

Chapter 9. INSTALLATION AND WIRING

9.1 Installation

9.1.1 Installation Environment

This unit has high reliability regardless of its installation environment, but be sure to check the following for system reliability.

1) Environment requirements

Avoid installing this unit in locations which are subjected or exposed to:

- (1) Water leakage and dust.
- (2) Continuous shocks or vibrations.
- (3) Direct sunlight.
- (4) Dew condensation due to rapid temperature change.
- (5) Higher or lower temperatures outside the range of 0 to 55
- (6) Relative humidity outside the range of 5 to 95
- (7) Corrosive or flammable gases

2) Precautions during installing

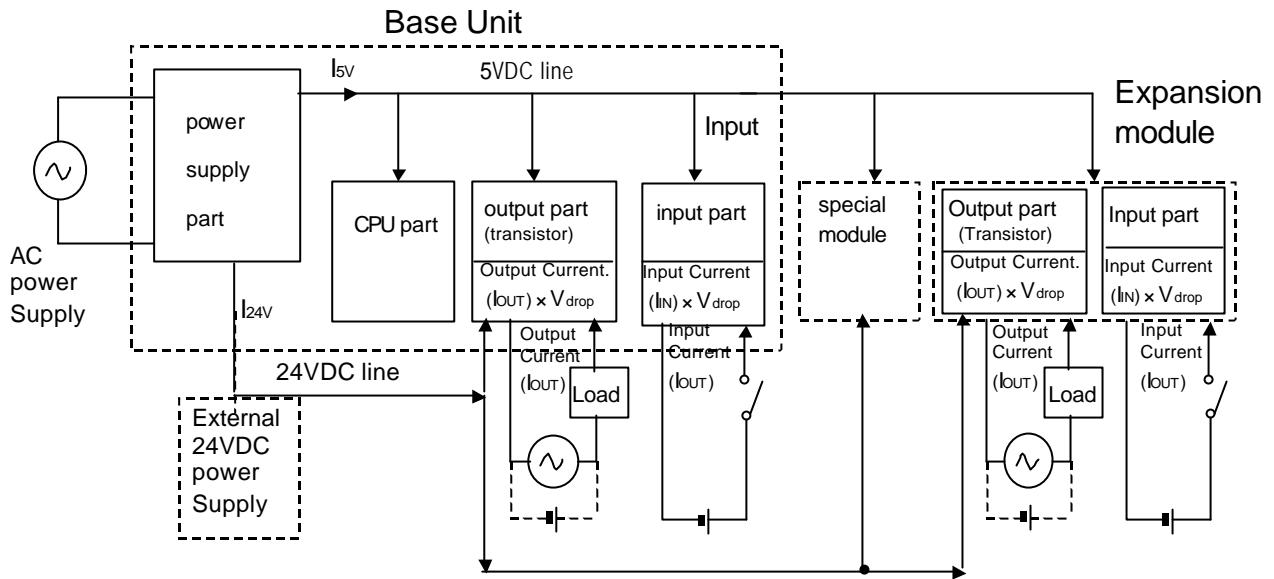
- (1) During drilling or wiring, do not allow any wire scraps to enter into the PLC.
- (2) Install it on locations that are convenient for operation.
- (3) Make sure that it is not located on the same panel that high voltage equipment located.
- (4) Make sure that the distance from the walls of duct and external equipment be 50mm or more.
- (5) Be sure to be grounded to locations that have good ambient noise immunity.

3) Heat protection design of control box

- (1) When installing the PLC in a closed control box, be sure too design heat protection of control box with consideration of the heat generated by the PLC itself and other devices.
- (2) It is recommended that filters or closed heat exchangers be used.

The following shows the procedure for calculating the PLC system power consumption.

1) PLC system power consumption block diagram



2) Power consumption of each part

(1) Power consumption of a power supply part

Approximately 70% of the power supply module current is converted into power 35% of that 65% dissipated as heat, i.e., 3.5/6.5 of the output power is actually used.

