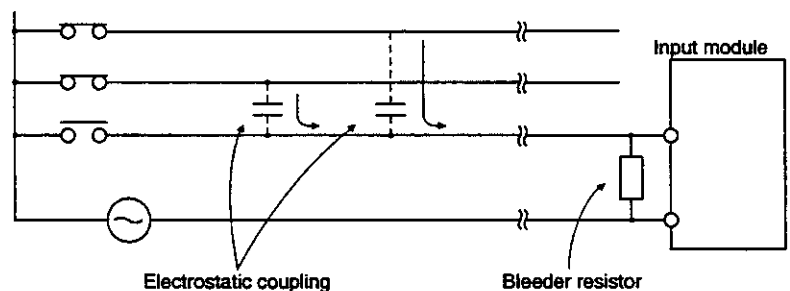
The input reading cycle means PLC scan cycle for the refresh input, or the execution interval of the direct input instruction when using a direct input instruction.

- (2) When an AC output sensor is connected to the I/O module, due to the leakage current from the sensor at OFF, there may be a voltage which exceeds the maximum OFF voltage between the input terminals. This will make the PLC unable to read input OFF when the sensor is OFF. In this case, install a bleeder resistor between the input terminals to lower the input impedance.



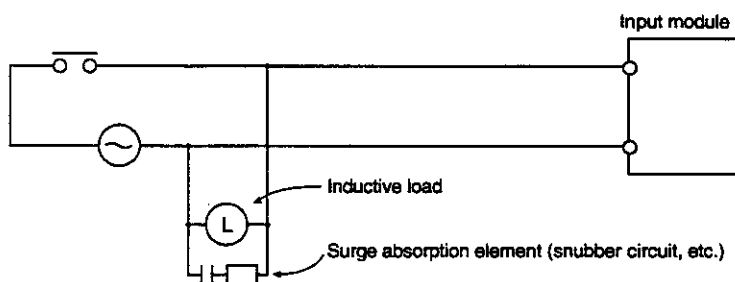
For selecting a bleeder resistor, refer to 3.1 (3).

- (3) If external lines for AC input become longer with using a multi-core cable, induced current may flow to an open wire from charged wires due to the electrostatic capacity of the cable, causing an erroneous ON input. In this case, install a bleeder resistor between the input terminals to lower the input impedance. Or, you had better apply the DC input.



3. Precautions for I/O Modules

- (4) If the AC lines are installed in parallel with high frequency or power lines, induced current may cause erroneous input. In this case, take necessary countermeasures as follows:
- Change the installation route of AC input lines so that they are not parallel with power lines and high frequency lines.
 - Use twisted-pair cables as input lines.
 - Use shielded cables as input lines.
 - Use relays at the leading in the control panel (the relay must satisfy larger ON current).
 - Install a bleeder resistor to lower the input impedance.
- (5) If the input module and an inductive load are connected in parallel, a surge voltage generated at both-ends of the load when the contact is changed to OFF may cause a malfunction of the PLC. In this case, install a surge absorption element in parallel with the load to suppress the surge voltage.



3.3 Precautions for DC output modules

- (1) The DC output module needs an external power supply to drive output transistors. For each common, connect the load power to the appropriate terminal. (For details, see 2.3, I/O module specifications)

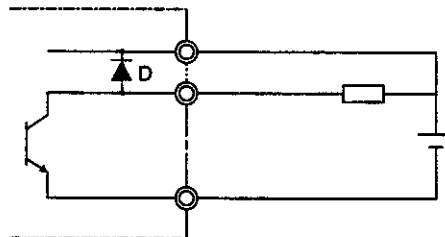
If the wrong polarity of the power supply to the terminal is connected, the module will be damaged. Check the polarity before connection.

For the DO333 and DO334 modules, if their built-in fuse is blown out or if the external power supply is not supplied, the front LED (FL, FH) of the module lights.

- (2) Protection coordination against over-current of DC output module

Type of module	Protection
DO333 (16-point output)	A fuse of 6 A per common (8 points) is built in this DC output module. For an overload and load short-circuit, the transistor will not be protected. This fuse, however, protects the DC output module and the external cable from burn-out.
DO334 (32-point output)	A fuse of 6 A per common (16 points) is built in this DC output module. For an overload and load short-circuit, the transistor will not be protected. This fuse, however, protects the module and the external cable from burn-out.
DO335 (64-point output)	Because a protection fuse is not built in this DC output module, the load short-circuit, etc. will cause burn-out of the module and external cable. Therefore, install an appropriate fuse on the outside to prevent accidental burn-out.

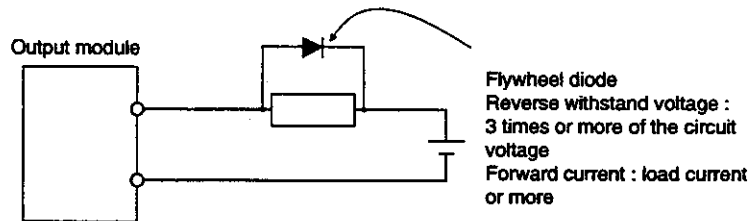
- (3) A diode as shown in the figure below is built in to protect the transistor from transient overvoltage.



D: Bypasses transient overvoltage to the power supply and suppresses the voltage between the collector and emitter of the transistor.

3. Precautions for I/O Modules

- (4) If a capacitive load is connected, rush current will flow when output is changed to ON.
At that time, necessary measures must be taken to protect the output transistor from being destroyed by the rush current.
To limit the rush current there are two effective measures. One is to connect a resistor to the load in series. The other is to apply dummy current to the load by connecting a resistor between the output terminals.
- (5) If an inductive load is connected, transient overvoltage will occur when the output is changed to OFF.
This surge voltage will be absorbed into the diode D mentioned before so that the transistor will be protected. However, if the output cable is installed closely to other signal lines, the surge voltage may cause other problem. In this case, install a flywheel diode in parallel with the inductive load (as near as possible to the load.)



If a flywheel diode is connected, the OFF restoration time of the load will become longer. If this becomes a problem, connect a CR snubber circuit to the load, similar to the countermeasure taken for surge voltage in AC output.

3. Precautions for I/O Module

3.4 Precautions for AC output modules

- (1) The AC output module (AC363, AC364) has a built-in fuse of 6A per common. For a load short-circuit, fusing will protect the triacs. However, in this case, semiconductor devices may be damaged to some extent. Therefore, take measures to prevent it.

In the case of fusing, or when the external power is not supplied, the LED (FL, FH) on the front of the module will light.

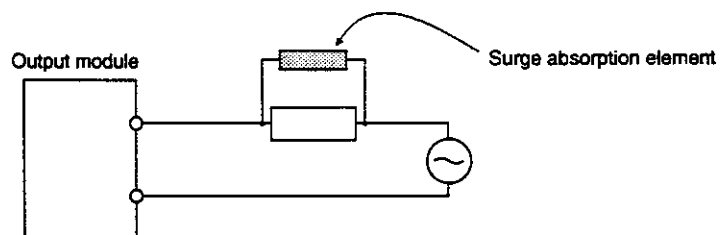
- (2) If a capacitive load is connected, rush current will flow when the output is changed to ON. Take necessary measures to suppress this rush current at a value lower than the allowable limit of the module.

Allowable inrush current :

AC363 ... 20 A/20 ms (point), 40 A/20 ms (common)

AC364 ... 20 A/20 ms (point and common)

- (3) If an inductive load is connected, transient overvoltage will be generated at the output is changed to OFF. To prevent malfunction caused by this surge voltage, a CR snubber circuit is installed in the AC output module. However, to prevent the problem for other signal systems, install a surge absorption element in parallel with the inductive load (install a surge absorption element as near as possible to the inductive load).



Surge absorption element :

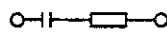
- Varistor (for the voltage clamp)



Bi-directional overvoltage absorption element with a rated voltage of approx. 1.2 times of the max. voltage (peak voltage)

- Snubber (CR) circuit (for high-frequency attenuation)

$R (\Omega)$ = DC resistance value of the load



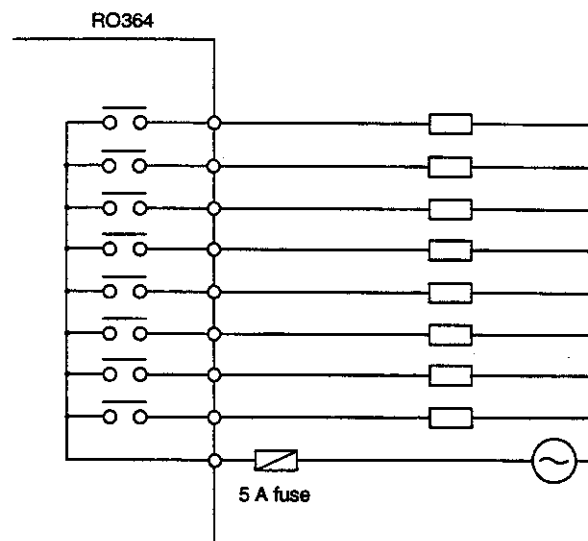
$C (\mu F) = \frac{I^2}{10} \sim \frac{I^2}{20}$ (I : peak value of load current in ordinary time)

- (4) Because the AC output module does not have a zero-cross function, the OFF->ON occurs regardless of the load voltage phases. However, the ON->OFF change occurs when load current is near zero. Check this point in load response.

3. Precautions for I/O Modules

3.5 Precautions for relay output modules

- (1) The relay output module (RO364, RO363S) needs external 24 Vdc power for driving relays. (For details, see 2.3, I/O module specifications.)
If external 24 Vdc power is not supplied, the LED (F) in the front of the module will light.
- (2) Because the relay output module does not have an built-in fuse to protect from overcurrent, install a fuse appropriate to the load current on the external wire. If the protective fuse is not inserted, module patterns could be burn out when a load is shorted.