- $W_{pw} = 3.5 / 6.5 \{ (I_{5v} \times 5) + (I_{24v} \times 24) \}$ (W)

where, I_{5v} : 5VDC circuit current consumption of each part

I_{24v} : 24VDC circuit average current consumption of output part (with points simultaneously switched ON). Not for 24VDC power supplied from external or power supply part that has no 24VDC output.

(2) Total 5VDC power consumption

The total power consumption of all modules is the power of the 5VDC output circuit of the power supply part.

- $W_{5v} = I_{5v} \times 5$ (W)

(3) Average DC24V power consumption (with points simultaneously switched ON)

The total power consumption of all modules is the average power of the DC24V output circuit of the power supply part.

- $W_{24v} = I_{24v} \times 24$ (W)

(4) Average power consumption by voltage drop of output part (with points simultaneously switched ON)

- $W_{out} = I_{out} \times V_{drop} \times \text{output points} \times \text{the rate of points switched on simultaneously}$ (W)

- I_{out} : output current (actual operating current) (A)
- V_{drop} : voltage dropped across each output load (V)

- (5) Average power consumption of input circuits if input part (with points simultaneously ON)
- $W_{in} = I_{in} \times E \times \text{input points} \times \text{the rate of points switched on simultaneously (W)}$
- [I_{in} : input current (effective value for AC) (A)
 E : input voltage (actual operating voltage) (V)

- (6) Power consumption of the special module
- $W_s = I_{5V} \times 5 + I_{24V} \times 24$ (W)

The sum of the above values is the power consumption of the entire PLC system.

- $W = W_{PW} + W_{5V} + W_{24V} + W_{out} + W_{in} + W_s$ (W)

Check the temperature rise within the control panel with calculation of that total power

consumption(W). The temperature rise in the control panel is expressed as:

$$T = W / UA \text{ [}^\circ\text{C]}$$

{ W : Power consumption of the entire PLC system(obtained as shown above)
 A : Control panel inside surface area [m^2]
 U : if the control panel temperature is controlled by a fan, etc 6
if control panel air is not circulated 4

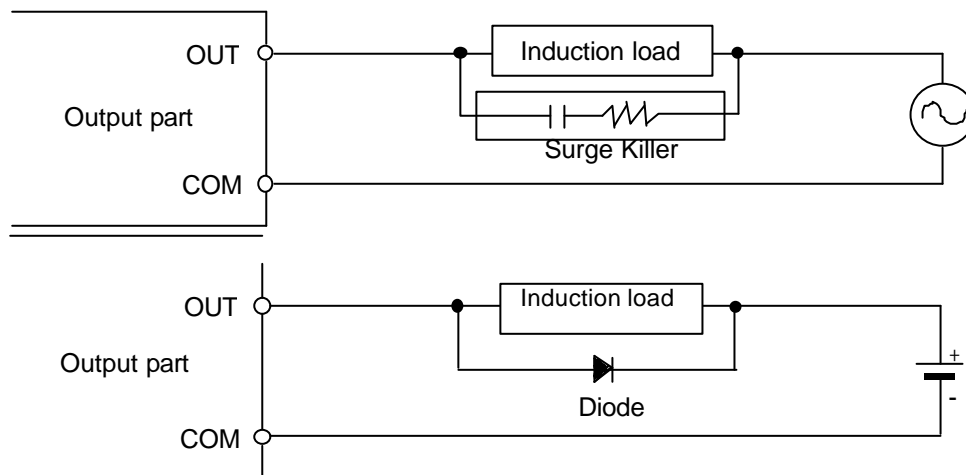
9.1.2 Handling Instructions

- Do not drop it off, and make sure that strong shock should not be applied.
- Do not unload the PCB from its case. It can cause faults.
- During wiring, be sure to check any foreign matter like wire scraps should not enter into the upper side of the PLC.
If any foreign matter has entered into it always eliminate it.

1) Base unit or Expansion Module handling instructions

The followings explains instructions for handling or installing the Base unit or Expansion Module.