- (3) The relay output module does not have a built-in surge absorption element. To connect an inductive load, always install a surge absorption element in parallel with the load. For details on selecting a surge absorption element, see 3.3 (5) and 3.4 (3).

4.1 Operating environment

Do not install the T3 in the following locations :

- Where the ambient temperature drops below 0°C (32°F) or exceeds 55°C (131°F)
- Where the relative humidity drops below 20% or exceeds 90%
- Where there is condensation due to sudden temperature changes
- Where there are vibrations that exceed the tolerance of the T3
- Where there are shocks that exceed the tolerance of the T3
- Where there are corrosive or inflammable gases
(The installation location should be below 0.05 ppm of sulfurous acid gas, below 0.01 ppm of hydrogen sulfide.)
- Where there are dust, machining debris or other particles
- In locations exposed to direct sunlight

Observe the following precautions when installing enclosures for mounting the T3 :

- Provide the maximum possible distance between high-voltage or high-power panels. This distance must be at least 200 mm (8 in).
- If the enclosures are installed near high-frequency equipment, be sure to ground the enclosures correctly.
- When sharing the channel base with other panels, check for leakage currents from the other panels or equipment.

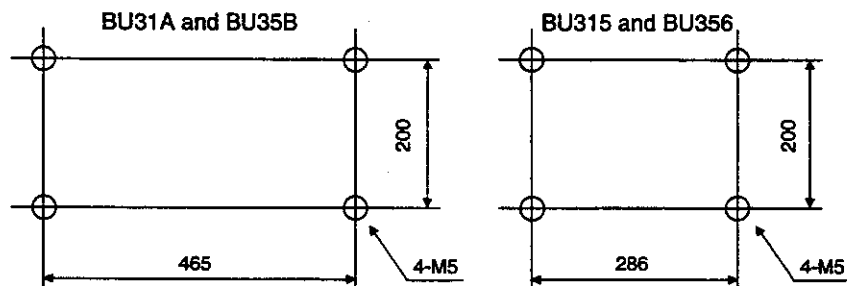
4. Installation and Wiring

4.2 Installing units

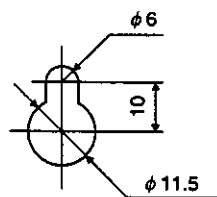
Installation precautions :

- Because the T3 is not dust-proof, install it in a dust-proof enclosure.
- Do not install the unit directly above equipment that generates a large amount of heat, such as a heater, transformer, or large-capacity resistor.
- Do not install the unit within 200 mm (8 in) of a high-voltage or power cable.
- Allow at least 100 mm distance (4 in) on all sides of the unit for ventilation.
- For safety during operation and maintenance, install the unit as far as is possible from high-voltage or power equipment. Alternatively, isolate the unit using a steel plate or similar separator.
- If the unit is installed on a horizontal panel, ambient temperature should be less than 40° C.
- Decide the units mounting position with considering the length of the expansion cables.
- Install the units in fully contacting with the mounting frame in order to equalize the potentials of basic and expansion units.

The unit mounting dimensions are as follows :



Rack mounting hole

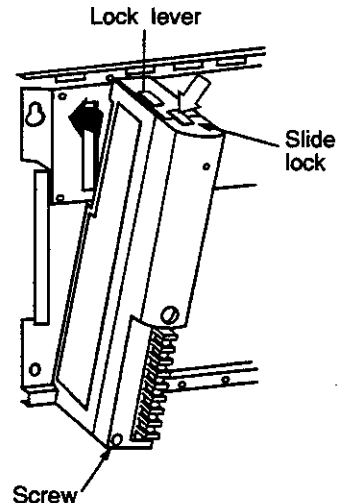


[units : mm]

4.3 Mounting modules

The power supply module must be mounted in the slot at the extreme left of the rack. Install the expansion interface module in the slot next to the power supply module, and the CPU module (for the basic unit only) and I/O modules in the following slots :
The modules, except for the expansion interface module, must be installed as follows :

1. Slide back the slide lock on the top of the module to release the lock lever.
2. Hang the bottom of the module on the rail of the rack and push up the lock lever.
3. While setting the bottom of the module as the supporting point, install the module in the slot to match the connector.
4. Release the lock lever and lock the module in the rack. Pull the slide lock towards you and lock the lever.



- While operating, fix the module with a screw at the bottom of the module.
- Remove the module in the reverse procedure for installation.
- Connector covers are attached to the rack and module connectors. Remove the connector covers when a module is installed.

Mount an expansion interface module by using a screw in the slot next to the power supply module slot as follows :

1. Insert the expansion interface module into the connector next to the power supply module.
2. Tighten screws on top and bottom of the module.



For safety, turn off power to the T3 before installing or removing a module. Also, refer to Section 6.8 I/O module replacement during operation.

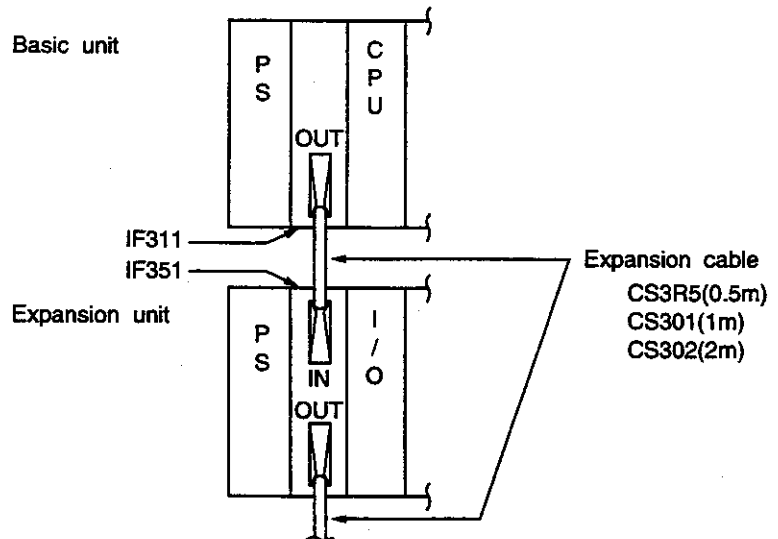
4. Installation and Wiring

4.4 Connecting expansion units

Up to three expansion units can be connected to the T3 basic unit. Either the standard type or the long-distance type of expansion configuration can be selected. For details, see 1.2 Unit configuration.

Standard expansion

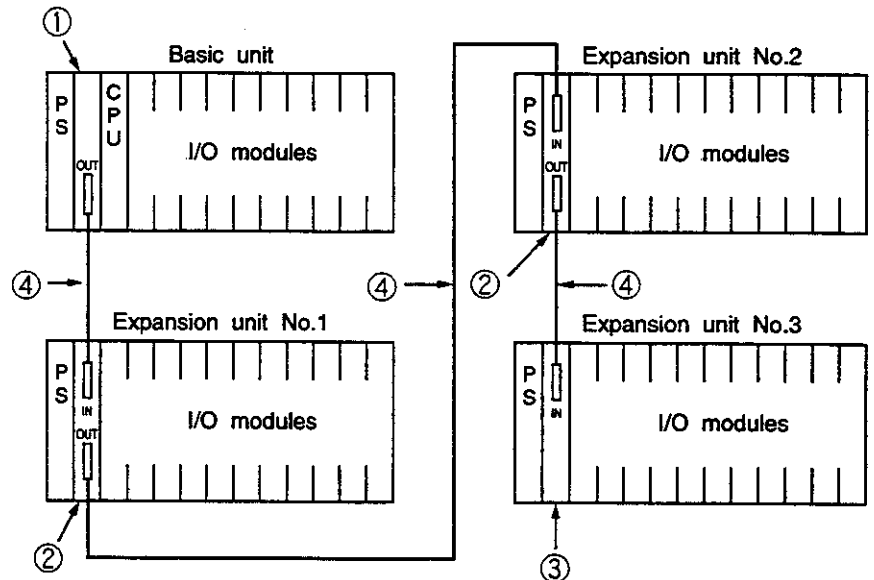
This type of expansion configuration uses the standard type expansion interface modules (IF311 for basic unit, and IF351 for expansion unit).



- The length of the expansion cable between the units is up to 2 meters, and 6 meters in total length.
- The expansion cable connects IN and OUT. Correctly connect IN and OUT.
- Keep the expansion cable away - at least 50 mm (2 inch) - from the I/O signal cables.
- For details on whether a power supply module for an expansion unit is necessary, see 1.9 Examining the power supply capacity. Change the power supply mode plug of the IF351, depending on the power supply being used. For details, see 1.6 Expansion interface module.

Long-distance expansion

The following figure outlines the long-distance expansion configuration using the long-distance type expansion interface modules (IF312 for basic unit, IF352 for middle expansion unit and IF353 for end expansion unit).



- ① Long-distance type expansion interface module IF312 (for basic unit)
- ② Long-distance type expansion interface module IF352 (for middle expansion unit)
- ③ Long-distance type expansion interface module IF353 (for end expansion unit)
- ④ Expansion cable (for long-distance expansion)
 - CL3R5 (0.5m)
 - CL301 (1m)
 - CL305 (5m)
 - CL310 (10m)
 - CL320 (20m)
 - CL340 (40m)

- Maximum total length of the expansion cables is 40m.
- Connect IN and OUT of the expansion cable. To prevent mis-connection, a colored mark is attached on each connector of the expansion cable and the module.
- The expansion cable must be separated as far as possible from power cables and I/O wires.
- Use the IF353 on the end expansion unit for termination.

4. Installation and Wiring

4.5 Grounding

To maintain the safety and stable operation of the T3, grounding is very important. Read and follow the check points below before grounding.