- (1) I/O specifications re-check
Re-check the input voltage for the input part. If a voltage over the maximum switching capacity is applied, it can cause faults, destruction or fire.
- (2) Used wire
Select the wire with due consideration of ambient temperature and rated current. Its minimum specifications should be AWG24(0.18 mm²) or more.
- (3) Environment
When wiring the I/O part, if it locates near a device generating an cause short circuit, destruction or malfunction.
- (4) Polarity
Before applying the power to part that has polarities, be sure to check its polarities.
- (5) Wiring
 - Wiring I/O wires with high voltage cable or power supply line can cause malfunction or disorder.
 - Be sure that any wire does not pass across during input LED(I/O status will not be clearly identified).
 - If an inductive load has been connected to output part, connect parallel surge killer or diode to a load. Connect the cathode part of the + part of the power supply.



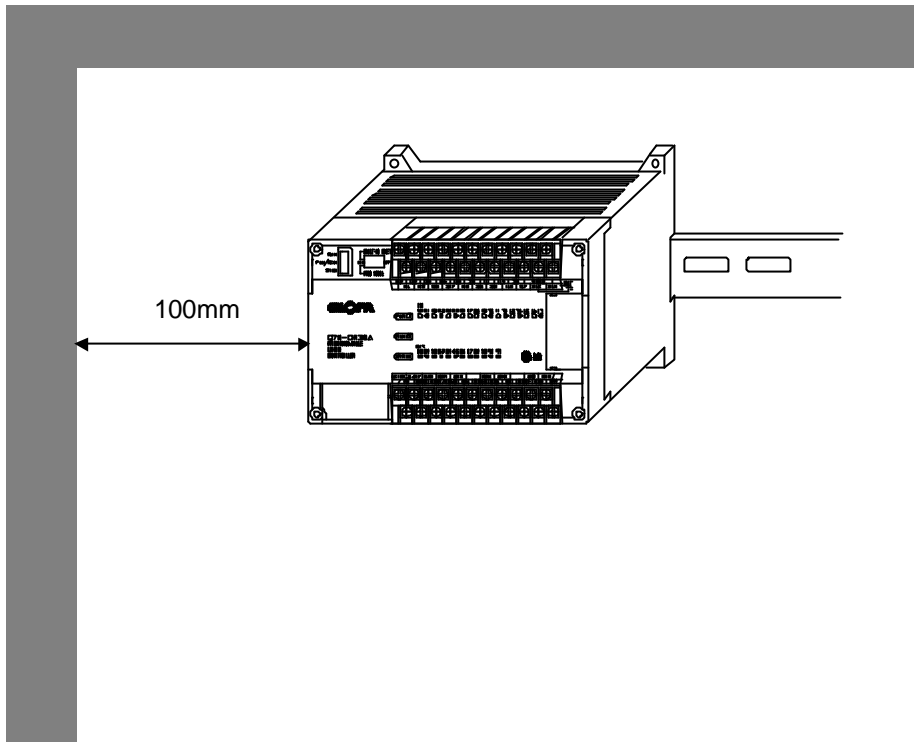
- (6) Terminal block
Check its fixing. During drilling or wiring, do not allow any wire scraps to enter the PLC. It can cause malfunction and fault.

- (7) Be cautious that strong shock does not applied to the I/O part.
Do not separate the PCB from its case.

2) Mounting instructions

The following explains instructions for mounting the PLC onto the control panel.