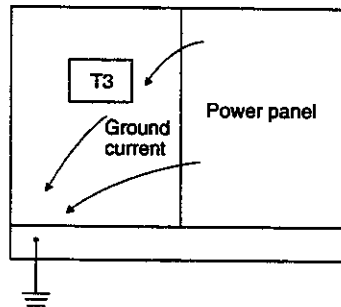
Check points for grounding

Check the grounding against the following criteria:

- (1) The T3 must not become a path for ground current. High-frequency current is particularly harmful.
- (2) Equalize the ground potentials of the basic and the expansion units. Ground them at a single point.
- (3) Do not connect the ground of the T3 to that of high-power systems.
- (4) Do not use a ground that has an unstable impedance, such as painted screws, or grounds subject to vibration.

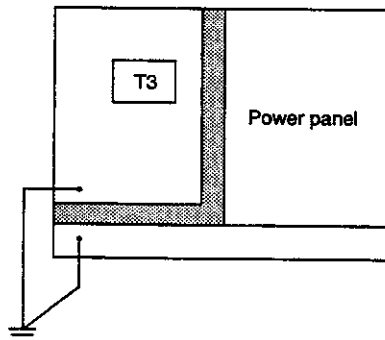
Grounding of control panel

In some cases, the T3 unit becomes a path of ground current from a power panel or high-frequency equipments.

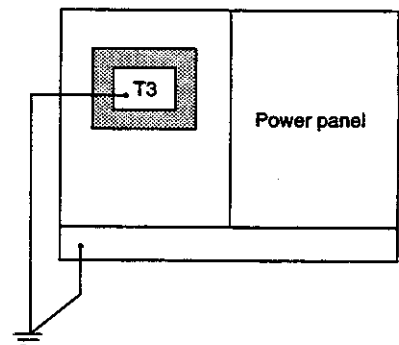


↓ Change

↘ Change

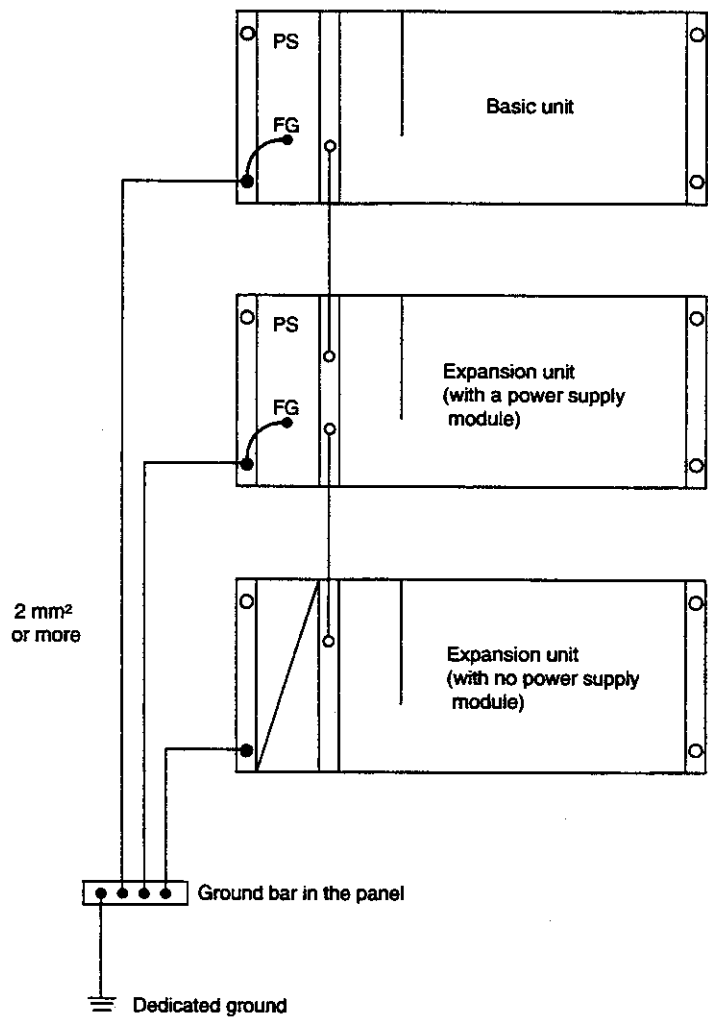


Isolate the T3 mounting panel and connect to the ground point separately.



Isolate the T3 from the mounting frame and connect to the ground point separately.

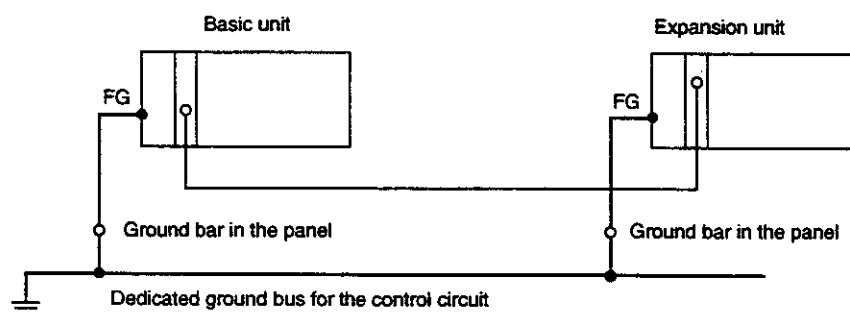
Ground connection between units



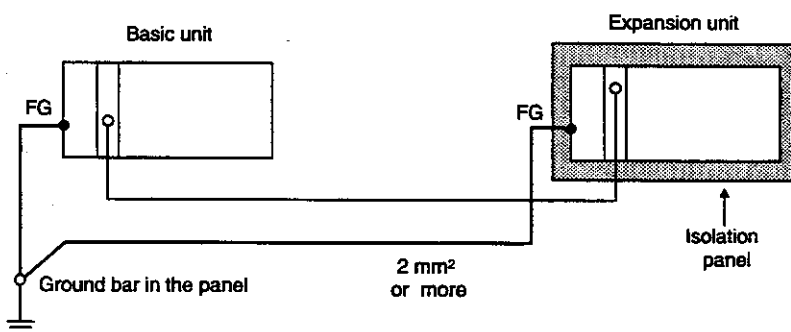
- Connect the FG terminal of the power supply module to the unit mounting screw, and to the ground bar in the panel by 2 mm² or larger wire in shortest possible distance.
- Use a dedicated ground for the control circuit, and keep the ground cable away from that for high-power systems.
- 100Ω or less to earth is recommended.

4. Installation and Wiring

Grounding of long-distance expansion



In principle, ground a long-distance expansion unit as shown in the above figure. If the potential changes at the grounding point, causing malfunctions of the T3, isolate the expansion unit from the mounting frame, and ground it with a dedicated cable (2 mm² or more).



Line filter ground (LG) terminal

The LG terminal is a neutral point of the primary power supply line filter. It can suppress the effect caused by the noise from the power supply line, by grounding the LG terminal.

Therefore, normally, ground the LG terminal together with the FG terminal.

However, depending on the power system, leakage current to the ground from the LG may cause problems. In this case, install an isolated transformer in the power line, or open the LG terminal. If the unit is installed in isolation, open the LG terminal.

Do not connect the LG and FG terminals without grounding them.

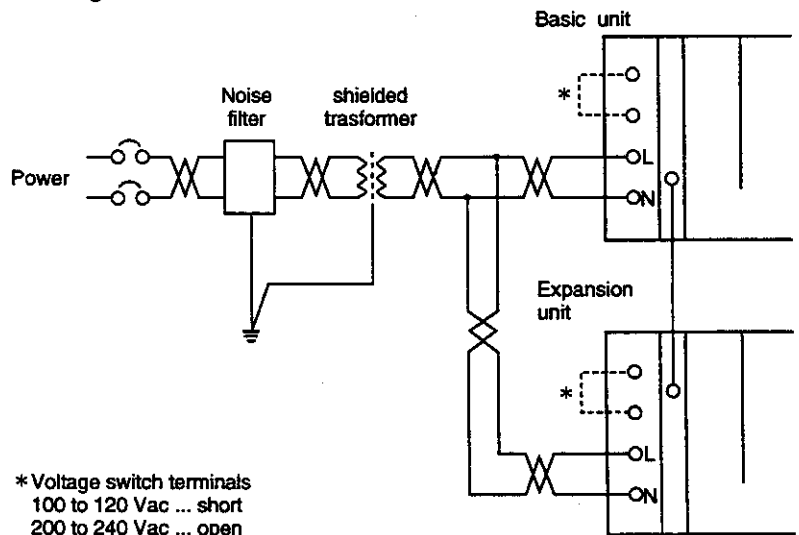
4.6 Wiring of the power supply

Wire the external power supply to the T3 power supply module. When using the expansion unit, supply the power simultaneously to the basic and expansion units.

(1) Power conditions

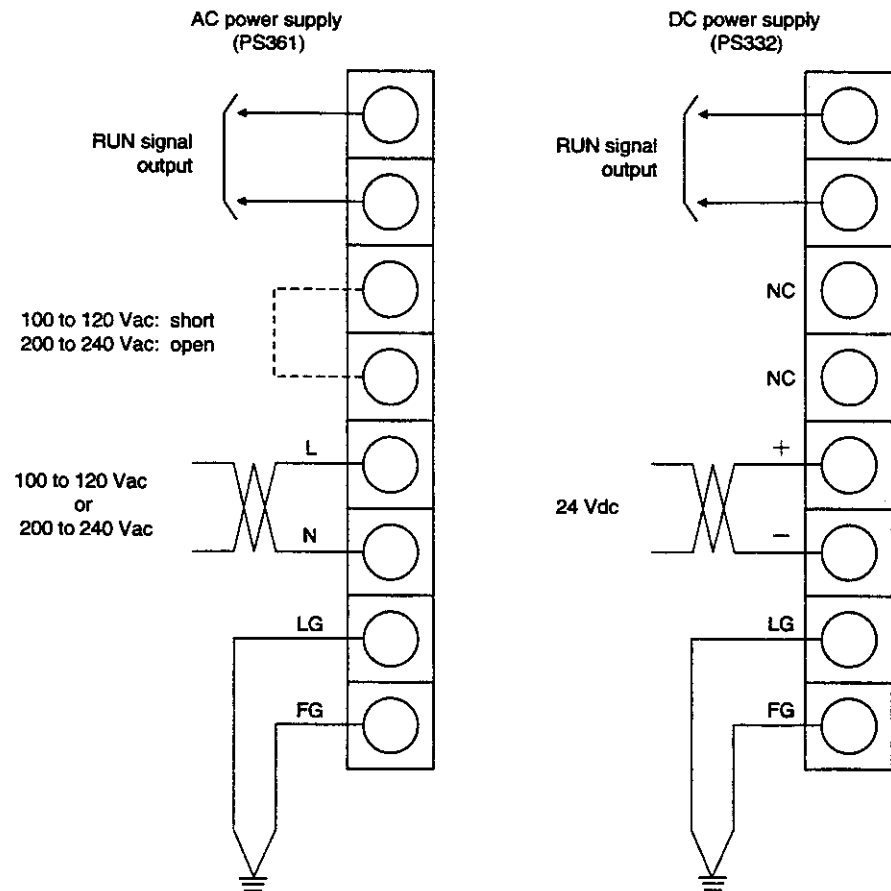
Power voltage	85 to 132 Vac/170 to 264 Vac, 50/60 Hz (PS361)
	20.4 to 28.8 Vdc (PS332)
Power consumption (per one PS)	80 VA or less (PS361)
	50W or less (PS332)
Retentive power interruption	10 ms or less

- (2) Correctly set the voltage switch terminals of the PS361 according to the power voltage. (100 to 120 Vac: short, 200 to 240 Vac: open)
- (3) Install an electrostatic shielded transformer or a noise filter if the power contains noise. See the figure at the bottom.
- (4) Use twisted-pair cables (1.25 mm²) as the power supply cable. Keep the cable as far as possible from the I/O cables.
- (5) If the expansion unit with a power supply module is used, the power for the basic and expansion units should be supplied from the same source. Apply power at the same time or in the order of the expansion unit then the basic unit.
- (6) If a CVCF or UPS supplies power to the T3, observe waveforms of the power supply; the peak voltage must be more than 130V for the 100 to 120 Vac setting or 260V for the 200 to 240 Vac setting.



4. Installation and Wiring

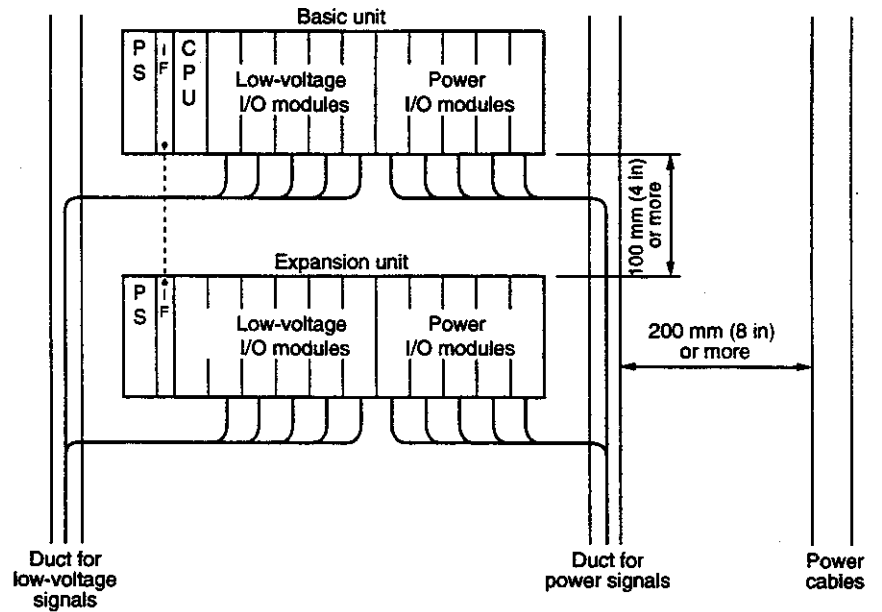
Wiring of the power supply module



- CAUTION**
- (1) The size of the terminal screw is M3.5. Use an appropriate crimp-style terminal with a width of 7 mm (0.27 in) or less for the M3.5 screw.
 - (2) The terminal block can be removed. Turn OFF the power before removing the terminal block for safety.
 - (3) The recommended cable size for the power supply module is 1.25 mm².

4.7 I/O wiring

The following module layout is recommended for noise immunity.



I/O modules for low-voltage system
DC input module
Analog input module
Analog output module
Pulse input module
ASCII module
Data link module

I/O modules for power system
AC input module
DC output module
AC output module
Relay output module

- (1) To improve the unit's resistance to signal interference, install modules for low-voltage signals toward the left of the unit, and modules for power signals toward the right. Also, separate the wires of each.
- (2) Allow at least 100 mm (4 in) clearance between the units and between other control equipment to allow access for maintenance and ventilation.
- (3) When installing the unit near high-voltage or high-power equipment, leave at least 200 mm (8 in) clearance, or shield the unit with a steel plate.

4. Installation and Wiring

- (4) Refer to the following table for the size of I/O cables.

Type of module	Cable size
16-point module	0.75~1.25 mm ²
32-point module	0.5~0.75 mm ²
64-point module	0.1~0.3 mm ²

Use a larger size cable for the common line. For the field-wiring cable, 1.25 mm² or larger cable is recommended.

- (5) The M3.5 screw is used as a terminal screw. Use an appropriate crimp-type terminal with a width of 7 mm (0.28 in) or less for the M3.5 screw.
- (6) Do not bind the I/O signal cables and high-voltage or power cables. Separate them as far as possible. If separation is difficult, use shielded cables for the I/O signals and ground the shield at the leading-in point of the control panel.

5.Maintenance and Checking

5.1 Daily checking items

To maintain the system and to prevent troubles, check the following points on daily basis.

Item	Content of checking	Corrective measures
LEDs on the power supply and CPU modules	POWER (green): Lit when 5V power normal	If the LEDs are abnormal, see Section 6, Troubleshooting.
	RUN (green): Lit when operating normally	
	FAULT (red): Not lit when the CPU normal.	
	I/O (red): Not lit when the I/O modules normal.	
	BATT (green): Lit when the battery voltage normal.	
Input LEDs (digital input)	Lit when the corresponding input signal is ON.	<ul style="list-style-type: none">●Check that the input voltage is within the specified range.●Check that the input terminal block is not loose.●Check that the modules are installed securely.
Output LEDs (digital output)	Lit when the output is ON and the corresponding external load should operate. Also, check that the LEDs (FL, FH, or F), which indicate a blown fuse and/or abnormal external power, are not lit.	<ul style="list-style-type: none">●Check that the external load voltage is within the specified range.●Check the built-in fuses.●Check that the output terminal block is not loose.●Check that the modules are installed securely.
Switches on the CPU module	Check that the operation mode switch (HALT/RUN/P-RUN) and the RAM/ROM switch are at the correct position. Operations are executed when the mode switch is set to RUN or P-RUN.	Change the switch to the correct position.



CAUTION If a serious error (e.g., the system RAM abnormal) is detected when the power is turned ON, the FAULT and I/O LEDs will blink. In this state, communication with the programmer is not possible. If that error continues even if the power is again turned ON, replace the CPU module.

5.Maintenance and Checking

5.2 Periodical checking items

Check the T3 based on the following points every six months.
Also perform checks when the operating environment is changed.

Item	Content of checking	Corrective measures
Power supply	Measure the voltage of the power (at the terminal of the module)	85 to 132/170 to 264 Vac 20.4 to 28.8 Vdc
	Check that the terminal screw of the module is not loose.	Check that the terminal screw of the module is not loose.
	Check that wiring cable is not damaged.	Check that wiring cable is not damaged.
Installation condition	Check that the basic unit is installed securely.	Not loose, no play
	Check that the expansion unit is installed securely.	Not loose, no play
	Check that each module is installed securely.	Not loose, no play
	Check that each expansion cable connector is not loose; and the cable is not damaged.	Not loose, not damaged
Programmer	Check that the functions of the programmer are normal.	Try executing simple operations.
	Check that the connector and the cable are not damaged.	Not damaged
I/O modules	Measure the voltage of each of the I/O modules at the terminal block.	The voltage must be within the specified range.
	Check the LED of the input status display.	The LED must light normally.
	Check the LED of the output status display.	The LED must light normally.
	Check that the I/O terminal block is installed securely.	Not loose, no play
	Check that the terminal screw is not loose and the terminal has a sufficient distance to the next terminal.	Not loose, and not contacting the next terminal
	Check that the wiring cable is not damaged.	Not damaged
Environment	Check that the temperature, humidity, vibration, dust, etc. are within the specified range.	Must be within the general specification range.
Program	Check that the content of the PLC program and the master program (e.g., saved on a floppy disk) are the same.	Check that these programs are identical by comparison.
Battery	Check whether the battery must be replaced. (The installed date is written on the rear of the CPU battery cover.)	Replace the current battery if more than two years has elapsed.
	Check that the connector of the battery is inserted firmly.	Not loose

5.3 Maintenance parts

To recover from failure quickly, it is recommended to keep the following spare parts:

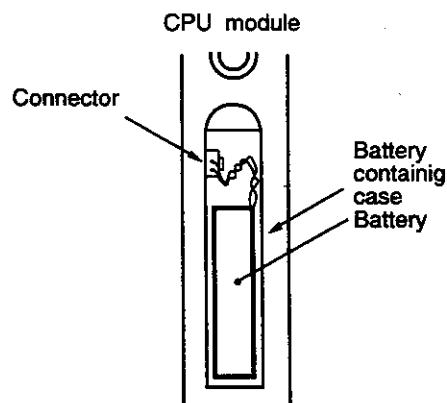
Part	Quantity	Remarks
I/O module	One of each type used	Check the service life of the relay output. See Section 2.3.
Fuse	Number to be used	See Section 5.5.
Battery	1	For emergency. See Section 5.4.
CPU module	1	Prepare at least one each to minimize the down-time of the system.
Power supply module	1	
Programmer	1	Useful for the troubleshooting procedure.
Master program	As required	Saved in a disk, or other media.