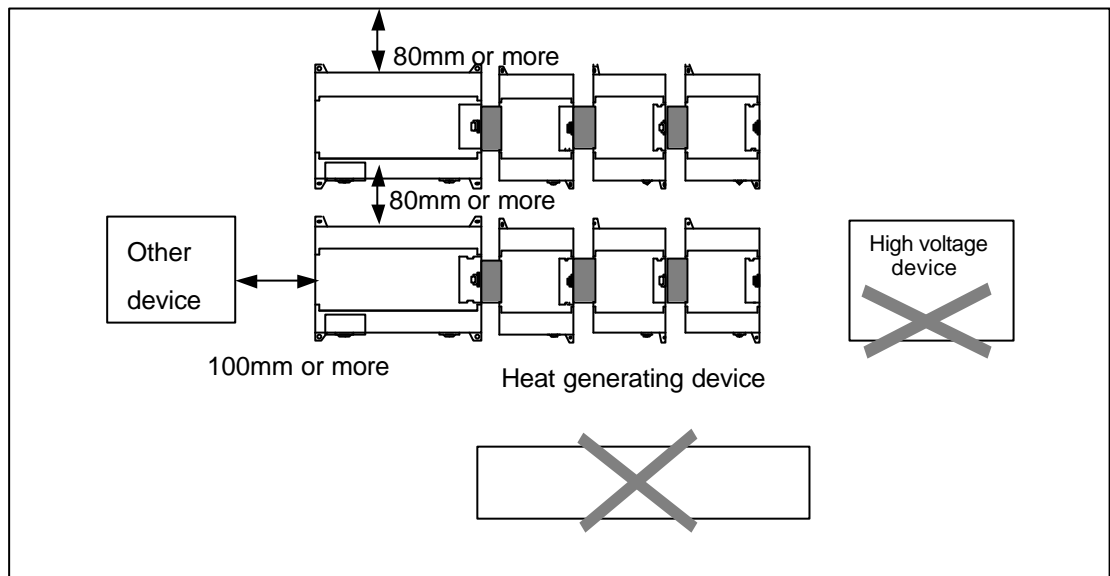
- (1) Allow sufficient distance from upper part of the Unit for easy module replacement and ventilation.
Especially the distance between the left side of the basic unit and the control panel should be 100 mm or more for periodic battery replacement.
- (2) Make sure that GM7 is installed in fig 9.1 for most effective heat radiation.



[fig 9.1]

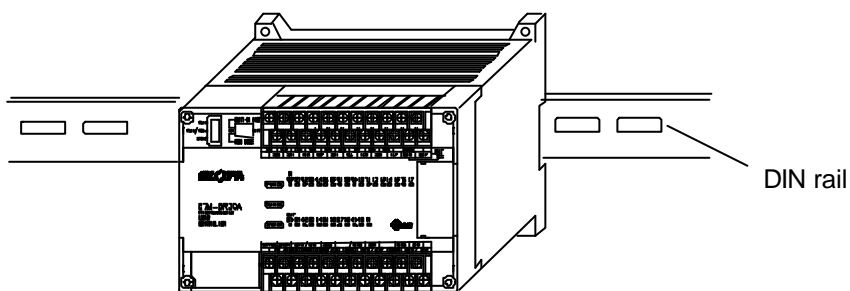
- (3) Do not mount the base board together with a large-sized electromagnetic contact or no-fuse breaker, which produces vibration, on the same panel. Mount them on different panels, or keep the unit or module away from such a vibration source

- (4) Mount the wire duct as it is needed.
If the clearances are less than those in Fig 9.1, follow the instructions shown below
- If the wire duct is mounted on the upper part of the PLC, make the wiring duct clearance 50 mm or less for good ventilation. Also, allow the distance enough to press the hook in the upper part from the upper part of the PLC.
 - If the wire duct is mounted on the lower part of the PLC, make optic or coaxial cables contact it and consider the minimum diameter of the cable.
- (5) To protect the PLC from radiating noise or heat, allow 100 mm or more clearances between it and parts. Left or right clearance and clearance from other device in the left or right side should be 100 mm or more.



[Fig 9.2] PLC mounting

- (6) GM7 has hooks for DIN rail in the base unit and expansion modules.