- Do not store spare parts in high temperature and humidity locations.
Keep the temperature at ordinary room temperature or below because the battery discharges when the ambient temperature is high.

5.4 Replacing battery

The lithium battery is used for maintaining the T3's RAM memory during power OFF. The battery is installed at factory shipment. The installed date of the battery is marked on the rear of the battery cover of the CPU module. Under normal service conditions, it is recommended to replace the battery every two years. Check the installed date and replace the battery with a new one if two years have elapsed.

The LED (BATT), which indicates the battery voltage is normal, is installed in the front of the CPU module. The LED lights when the battery voltage is normal. If this LED does not light or blinks, the service life of the battery has ended. Replace the battery within 14 days. To maintain the RAM program, it is recommended to keep the power ON until the battery is replaced.



- ① Remove the battery cover.
- ② Remove the battery from its case.
- ③ Unplug the connector of the battery.
- ④ Connect a new battery connector.
- ⑤ Insert a new battery into its case.
- ⑥ Mount the battery cover on its case.

5. Maintenance and Checking

CAUTION



1. The battery can be replaced either with power ON or with power OFF.
However if the battery is replaced with power OFF, insert a new battery within five minutes after the old battery is removed. If the new battery is not inserted quickly, the data in RAM memory will be lost.
2. Keep the following points in mind when handling batteries.
 - Do not replace a lithium battery with a manganese dry cell or an alkaline battery since their voltages are not compatible with the former.
 - Do not short the + (positive) and the - (negative) terminals of the battery.
 - Do not dismantle, or apply heat to, or throw the battery into fire.
 - Do not try to charge a battery. This is dangerous.
3. The battery is dedicated for Toshiba PLC. Order it from Toshiba. (Part code: TBT911*AS)

5.5 Replacing fuses

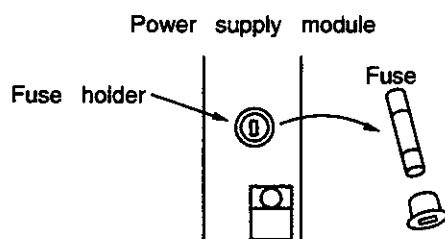
The following modules have built-in protection fuses.

Name of module (type)	Fuse type	Number of units	Fuse rating
AC power supply (PS361)	FU913	1	250 Vac - 3A
DC power supply (PS332)	FU916	1	250 Vac - 6A
DC output (DO333)	FU916	2	250 Vac - 6A
DC output (DO334)	FU916	2	250 Vac - 6A
AC output (AC363)	FU916	2	250 Vac - 6A
AC output (AC364)	FU916	2	250 Vac - 6A

The AC and DC power supply modules have a built-in protective fuse to prevent burn-out of internal circuits of the modules. Over long term use, ON/OFF changes of the power may cause fatigue; check the fuse periodically (a spare fuse is attached). The above output modules have protective fuses to prevent their internal circuits from burn-out when short-circuit occur. In the front of each output module, the LEDs (FL, FH or F) which indicate the status of fuses are provided. When a fuse is blown, these LEDs light.

5. Maintenance and Checking

- Replacing the fuse of the power supply module



- ① Remove the fuse holder from the front of the module.
- ② Remove the blown fuse.
- ③ Install a new fuse.
- ④ Attach the fuse holder.

5. Maintenance and Checking

5.6 IC memory card handling

By inserting the IC memory card (type: ME914) into the CPU module, program loading/saving between the IC memory card and T3's memory or use of expanded file registers become available. (For details, refer to the "T3 User's Manual - Functions" in a separate volume.) By inserting the IC memory card which stores a user program, the program can be transferred to the RAM of the CPU without using the programmer. Use the following procedure:

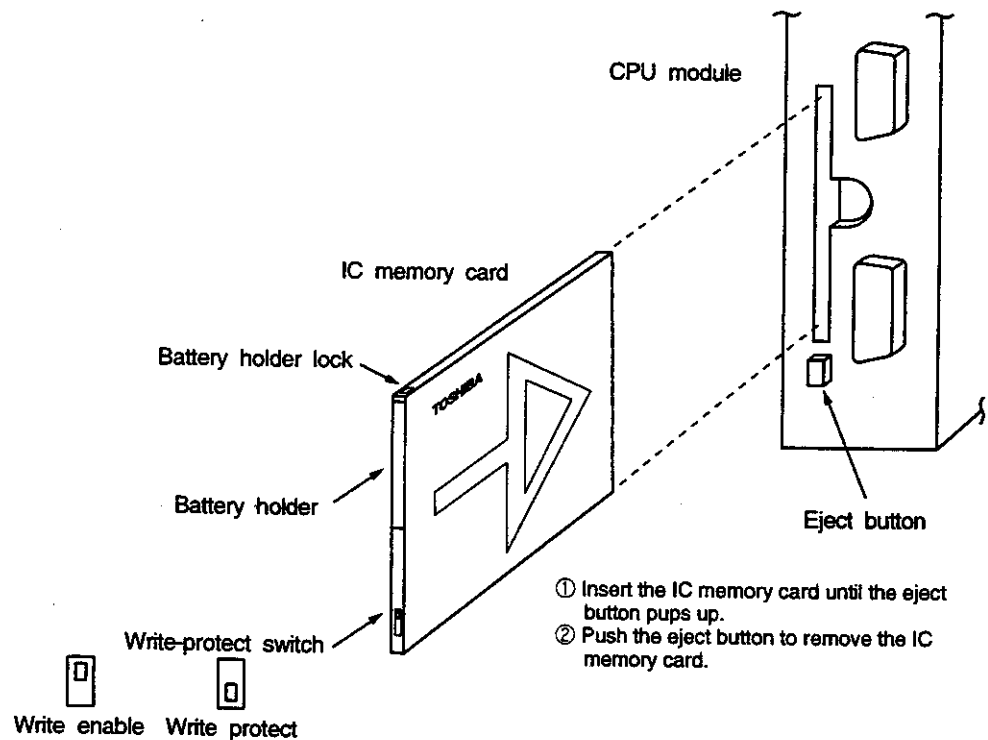
- ① Turn OFF power. Insert the IC memory card into the CPU module.
- ② Set the RAM/ROM switch of the CPU module to ROM, and set the operation mode switch to HALT.
- ③ Turn ON power.

The above procedure enables the program stored in the IC memory card to transfer the RAM memory of the T3.

Note the following points when handling the IC memory card.

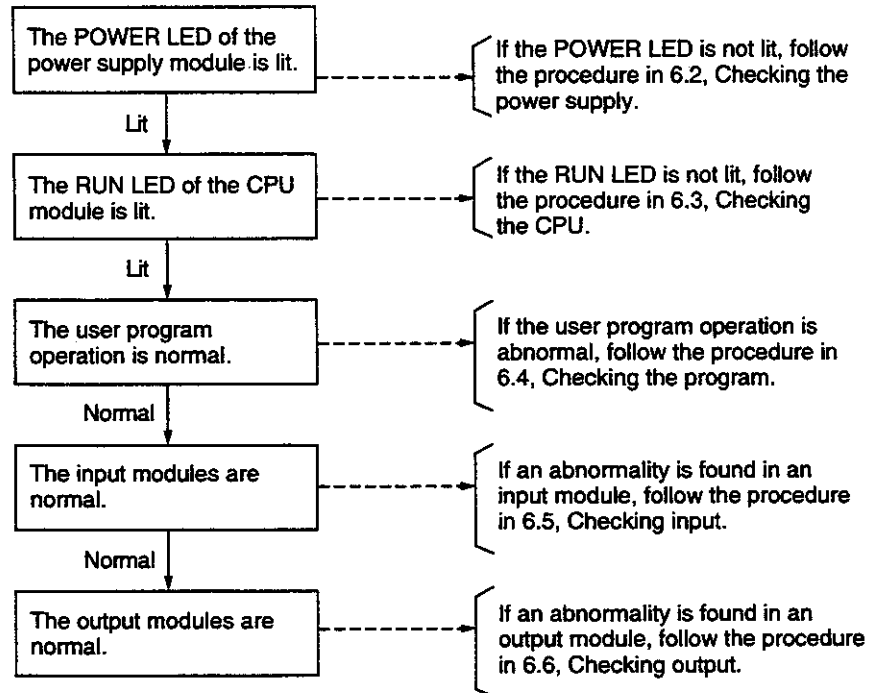
- (1) The IC memory card can be inserted or ejected while power ON.
- (2) To maintain the memory, the IC memory card has a built-in battery (coin type lithium battery CR2325, approx. one year of service life at 20°C).

If power is applied to the IC memory card for more than ten minutes before removing the card, it can maintain the memory for approx. 30 minutes after the lithium battery is removed. However, memory on the IC memory card disappears if a longer time has elapsed.



6.1 Troubleshooting procedure

If a trouble occurs, determine whether the cause lies on the mechanical side or on the control system (PLC) side. A problem may cause a secondary problem, therefore, try to determine the cause of the trouble by considering the whole system. If the problem is found in the T3 or in the T3's I/O operation, check the following points:



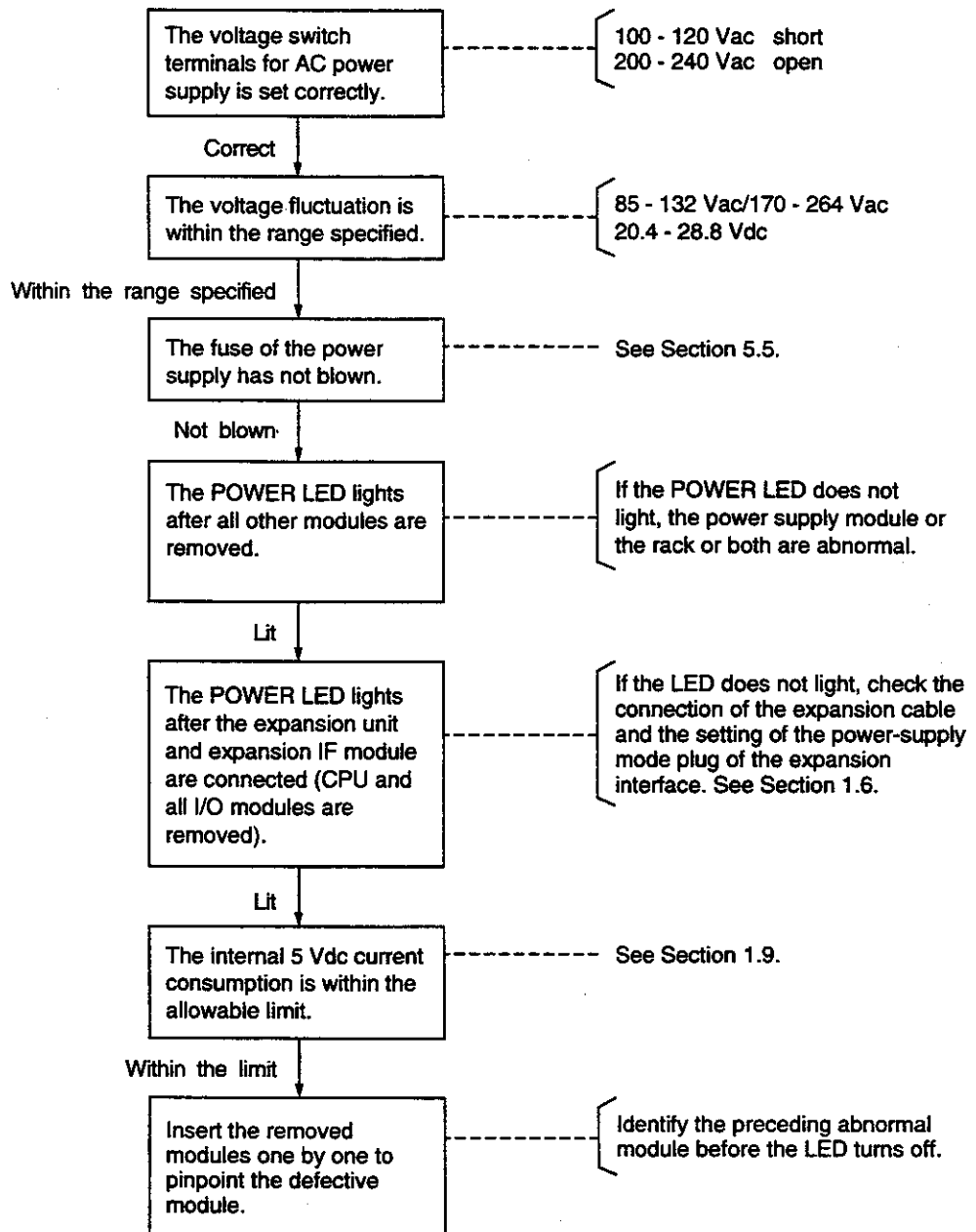
If the problem appears temporary and is synchronous with the operation of the system/equipment, the external environment (noise, voltage fluctuations, etc.) may have caused it. For details, follow Section 6.7.

6. Troubleshooting

6.2

Checking the power supply

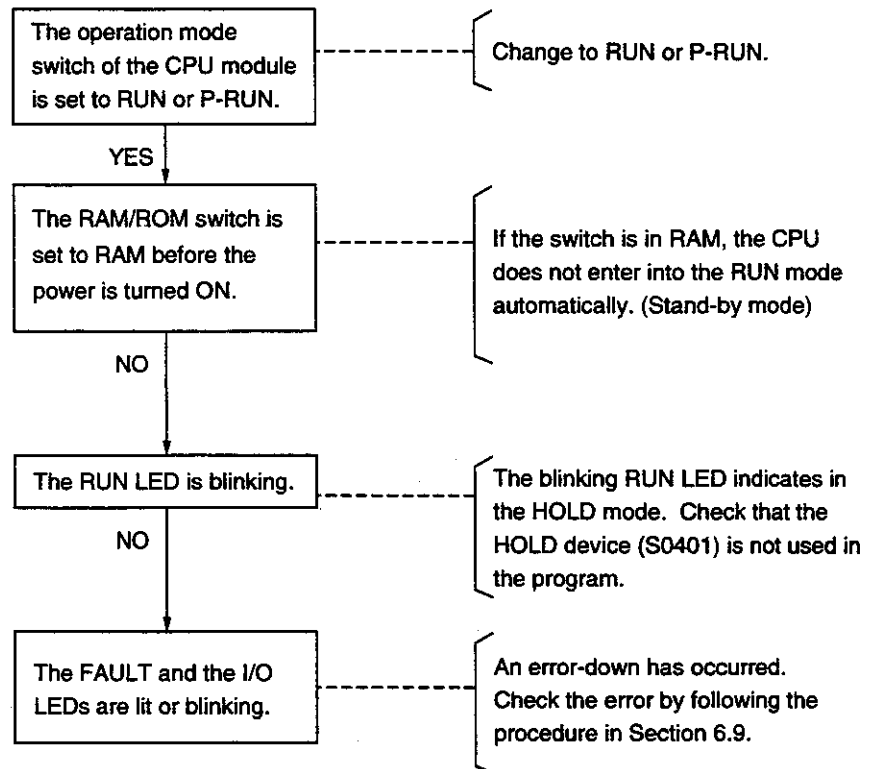
If the POWER LED in the front of the power supply module does not light after power ON, check the following points:



- (1) Turn OFF power before disconnecting cables and removing modules.
- (2) The blown fuse of the power supply may be caused by a failure of an internal circuit.

6.3 Checking the CPU

If the POWER LED is lit, but the RUN LED is not lit, check the following points:



6.4 Checking program

Check the program based on the following points if it is running but the operation does not work as intended.

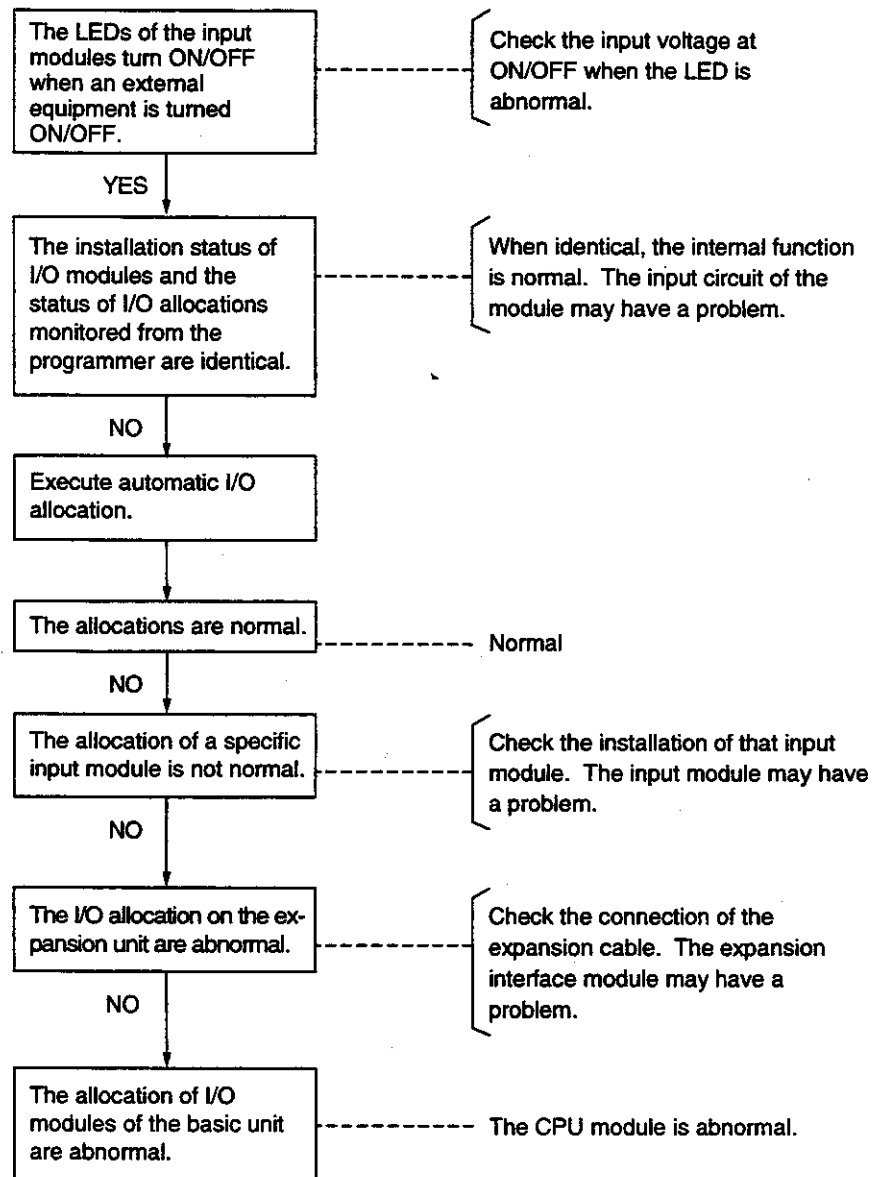
- (1) Output is not carried on the same coil or register of two or more locations during one scanning; the devices for coil instructions and for function instructions are not overlapping.
- (2) The signal which changes faster than the scanning cycle is not input.
- (3) Timer register or counter register is not duplicated.
- (4) When an interrupt is used, the device/register which is used in the main program is not operated erroneously in the interrupt routine.