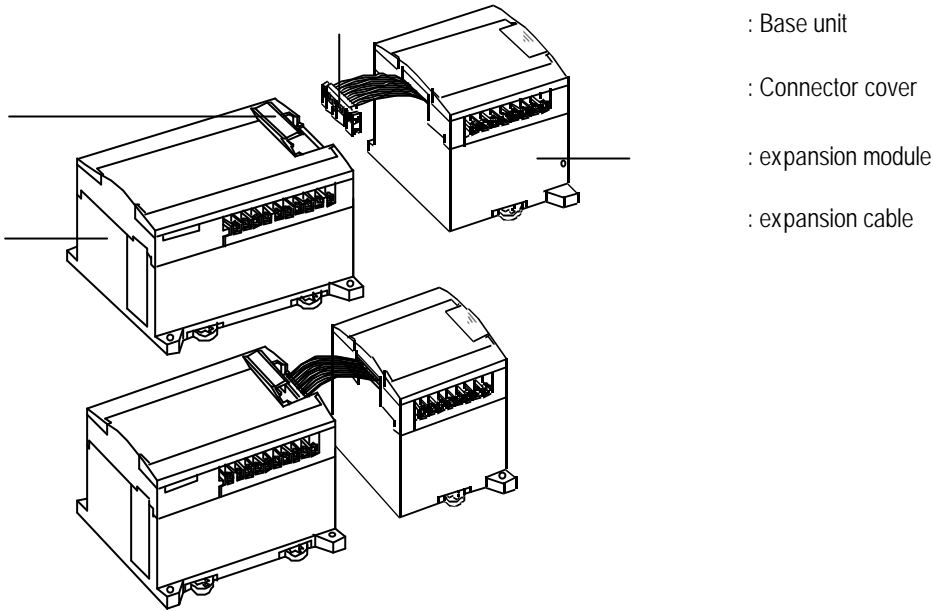


[Fig 10.3]

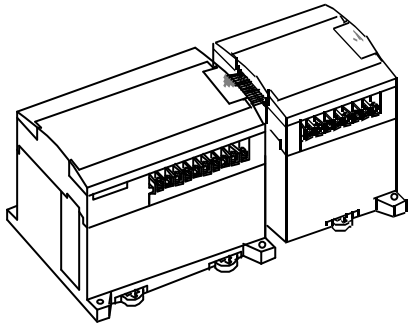
9.1.3 Connection of expansion module

The following explains the Connection of expansion modules to the base unit.

- (1) Open the connector cover of the base unit.
- (2) Insert the connector of the expansion module to the connector of the base unit.



- (3) Close the connector cover of the base unit.

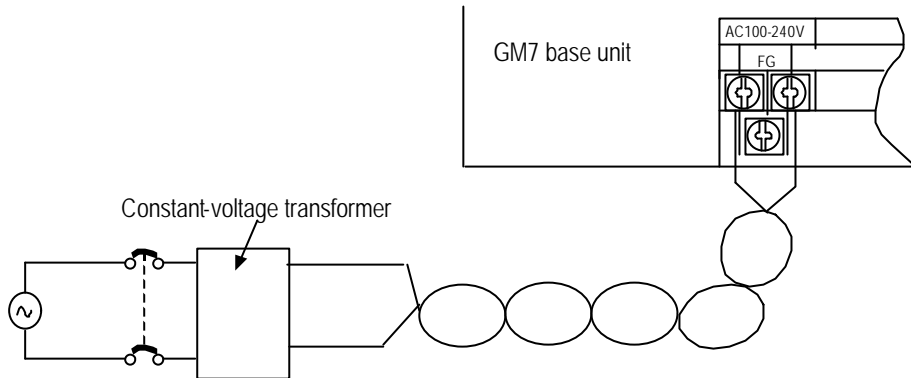


9.2 Wiring

The followings explains the wiring instructions for use of the system.