6. Troubleshooting

6.5

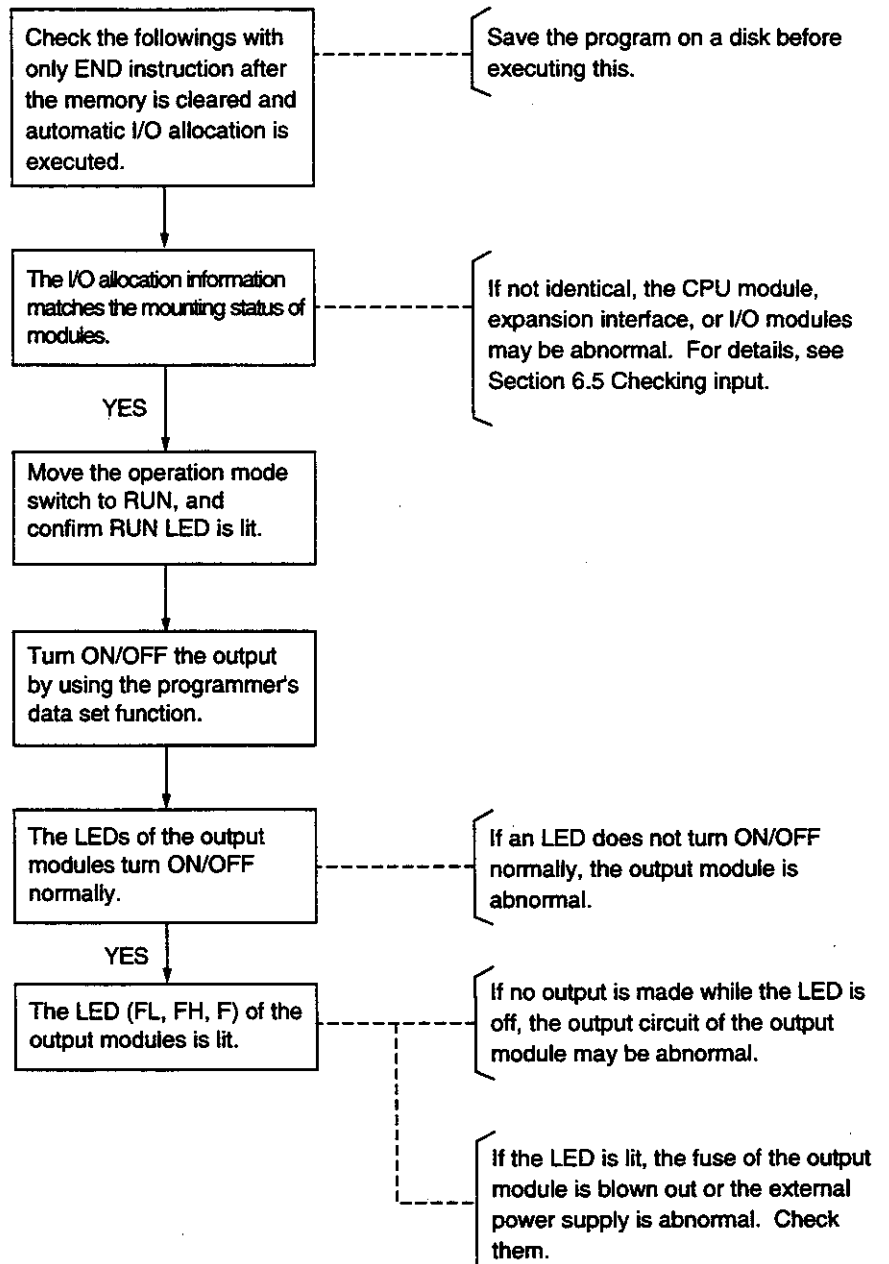
Checking input

If the program is running, but the input signal is not read normally, check the following points:



6.6 Checking output

If the output to registers and devices is normal, but the actual output to equipment is abnormal, check the following points:



6. Troubleshooting

6.7

Troubles due to external factors

If one of the following abnormalities occurs in the system, check possible external factors.

- (1) If an abnormality occurs synchronously with the operation of I/O equipment:
The noise caused at ON/OFF of the output equipment may be the source of the abnormality. Take necessary measures mentioned in Section 3 Precautions for I/O modules.
- (2) If an abnormality occurs synchronously with the operation of surrounding equipment or high-frequency equipment:
The noise induced on I/O signal lines may be the source of the abnormality. The surge voltage, voltage fluctuations, or differences of grounding potentials may have caused the abnormality, depending on the power supply system or the grounding system.
Check the abnormality in accordance with the precautions in Section 4 Installation and Wiring. For some cases, isolation from the ground may lead to the stable operation.
- (3) If an abnormality occurs synchronously with the operation of machinery:
The vibration of the equipment may have caused the abnormality.
Check that the installation status of the units and modules and take necessary measures, including the use of vibration-proof installation.
- (4) If a similar failure is repeated after the module is replaced:
Check that no metal debris or water drops have been entered into the unit/module.
Apart from the above points, consider environmental conditions. If the ambient temperature is beyond the specified range, stable operation of the system is not guaranteed.

6.8 I/O module replacement during operation

If an I/O module becomes abnormal during operation, the module can be replaced with a new one during the system operation. The procedure is as follows:

- ① Connect the programmer to the CPU module.
- ② From the programmer, specify the module for removal. (The module is disconnected from the T3 operation.)
- ③ Remove the failed module.
- ④ Insert a new module.
- ⑤ By using the programmer, cancel the function for removal.

This function can be applied to the following failures of discrete I/O modules.

- An input module does not read the specific signal (failure of the input photo-coupler, etc.).
- An output module does not output a specific signal (failure of the output device, etc.).
- The fuse of an output module has blown out.



- (1) Except when using this function, turn OFF power before replacing a module. Exercise caution when this function is used for safety.
- (2) Effective I/O modules for this function are the discrete I/O modules.
(See separate T3 User's Manual-Functions, for details.)
- (3) Refer to 4.3 Mounting modules, for replacing I/O modules.

6. Troubleshooting


6.9

List of self-diagnostic items





If an error is found through the self-diagnostic check of the CPU of the T3, error messages (and related information) shown in the tables on the following pages will be recorded in the T3's event history table. If the error is so severe and continuation of operation is not possible, the T3 turns OFF all outputs and stops the operation (error-down).

The latest 30 error messages and the time and date of the errors are stored in the event history table. Those error messages can be displayed on the programmer. (Power ON/OFF is also registered.)

If the T3 has entered to error-down, connect the programmer to the T3 to confirm the error message in the event history table. The procedure to display the event history is as follows:

- ① Connect the CPU module of the T3 and the programmer (T-PDS) via dedicated cable.
- ② Turn ON the power of the programmer (T-PDS). The power of the T3 must be turned ON in advance.
- ③ Type "TPDS  " from the programmer (T-PDS) to start the T-PDS.
- ④ Press any key to display the main menu of the T-PDS. At this time, check that "Receive timeout" is not displayed on the screen.
- ⑤ In this state, type the S and E keys to display the event history.

(An example of the event history display)

<Event History>							
	Date	Time	Event	Count	Info 1	Info 2	Info 3 Mode
1.	94-04-12	09:23:09	I/O no answer	5	800-03	YW001	RUN 
2.	94-04-12	09:18:08	System power on	1			INIT.
3.	94-03-25	13:27:30	System power off	1			RUN
4.	94-03-25	13:10:04	LP exec timeout	1			RUN 
5.	94-03-25	13:01:01	LP exec timeout	1			RUN 
6.	94-03-25	12:54:06	LP exec timeout	1			RUN 
7.	94-03-25	11:50:23	Boundary error	255	M-001	80007	025 RUN
8.	94-03-25	10:44:08	System power on	1			INIT.
9.	94-03-23	14:30:47	System power off	1			RUN
10.							
11.							
12.							
13.							
14.							
15.							


PLDERROR	PROG	Event							
Next							Control	Cancel	
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10

When "Receive timeout" is displayed on the screen, communications between the programmer (T-PDS) and T3 are not established. Blinking FAULT or I/O LEDs indicates a failure of the CPU. If this state continues even after the power turned ON again, replace the CPU module with a new one. If "Receive timeout" is displayed on the screen while FAULT or I/O is ON and not blinking, check the setting environment of the programmer (T-PDS) and the connection cable. If these are correct, the communication circuit of the CPU module or programmer may have become abnormal.

When the event history is displayed, check the error messages registered. Error message No.1 indicates the latest event registered.

The following pages of this manual explain, error messages and related information, relevant special relays, the status of LEDs after event occurrences, and their meanings. If an error occurs, identify the cause of the error based on the error message on the screen and take necessary measures.

In the error-down state, operations to correct the program are not accepted. In this case, execute Error reset from the programmer to return to the HALT mode before starting the correction operation. To activate RUN again, turn the operation mode switch to HALT and change to RUN (or P-RUN), or execute an operation command from the programmer.

CAUTION  If the CPU module has an EEPROM or an IC memory card, the program of the EEPROM or the IC memory card will be transferred to RAM when the RAM/ROM switch is set to ROM and RUN is activated (except when the operation mode switch is set to P-RUN); in this case, the corrections on RAM memory will be lost. Therefore, to check the operation of a program corrected in the RUN mode, turn the RAM/ROM switch to RAM before activating RUN.