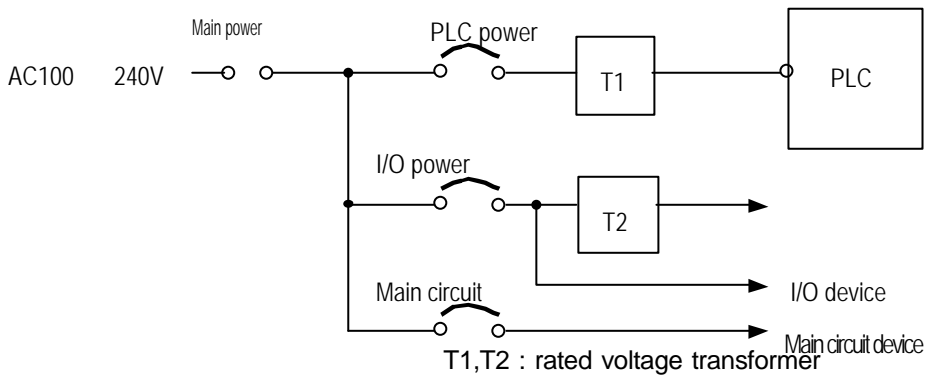
9.2.1 Power Supply Wiring

- 1) Use AC 100 240V (50Hz 60Hz) as the main power.
 - 2) When voltage fluctuations are larger than the specified value, connect a constant-voltage transformer.
- Use a power supply which generates minimal noise across wire and GM7 and ground when excessive noise Generated, connect an insulating transformer.

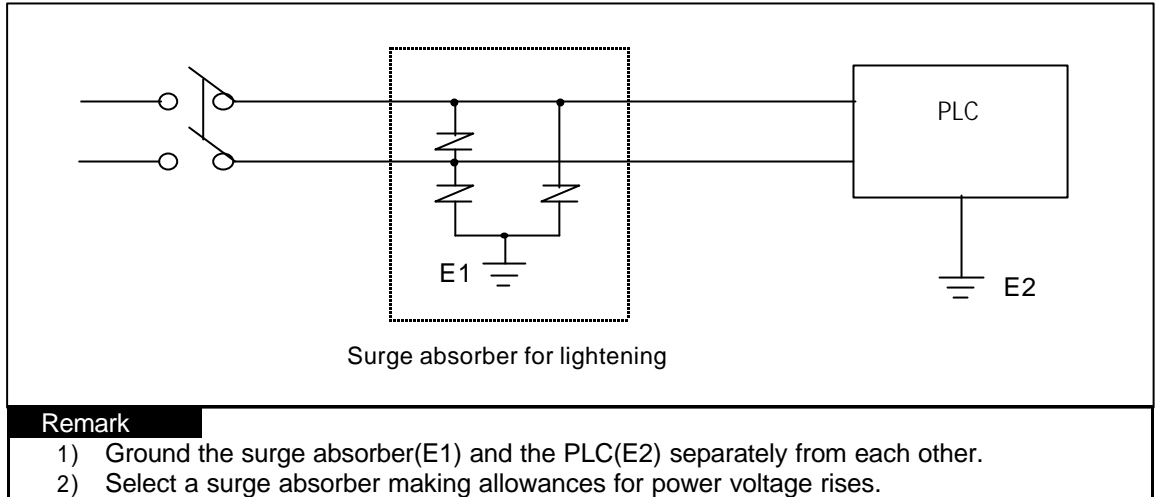


- 3) Use a power supply which generates minimal noise across wire and across PLC and ground. (When excessive noise is generated, connect an insulating transformer)

4) When wiring, separate the PLC power supply from those for I/O and power device as shown below.



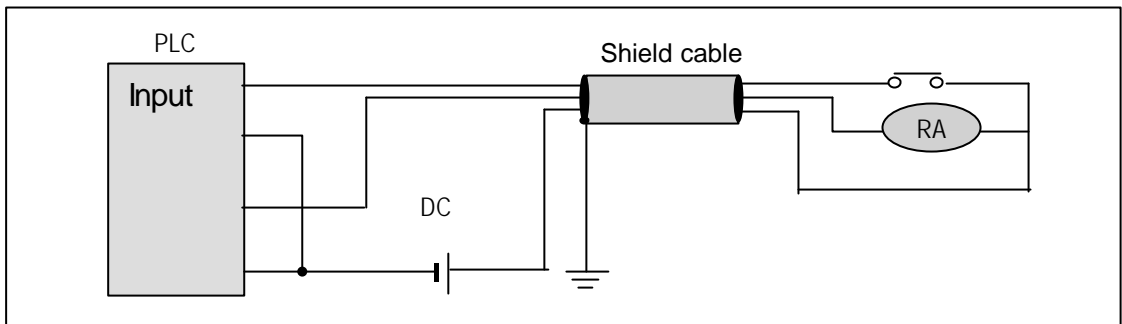
- 5) To minimize voltage drop, use the thickest (max. 2 mm²) wires possible
- 6) Do not bundle the 100 VAC and 24VDC cables with main-circuit (high voltage, large current) wires or the I/O signal wires. If possible, provide more than 80 mm distance between the cables and wires.
- 7) As a measure against very large surge (e.g. due to lightning), connect a surge absorber as shown below.