The meanings of LED displays shown in the tables on the following pages and onward are as follows:

- : Lit
- : Not Lit
- ◐ : Blinking
- : No effect on state

6. Troubleshooting

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
Power supply	System power on								Power ON (no error)
	System power off								Power OFF (no error)
	Expansion unit err.				S0005 S0024	○	●	●	The 5-volt power of the expansion unit, or the termination of the expansion IF module is not normal. Check whether power supply to the expansion unit is overload; the power supply of the basic unit is ON but the power supply of the expansion unit is OFF; and the expansion IF module is terminated correctly.
Memory	Power interrupt				S001D	○	●	○	A power interruption is detected. When the power interruption detecting function is used, the operation is stopped if a power interruption longer than the specified time is detected.
	Power intr resumed				S001C				The power interruption has been recovered. When the hot restart function is used, the operation is restarted without initialization.
	RAM check error	Address of the error occurred	Error data	Test data	S0004 S0012	○	●	○	An abnormality has been found in executing read/write check on the user data memory (RAM). If the abnormality continues after the power supply is turned ON again, replace the CPU module.
	Program BCC error	BCC error data			S0006 S0030	○	●	○	BCC check of the user program memory (RAM) has detected an abnormality. After "clear memory" is executed, reload the program.
	Batt voltage drop				S000F	—	—	—	When turning the power ON, the voltage drop of the battery to back up the RAM memory has been detected. (The BATT LED is off. No error-down.) Replace the battery with a new one.

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
Memory	EEPROM BCC error	BCC error data			S0004 S0023	○	●	○	BCC abnormality has been detected in the user program of the EEPROM (transfer is not executed). Check the program and try writing into the EEPROM again.
	EEPROM warning	Number of times of writing exceeded			S0007	—	—	—	The number of times of writing into the EEPROM has exceeded the service life (100,000 times). Because the possibility of an abnormality in writing into the EEPROM will rise, replace the CPU module with a new one.
CPU	Sys RAM check err	Address of the error occurred	Error data	Test data	S0004 S0011	○	●	○	Read/write check of the system memory (RAM) has detected an abnormality. If the abnormality continues after turning ON the power again, replace the CPU module.
	Sys ROM BCC error	Abnormal BCC data			S0004 S0010	○	●	●	The BCC check of the system ROM has detected an abnormality. If the abnormality remains after the power is turned ON again, replace the CPU module.
	Peripheral LSI err	Error code			S0004 S0016	○	●	●	Checking the peripheral control LSI of the CPU module has detected an abnormality. If the abnormality continues after the power is turned ON again, replace the CPU module.

6. Troubleshooting

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
CPU	Clock-calendar err				S000A	—	—	—	An abnormality has been detected in the data of the built-in calendar LSI (No error-down occurs). If the abnormality remains after the calendar is reset, replace the CPU.
	Illegal sys intrpt	Interrupted address 1	Interrupted address 2			—	—	—	The CPU module received a request for interrupt not registered (No error-down occurs). If the abnormality occurs frequently, replace the CPU module.
	WD timer error	Address 1	Address 2		S0004 S001F	○	●	○	A watchdog timer error has been detected. If the abnormality occurs frequently, replace the CPU module.
	I/O bus error	Unit No.	Data		S0005 S0020	○	●	●	An abnormality has been detected in I/O bus checking. Check that the connection of cables and the mounting conditions of the modules are correct.
I/O	I/O mismatch	Unit No. - Slot No.	Register No.		S0005 S0021	○	●	●	The I/O allocation information and the actual I/O module mounting are not identical. Set the I/O allocation information correctly.
	I/O no answer	Unit No. - Slot No.	Register No.		S0005 S0022	○	●	●	I/O modules are not mounted in the slots where I/O allocation is specified. Mount modules in the slots, or activate the system in the RUN-F mode (forcible operation).
	I/O parity error	Unit No. - Slot No.	Register No.		S0005 S0023	○	●	●	A parity error has been detected when transferring data from/to I/O modules. Check the mounting condition of the I/O modules.

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
I/O	Invalid I/O Intrpt	Unit No. - Slot No.			S0005 S0025	—	—	—	A request for I/O interrupt from an interrupt module not registered has been detected (No error-down occurs). Register the interrupt module, or do not mount that interrupt module.
	Duplicate I/O reg	Unit No. - Slot No.	Register No.		S0005 S0021	○	●	●	An overlap is detected in allocating I/O registers to I/O modules. Correct the I/O allocation information.
	Illegal I/O reg	Unit No. - Slot No.	Register No.		S0005 S0021	○	●	●	The allocation of I/O modules to I/O registers has exceeded the limit. Reduce the number of allocations to I/O modules.
	LP function error	Error code	Error data		S0004 S0015	○	●	○	An abnormality is detected in the language processor (LP). If the abnormality remains after power cycle, replace the CPU module.
Proc- essing	LP reg R/W error	Port No.	Error data	Test data	S0004 S0015	○	●	○	At initial setting of the language processor (LP), an abnormality has occurred in the read/write checking. If the abnormality remains after power cycle, replace the CPU module.
	LP exec timeout				S0004 S0015	○	●	○	The execution of the language processor (LP) did not finish within a time specified. Reduce the program execution time or use the "WDT" instruction. If the situation is repeated after power cycle, replace the CPU module.
	Scan time over	Scan time			S0006 S0031	○	●	○	The scan time exceeded 200 ms. Reduce the scan time or use the "WDT" instruction.

6. Troubleshooting

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
Program	END/IRET error	Program type - Block No.	Address in the block		S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	The "END" instruction has not been found in the main program or in the subprogram, or the "IRET" instruction has not been found in the interrupt program. Write the "END" instruction or the "IRET" instruction at the end of the program.
	Pair inst error	Program type - Block No.	Address in the block		S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	An abnormality has been found in combination of the MCS/R and JCS/R instructions. Check the combination of MCS/R and JCS/R instructions is correct.
	Operand error	Program type - Block No.	Address in the block		S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Specifying the operand for the coil instruction or the FUN instruction is abnormal. Check that an input (X) is not allocated to an output operand.
	Invalid program	Program type - Block No.			S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	An abnormality is detected in the program management information. Execute "Clear memory" and re-load the program.
	Jump target error	Program type - Block No.	Address in the block	Jump label No.	S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	The "LBL" instruction for the "JUMP" instruction is not programmed in the same program type. Or, the "LBL" instruction is programmed at an address before the "JUMP" instruction (backward jump). Insert the "LBL" instruction at the right position.

6. Troubleshooting

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
Program	No sub-r entry	Program type - Block No.	Address in the block	Subroutine No.	S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	The "SUBR" instruction of the subroutine No. specified by the "CALL" instruction is not programmed. Insert the "SUBR" instruction.
	No RET error	Program type - Block No.	Address in the block	Subroutine No.	S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	The "RET" instruction is not programmed in the subroutine. Insert the "RET" instruction.
	Sub-r nesting err	Program type - Block No.	Address in the block	Subroutine No.	S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	The number of nesting of subroutines exceeds six overlays. Change the program to reduce the number of nesting overlays to six or fewer.
	Loop nesting error	Program type - Block No.	Address in the block		S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	The number of nestings of "FOR" and "NEXT" instructions exceed six overlays. Reduce the number of overlays of the "FOR" and "NEXT" instructions to six or fewer in the program.
	SFC step No. error	Program type - Block No.	Step No.		S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Step No. is duplicated in the SFC program, or the step Nos. specified by the initial step and the end step are not identical. Change the step No., or check the step No. of the end step.
	SFC macro No. err	Program type - Block No.	Macro No.		S0006 S0030	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Macro No. is duplicated, or the same macro program is called from two or more locations. Change the macro No. Or, limit the calling of the macro program to one location.

6. Troubleshooting

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
Program	No SFC macro entry	Program type - block No.	Macro No.		S0006 S0030	○	●	○	The macro program specified by macro step is not programmed. Check that the macro program has been programmed, and that the macro No. is correct.
	SFC jump label err	Program type - block No.	SFC label No.		S0006 S0030	○	●	○	The SFC label No. is duplicated. Change the SFC label No.
	No SFC jump label	Program type - block No.	SFC label No.		S0006 S0030	○	●	○	The SFC label instruction specified by the SFC jump instruction is not programmed. Insert the SFC label instruction.
	Duplicate SFC No.	Program type - block No.	SFC program No.		S0006 S0030	○	●	○	The SFC program No. is duplicated. Change the SFC program No.
	Invalid SFC prog	Program type - block No.			S0006 S0030	○	●	○	The correspondences between the initial step and end step or SFC end, or macro entry and macro end do not match. Change the program so that the correspondences match.
	Illegal Inst	Program type - block No.	Address in the block		S0006 S0030	○	●	○	An illegal instruction has been detected in the program. After executing "Clear memory," reload the program.
	Invalid Fun Inst	Program type - block No.	Address in the block	FUN No.	S0006 S0030	○	●	○	An instruction which is not supported by T3 has been detected. Erase the relevant instruction.
	Boundary error	Program type - block No.	Address in the block	FUN No.	S0064 or S0065	—	—	—	The operand specified by Indexed FUN instruction has exceeded the limit. Check the value of the index register.
	Duplicate entry No.	Program type - block No.	Address in the block	Entry No.	S0006 S0030	○	●	○	"LBL" or "SUBR" instruction is duplicated. Check the program.

Part	Error message and related information				Relevant special relay	LED displays			Meaning of the error and countermeasures
	Error message	Information 1	Information 2	Information 3		RUN	FAULT	I/O	
IC memory card	IC card BCC error				S0004 S0014	○	●	○	BCC error has been detected in the user program stored in the IC memory card (transfer is not executed).
	IC card type error				S0004 S0014	○	●	○	When the initial load is executed from the IC memory card at power up, loading cannot take place because the program capacity in the IC memory card is greater than the RAM capacity of the T3.

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