- 8) Use an insulating transformer or noise filter for protection against noise.
- 9) Twist every input power supply wire as closely as possible. Do not allow the transformer or noise filter across the duct.

9.2.2 Input and Output Devices Wiring

- 1) Applicable size of wire to the terminal block connector is 0.18 to 2 mm². However, it is recommended to use wire of 0.3 mm² for convenience.
- 2) Separate the input and output lines.
- 3) I/O signal wires must be at least 100 mm (3.94 in) away from high voltage and large current circuit wires.
- 4) When the I/O signal wires cannot be separated from the main circuit wires and power wires, ground on the PLC side with batch-shielded cables. Under some conditions it may be preferable to ground on the other side.

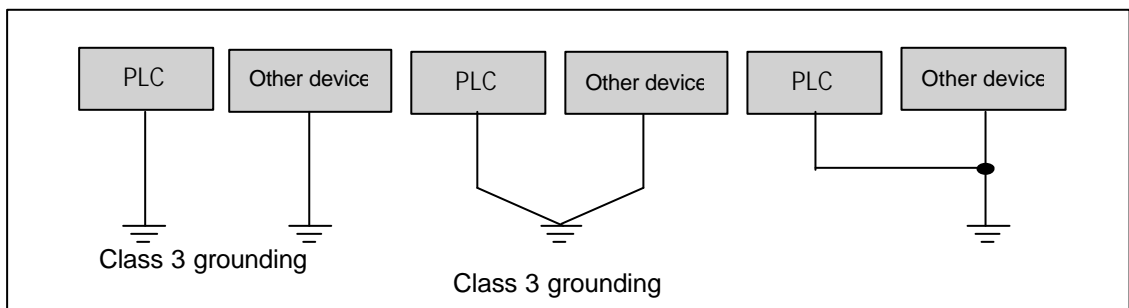


- 5) If wiring has been done with piping, ground the piping.
- 6) Separate the 24VDC I/O cables from the 110VAC and 220VAC cables.

If wiring over 200 mm (7.88 in) or longer distance, trouble can be caused by leakage currents due to line capacity. Refer to the section 11.4 Example.

9.2.3 Grounding

- 1) This PLC has sufficient protection against noise, so it can be used without grounding except for special much noise. However, when grounding it should be done conforming to below items.
- 2) Ground the PLC as independently as possible. Class 3 grounding should be used (grounding resistance 80 or less).
- 3) When independent grounding is impossible, use the joint grounding method as shown in the figure below (B).



(A) Independent grounding : Best (B) Joint grounding : Good (C) Joint grounding : Not allowed

- 4) Use 2 mm² (14AWG) or thicker grounding wire. Grounding point should be as near as possible to the PLC to minimize the distance of grounding cable.

9.2.4 Cable Specifications for wiring

The specifications for wiring is as follows:

Kinds of external connection	Cable Specifications (mm ²)	
	Minimum	Maximum
Digital Input	0.18 (AWG24)	1.5 (AWG16)
Digital Output	0.18 (AWG24)	2.0 (AWG14)
Analog Input / Output	0.18 (AWG24)	1.5 (AWG16)
Communication	0.18 (AWG24)	1.5 (AWG16)
Main power	1.5 (AWG16)	2.5 (AWG12)
Grounding	1.5 (AWG16)	2.5 (AWG12)

Be sure to use solidness terminal for power supply and I/O wirings.

- Be sure to use M3 type as terminal screw.
 - Make sure that terminal screw is connected by 6 - 9 kg · cm torque..
 - Be sure to use fork shaped terminal screw as shown below.

